Cisco BGP Best Path Selection Algorithm

Priority	Step/Attribute	Description	Notes/Configurations/Exceptions
Prerequisite	Next Hop Reachability & Validity	Verify the path is valid and the next hop is reachable via the routing table. Invalid paths (e.g., not synchronized if BGP synchronization is enabled, AS loop detected, policy rejected) are discarded.	- Paths marked as not synchronized (if sync enabled) or damped are ignored. - Next hop validation uses IGP or static routes. - If unreachable, path is not considered for best path.
1	Weight (Cisco Proprietary)	Prefer the path with the highest weight.	- Local to the router; not advertised. - Default: 0 for learned routes, 32768 for locally originated. - Range: 0-65535. - Configured via neighbor weight or route-map. - Influences outbound traffic; higher weight wins. - No multipath impact here.
2	Local Preference	Prefer the path with the highest local preference.	- Default: 100 (or set via bgp default local-preference). - Advertised within AS (iBGP); not to eBGP peers. - Influences outbound traffic. - If equal, proceed to next step.
3	Locally Originated	Prefer paths originated locally via network or redistribute commands over aggregate-address.	- Locally originated paths have next hop 0.0.0.0. - Aggregation considered local but lower than network/redistribute. - AIGP: If configured (bgp additional-paths) and not ignored (no bgp bestpath aigp ignore), consider AIGP metric here. Lower AIGP (adjusted for IGP cost) is preferred. AIGP is for inter-AS metric comparison; ignored in confederations. - If equal, proceed.
4	AS Path Length	Prefer the shortest AS_PATH.	- AS_SET counts as 1; AS_CONFED_SEQUENCE/SET not counted. - Skipped if bgp bestpath as-path ignore configured. - Used for loop prevention; prepends affect length. - If equal, proceed.
5	Origin Type	Prefer lowest origin: IGP (i) < EGP (e) < Incomplete (?).	- IGP: From network command. - Incomplete: From redistribution. - If equal, proceed.

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6	Multi-Exit Discriminator (MED)	Prefer the lowest MED.	- Default: 0 if missing (or 4,294,967,294/295 with bgp bestpath med missing-as-worst). - Compared only if first AS in AS_PATH is the same (ignores confed). - Configs: bgp always-compare-med (compare regardless of AS); bgp deterministic-med (group by AS for consistent comparison, recommended to avoid loops); bgp bestpath med confed (compare within confed). - Influences inbound traffic. - MED of 4,294,967,295 treated specially (changed to 4,294,967,294). - If equal, proceed.
7	Neighbor Type (eBGP over iBGP)	Prefer eBGP paths over iBGP or confed paths.	- Confed paths treated as internal (no distinction between confed-external/internal). - eBGP preferred as typically closer. - If best path selected here, skip to multipath check (step 9). - If equal, proceed.
8	IGP Metric to Next Hop	Prefer the lowest IGP metric (cost) to the BGP next hop.	- Uses IGP (e.g., OSPF, EIGRP) cost. - Proceed even if best path already selected (for multipath prep). - If equal, proceed.
9	Multipath Check	Determine if multiple paths can be installed for load balancing.	- Enabled via maximum-paths (eBGP/iBGP) or maximum-paths ibgp. - Requirements: Equal weight, local pref, AS_PATH length, origin, MED, neighbor type, IGP metric. - Additional for eBGP multipath: From eBGP/confed-external, equal IGP to next hop. - Additional for iBGP: From iBGP, equal IGP to next hop. - Up to 128 paths (depending on IOS). - Does not affect best path; best path still advertised. - If multipath enabled and criteria met, install multiple; else, proceed if best not selected. - BGP Cost Community (extended): Optional insertion point for custom cost (0-4,294,967,295); lower cost preferred; skipped if bgp bestpath cost-community ignore.
10	Oldest Path (External Paths)	For external paths, prefer the oldest (first received) to minimize flapping.	- Applies only to eBGP/confed-external. - Skipped if: bgp bestpath compare-routerid configured (proceed to router ID), same router ID, confed peer, no current best path. - If not configured (default), oldest wins. - If equal or skipped, proceed.
11	Router ID	Prefer the lowest BGP router ID (or originator ID if present from RR).	- Router ID: Highest loopback IP, or manual (bgp router-id). - Used in RR environments (originator ID substitutes). - If equal, proceed.
12	Cluster List Length	Prefer the shortest cluster list (RR attribute).	- Present in RR setups; length 0 if none. - Allows peering across clusters. - If equal, proceed.
13	Neighbor IP Address	Prefer the lowest neighbor IP address (from BGP neighbor config).	- Final tiebreaker for same router (e.g., multiple links). - TCP peer address used.

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Juniper BGP Best Path Selection Algorithm

Priority	Step/Attribute	Description	Notes/Configurations/Exceptions
1	Next Hop Resolution	Verify the next hop is resolvable via routing table.	- If not resolvable, path ineligible. - Ineligible paths (policy rejected, etc.) have preference -1, never chosen.
2	Protocol Preference	Choose lowest preference value (AD-like).	- BGP default: 170. - Non-BGP: Use lowest preference2. - Lower (more preferred) wins.
3	Local Preference	Prefer highest local preference.	- For BGP paths; higher wins. - Non-BGP: Use preference2.
4	AIGP Attribute	If AIGP enabled, add IGP metric and prefer lowest AIGP.	- AIGP for inter-AS cost; enabled via policy or config. - Lower AIGP (after adding IGP) preferred. - If not enabled, skipped.
5	AS Path Length	Prefer shortest AS path.	- Confed segment: Length 0; AS set: 1. - Skipped if as-path-ignore configured (supported in instances from Junos 14.1R8+). - If skipped, proceed.
6	Origin Code	Prefer lowest: IGP < EGP < Incomplete.	- IGP: From IGP; Incomplete: Unknown/redistributed.
7	MED Metric	Prefer lowest MED.	- Default: Compare only if same neighboring AS (front of AS path); confeds ignored. - Missing MED = 0. - Configs: path-selection always-compare-med (compare always); path-selection cisco-nondeterministic (compare all, no AS grouping; may cause inconsistency, not recommended); med-plus-igp (add IGP cost to MED before compare; multipliers for IGP/MED). - Influences inbound; works intra-AS too. - If cisco-nondeterministic not configured (default), group by AS. - If equal, proceed.
8	Internal Paths	Prefer strictly internal (IGP, local, static, direct) over external.	- Locally generated preferred.
9	EBGP over IBGP	Prefer EBGP over IBGP/external-IBGP.	- EBGP considered stricter external.

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10	IGP Metric to Next Hop	Prefer lowest IGP metric to next hop.	- Resolves via IGP; prefers reachable over rejected. - Multipath: If enabled (multipath or per-prefix-load-balance), consider equal-cost after this step (same neighbor AS, from multipath BGP peer). - Multipath requirements: Equal up to this step; based on IGP metric (not MED-plus-IGP if differing IGP). - Up to platform limit (e.g., 64). - If multipath enabled, install multiple; does not affect best path advertisement. - Proceed even if best selected.
11	Oldest Path (External)	For external paths, prefer oldest (first learned) to reduce flapping.	- Applies to EBGP. - Skipped if: path-selection external-router-id configured (proceed to router ID), same router ID, confed peer, neither current active. - If not configured (default), oldest wins. - If skipped or equal, proceed.
12	Primary over Secondary Route	Prefer primary (in routing table) over secondary (added via export policy).	- Secondary from policy export.
13	Router ID	Prefer lowest router ID (substitute originator ID if present).	- Originator ID from RR. - If equal, proceed.
14	Cluster List Length	Prefer shortest cluster list.	- RR attribute; 0 if none. - For RR clients peering across clusters.
15	Peer IP Address	Prefer lowest peer IP address.	- Final tiebreaker.

Cisco BGP Path Selection References

- **Official Documentation**: Cisco Systems. (n.d.). *How the Best Path Algorithm Works*. Retrieved from https://www.cisco.com/c/en/us/support/docs/ip/border-gateway-protocol-bgp/13753-25.html
- **Networklessons bgp attributes and path selection:** https://networklessons.com/bgp/bgp-attributes-and-path-selection

Juniper BGP Path Selection References

- **Official Documentation**: Juniper Networks. (n.d.). *Understanding BGP Path Selection*. Retrieved from https://www.juniper.net/documentation/us/en/software/junos/vpn-l2/bgp/topics/concept/routing-protocols-address-representation.html