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JunOS BGP

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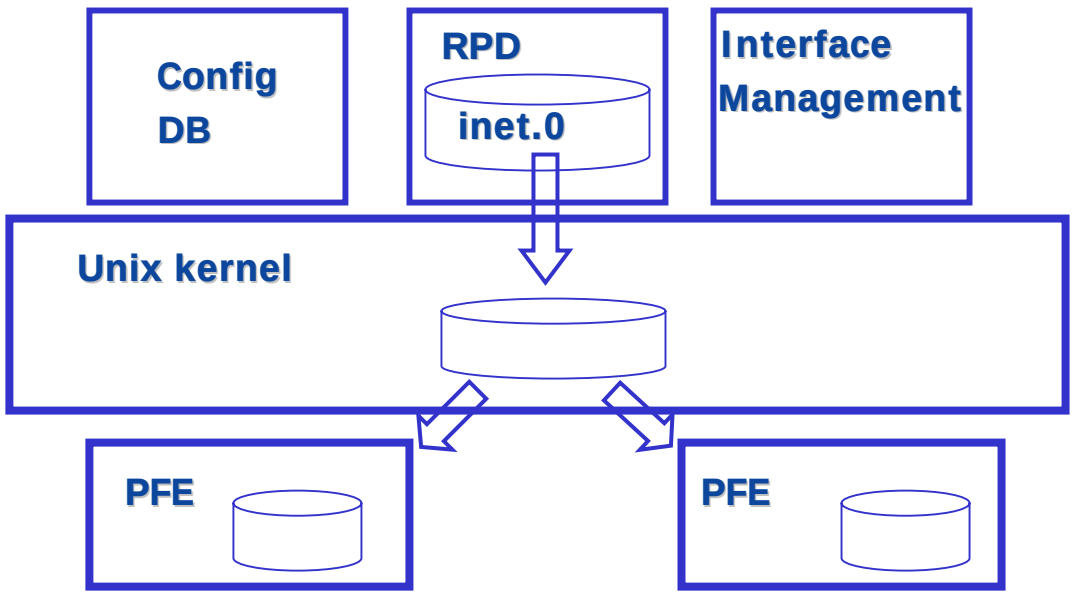
JunOS

- Routing Engine (RE)
  - Unix kernel
  - Daemons
    - Routing (rpd)
    - Interface management
    - Configuration management
    - SNMP
    - CLI
- Packet Forwarding Engine (PFE)
  - PPC microprocessor (for control)
  - Forwarding ASIC

Routing Protocol Daemon

- IP/MPLS routing and signaling.
- Shared data structures:
  - Multiple routing tables
    - inet.0 – IP routing table
    - inet.3 – MPLS routing table
    - routing-instance tables
- Forwarding information installed in the kernel.
- Kernel distributes to control CPUs on line cards.



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Configuration

- **Database model**
  - **Commit / rollback.**
  - **No actions in inconsistent state.**
- **Without a database model:**
  - **“no access-list 101”**
  - **Followed by new access-list configuration.**
  - **Any routing updates received are processed according to the current state.**
  - **Race between operator / script and events on the network.**

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“commit” processing

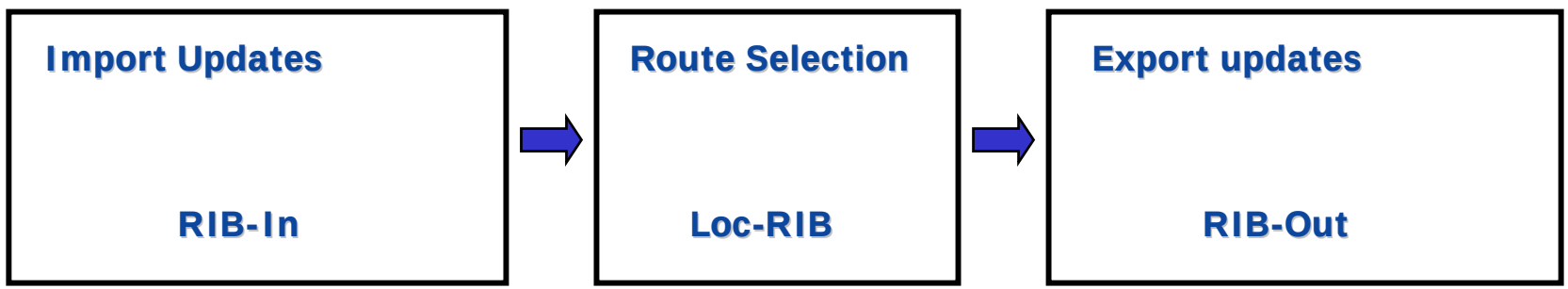
- Subsystems calculate differences between previous and new state.
- Reevaluate received/advertised routing information.
- Can lead to high CPU utilization/poor response time to new events.
- Improvements:
  - Skip database objects that where not modified.
  - Incremental changes (5.2, 5.3, 5.5)
- Influential in the design of the system.

Adjacency maintenance

- RPD cooperative multitasking nature:
  - “scheduler slips”.
  - Specially while processing reconfiguration (before configuration change improvements).
- Periodic packet management (ppmd)
- Protocol hellos (ospf, isis).
- “real time” component of routing.
- In JunOS R5.3

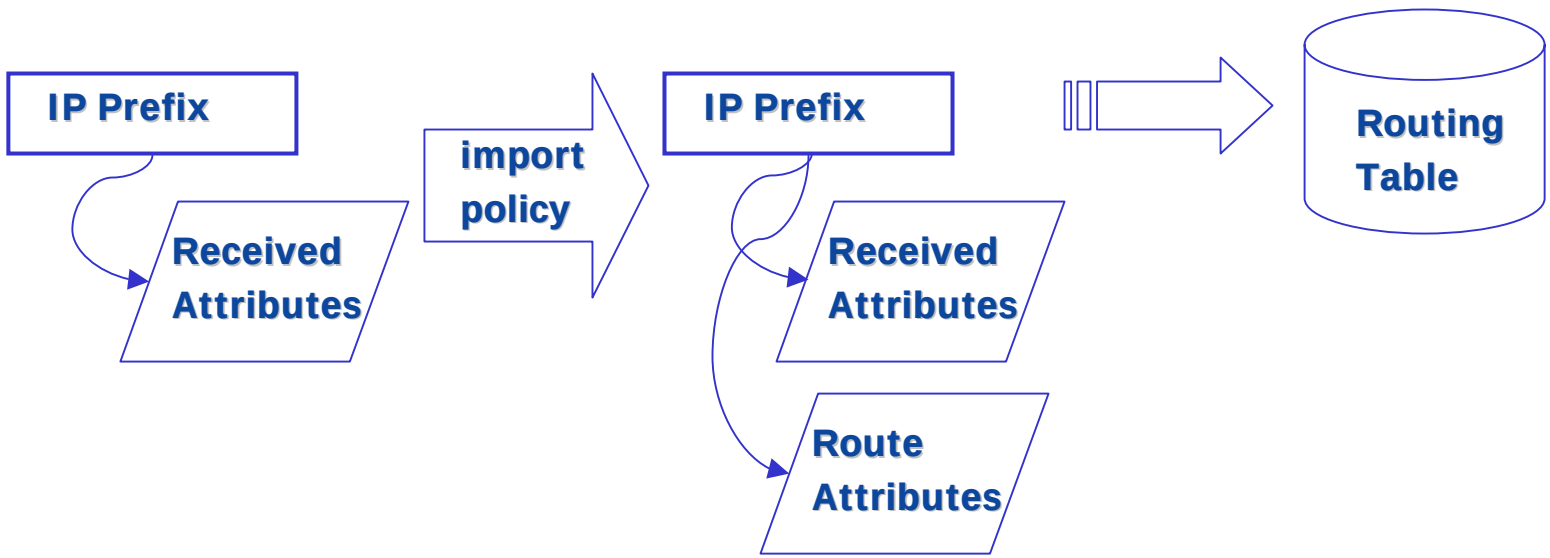
JunOS BGP

- Receiving Updates
  - Apply inbound policy (import).
  - Keep copy of original attributes.
- Route selection
  - Centralized (all routes from all protocols).
- Update generation
  - “export” policy applied on selected route.
  - Per-group copy of advertised attributes.



Receiving UPDATEs

- **Display received attributes:**
  - **"show route receive-protocol bgp <neighbor> all"**



Policy language

- Sequence of terms with <match, action> pairs.
- Policies can be used as sub-routines.
- Policies can be chained.

```
policy-options {
    policy-statement example {
        term one {
            from policy (a && b);
            then accept;
        }
        term two {
            then next-policy;
        }
        then reject;
    }
}
```

RIB-in

- By default, reject routes with:
  - As-path loop.
  - Cluster-list loop.
  - Invalid 3rd party eBGP next-hop (non-connected).
  - neighbor "`keep all`" option disables this behavior.
- In case of a configuration change that modifies the neighbor "import" policy:
  - New route attributes are automatically calculated.
  - No need to request REFRESH to N neighbors; local processing.

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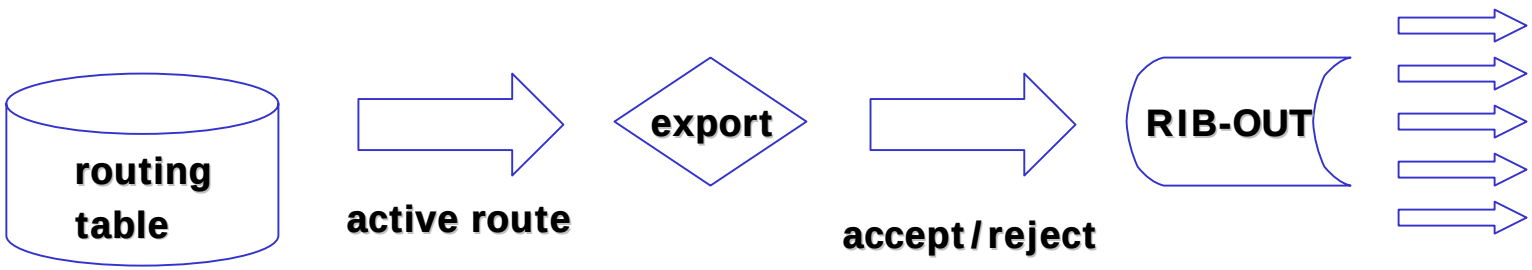
Route selection

- Includes routes from all protocols.
- E.g.: static (higher admin preference) and BGP route present. Inactive BGP route is not advertised.
- May override this behavior with "`advertise-inactive`" knob.
- BGP path selection depends on IGP metrics.
- Triggered by receiving a routing update or resolution metric change.

Generating UPDATEs

- Best route for a given prefix is selected.
- Per peer-group processing of routes.
- Default export policy: accept all BGP routes.
- Generate advertisement metrics (values for BGP attributes).
- Compare with previously advertised value.



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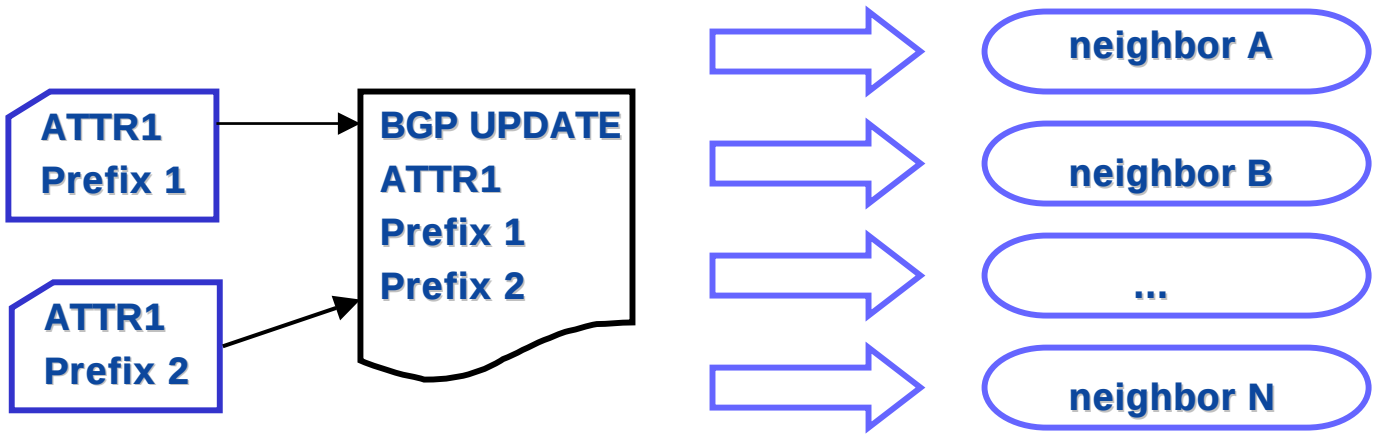
RIB-out

- Memory usage: number of groups.
- Group: consistent export policy.
- Groups will be split when export parameters differ. Configuration is a template.
- “`show bgp group`”.
- “`show route advertising-protocol bgp <neighbor>`”.
  - Displays what the router has advertised.
  - Equiv. commands in other implementations rerun their export processing and calculate what would be advertised w/ current state.

Send process

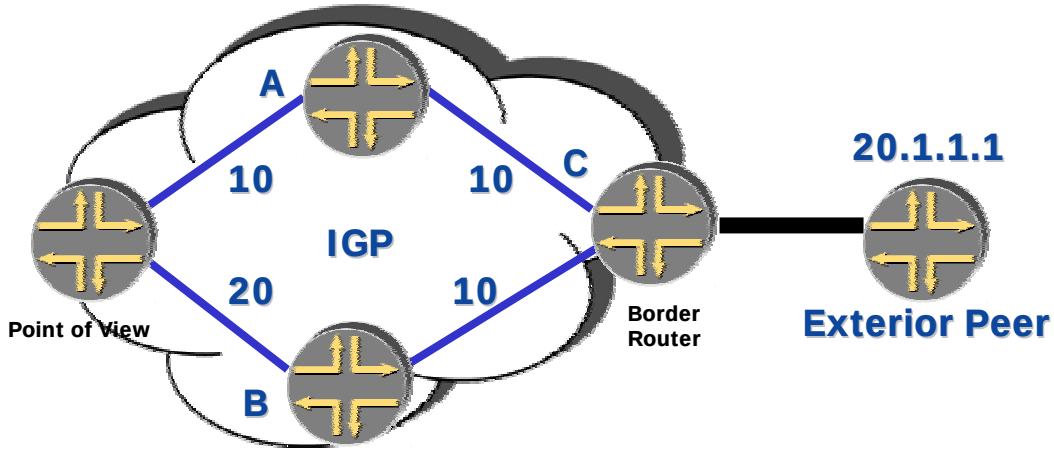
- Encode metrics calculated via export policy.
- NLRI for which “export” is pending is delayed.
- Replicates UPDATE to members of the group.
- Efficient packing of NLRI with same set of attributes.



Send process

- Send may be synchronous or asynchronous in relation to “export” stage.
- Differences in load and latency between members of group.
- When a receiver blocks its TCP socket it gets “out-of-sync”.
- Generate UPDATEs for subsets of “out-of-sync” peers at same stage in queue (R5.4).
- “`show bgp summary`” – “`OutQ`” field

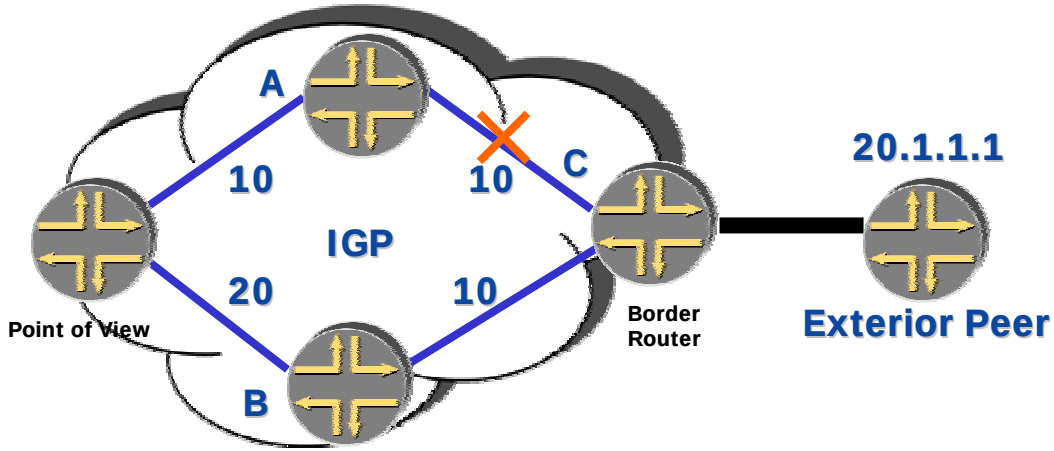
Route Resolution



Prefix	Protocol	Next-hop	Metric
10.0.1/24	BGP	20.1.1.1	-
20.1.1.1/32	ISIS	<interface A>	20

- BGP route selection depends on IGP metric

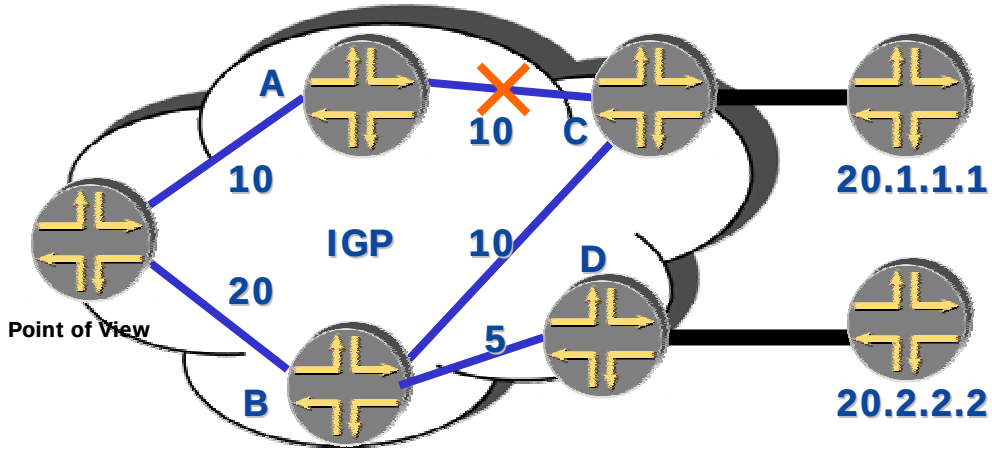
IGP change



Prefix	Protocol	Next-hop	Metric
10.0.1/24	BGP	20.1.1.1	-
20.1.1.1/32	ISIS	<interface B>	30

- Immediate change for all IP prefixes dependent on C.

External route change



Prefix	Protocol	Next-hop	Metric
10.0.1/24	BGP	20.1.1.1	-
10.0.1/24	BGP	20.2.2.2	-
20.1.1.1/32	ISIS	<interface B>	30
20.2.2.2/32	ISIS	<interface B>	25

Route Resolver

- Change in IGP metric results on running route selection on dependent routes.
- Resolution independent of protocol:
  - Same mechanism for IP and MPLS
- Recursion loop avoidance.
- Forwarding table update:
  - 1 update to PFE for change in IGP next-hop
  - No recalculation on PFE.
  - Fast convergence.
- “`show route resolution`”

JunOS BGP Characteristics

- Changes in “import” or “export” policy.
  - Router updates its states so that it is consistent with the new configuration.
  - Differential updates are sent for export changes.
- BGP always knows what it actually advertised to a given peer/group. No duplicate advertisements.
- Not optimized for small memory footprint.
- No periodic processing.

Address family support

- The “What about IPv6?” question.
- NLRI-types supported: inet, inet6, inet-labeled, inet6-labeled, inet-vpn, inet6-vpn, l2vpn…
- Validation of received attributes and selection of advertisement attributes is a per NLRI-type function.
- BGP as a database exchange protocol:
  - Flow control between peers.
  - Flooding of routing information (loop avoidance).

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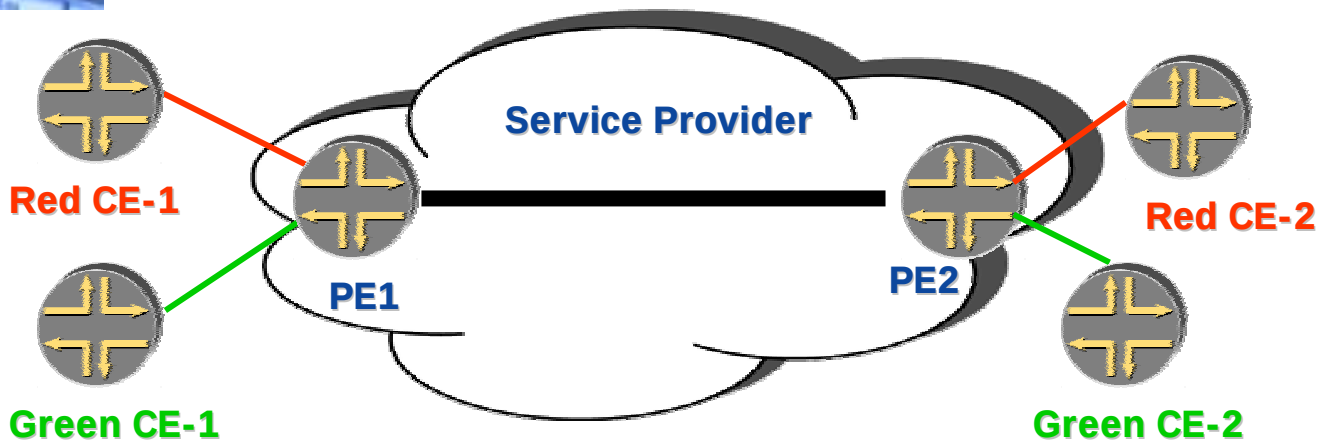
L3VPNs



- PE routes are received into a separate BGP table (bgp.l3vpn.0).
- Route selection performed in Red/Green instance (VRF) table.
- Difference from inet routes: add/strip RDs.

Scalability

- Growth of Internet routing-table prefixes:
  - When do we run out of memory ?
  - When do we run out of CPU ?
- Memory consumption is a function of the number of distinct paths (!= prefixes).
- Juniper currently maxes out at 2GB RAM and about 1M prefixes in forwarding engines.
- CPU maybe more of a concern:
  - In terms of the number of distinct change sets that occur.
  - Some overhead in terms of per prefix processing.
- L3VPN (2547) RRs “pushing the envelope” in terms of number of prefixes and events.

Configuration tips

- BGP configuration is hierarchical.
- Less lines makes it easier to read/understand.
- “peer-as” unnecessary in internal groups.
- “local-as” unnecessary if same as autonomous-system setting.

```
protocols bgp {
    /* top level */
    group <name> {
       type [internal | external];
       export <policy>;
       neighbor <address> {
           peer-as <as#>;
       }
    }
}
```

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Securing BGP

- Filter own prefix at edges to avoid spoofed sources.
- Firewall filter can be applied to packets addressed to the router.
- Automatic expansion of configured BGP peers.

```
[edit policy-options prefix-list foo]
# set apply-path "protocols bgp group <*> neighbor <*>"
[edit firewall family inet filter bar]
# set term 1 from source-prefix-list foo
# set term 1 from destination-port bgp
# set term 1 then accept
```

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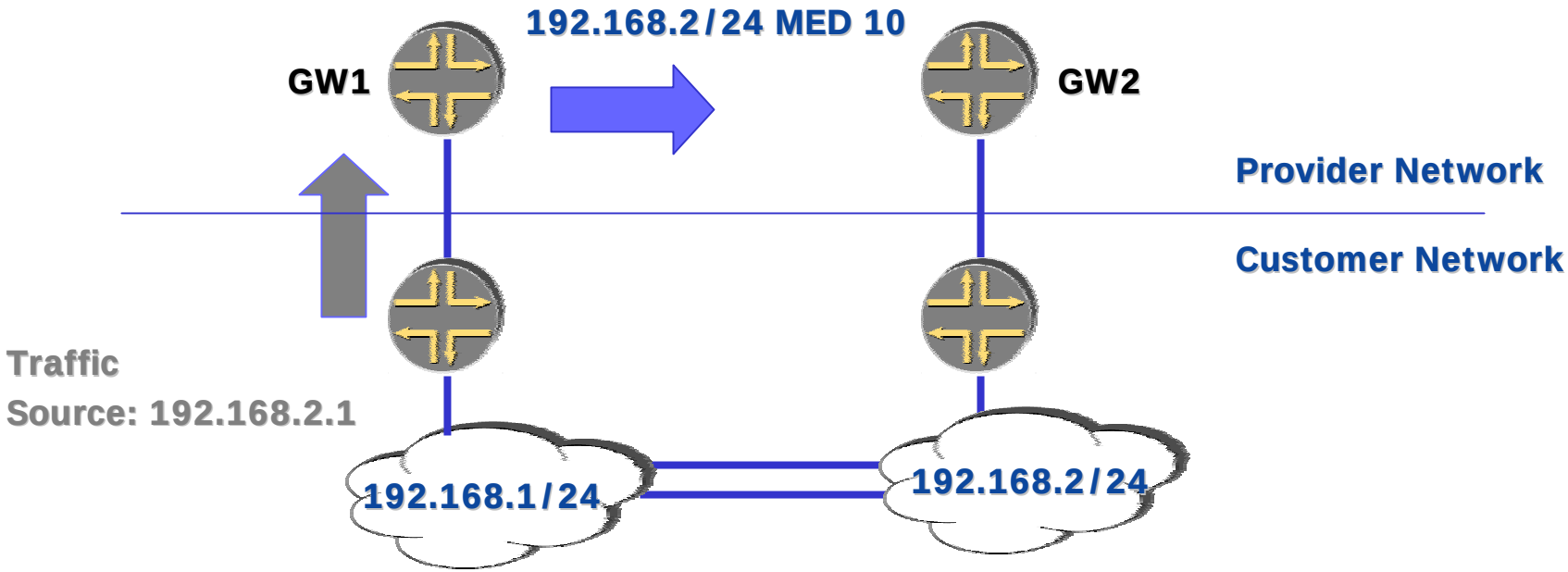
Unicast Reverse Path Check

- IP source address anti-spoofing
- Verify that the source was received from an interface or set of interfaces that match reverse path.
- 3 modes available:
  - Best path
  - All feasible paths
  - Any feasible path
- Feasible-path option can work with multi-homing if peer/customer advertises all prefixes on all connections.

Feasible paths



- **Scenario:**
  - **Provider accepts MEDs for customer routes.**
  - **Preferred exit point for a external network is GW-1.**
- **Accepting source from a feasible path allows SP to perform anti-spoofing validation.**

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Thank You

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