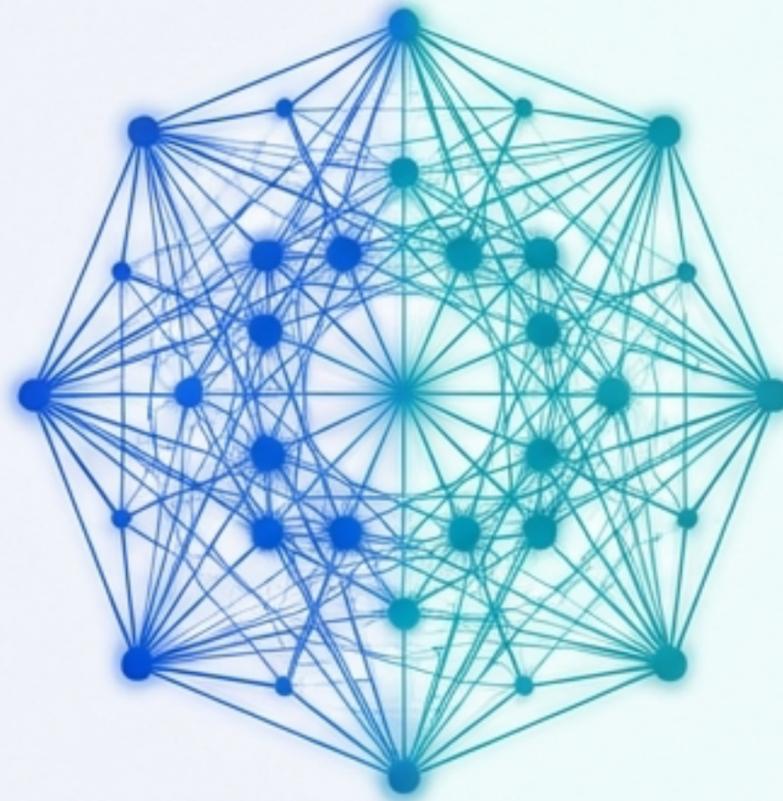


Interoperability in the Core

Unifying Nokia SR OS & Cisco IOS XR

A Layered Integration Architecture Guide



1. Interface:
CLI & Management

2. Underlay:
ISIS & IPv6

3. Overlay:
BGP Policy

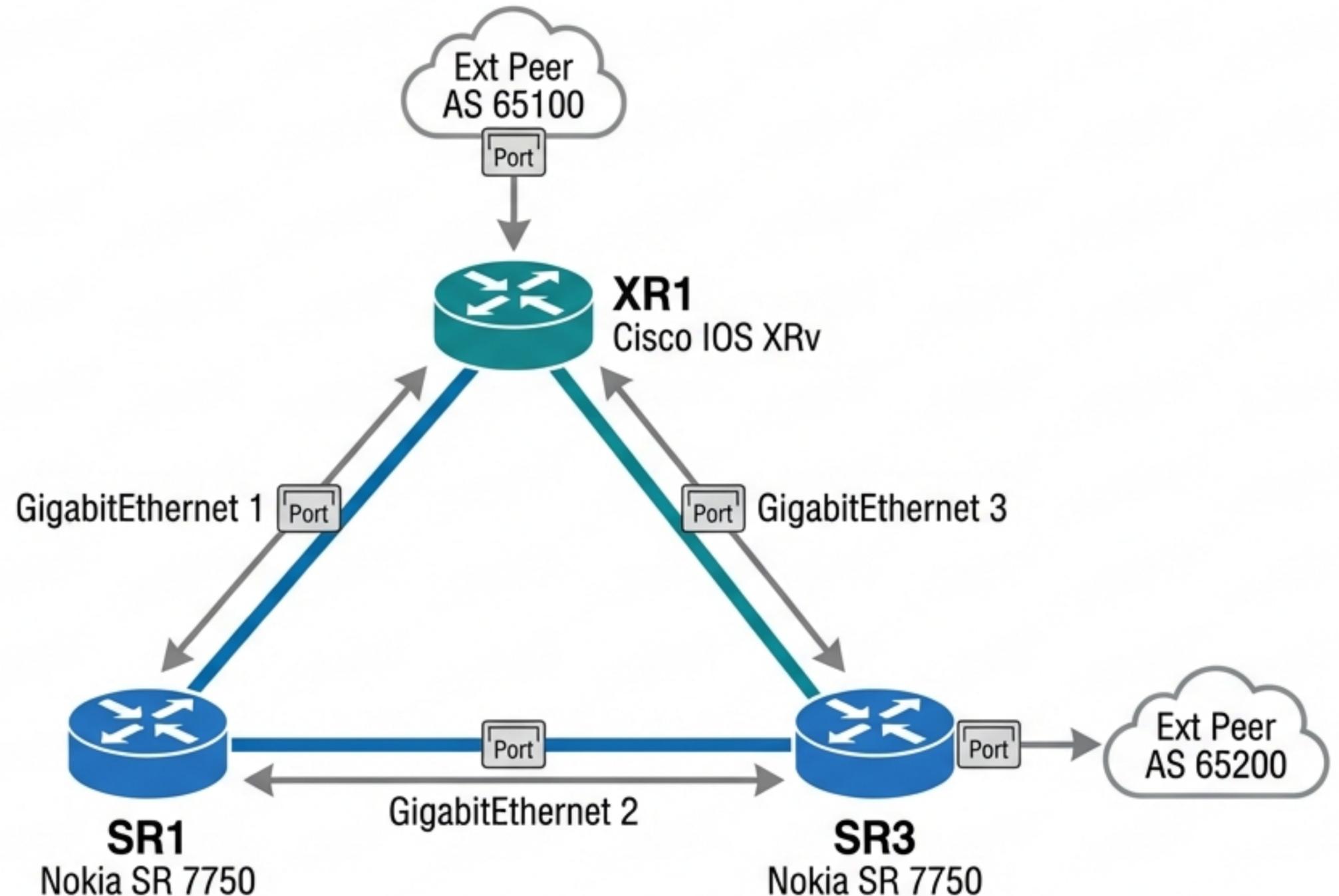
4. Transport:
Segment Routing

The Multi-Vendor Lab Topology

Testing Interoperability in a Controlled Environment

Context

- Business Case: Cost efficiency and vendor flexibility.
- Routing Domain: AS 65000 (Core).
- Challenge: Syntax, defaults, and protocol implementation variances.



The Rosetta Stone: CLI Survival Guide

	Nokia SR OS (Classic CLI)	Cisco IOS XR
Configuration Mode	<code>configure</code>	<code>configure terminal</code>
Save/Commit	<code>admin save</code>	<code>commit</code>
Show Config	<code>admin display-config</code>	<code>show running-config</code>
Exit Level	<code>exit all</code>	<code>end</code>
Show Interface	<code>show router interface</code>	<code>show ip interface brief</code>
System Name	<code>system name <name></code>	<code>hostname <name></code>

Note: Nokia SR OS applies changes immediately in classic CLI mode. Cisco IOS XR uses a candidate configuration that requires a “commit”.

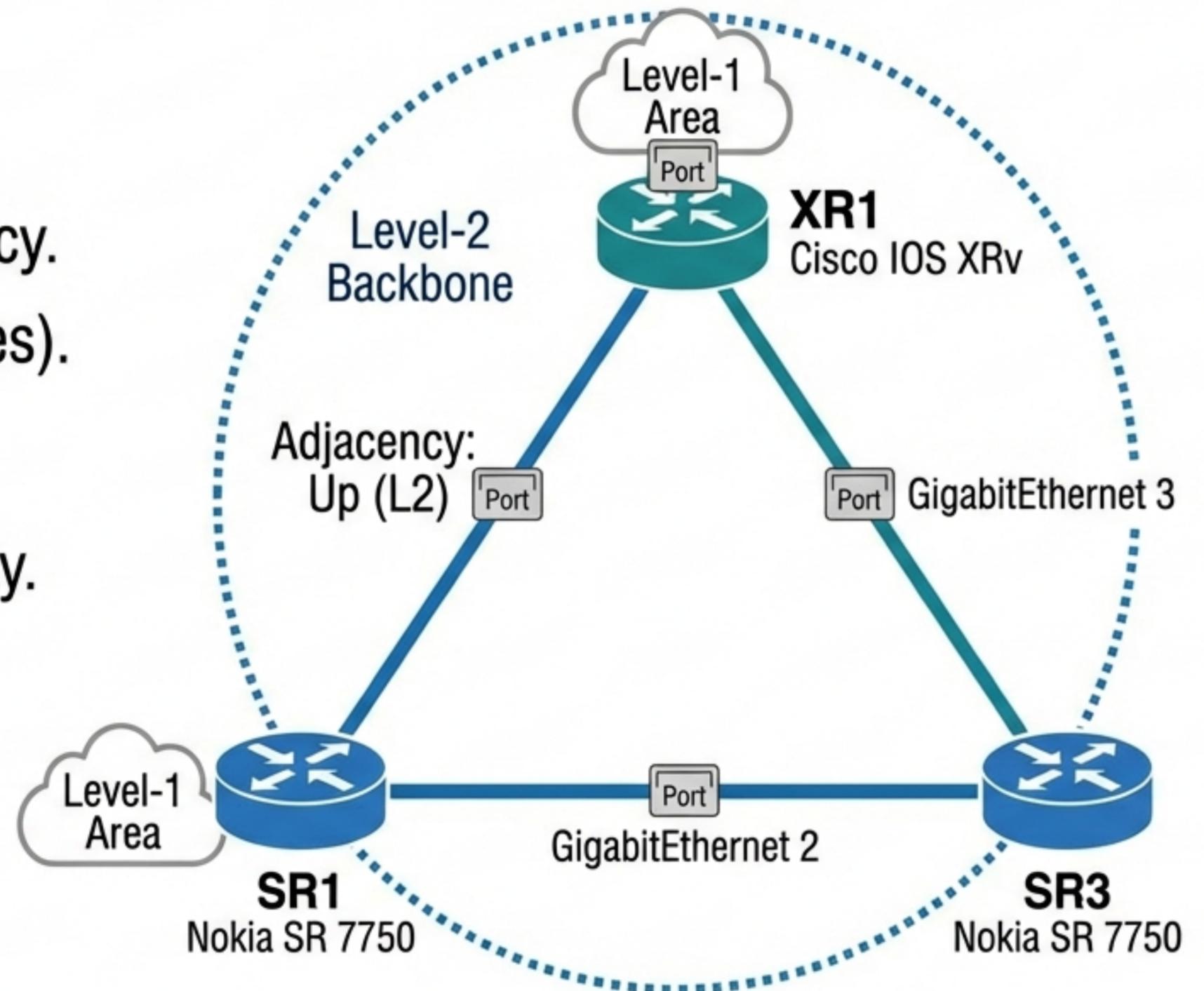
Establishing the Underlay: ISIS Architecture

NET Addressing & Areas

- Routers must share the Area ID (e.g., 49.0001) for Level-1 adjacency.
- System IDs must be unique (6 bytes).

Metric Style

- Critical for MPLS-TE interoperability.
 - Cisco: `metric-style wide`
 - Nokia: `wide-metrics-only`



The IPv6 Trap: Multi-Topology vs. Native ⚠

Cisco IOS XR Default

- **Multi-Topology (MT)**
- Maintains separate topologies for IPv4 and IPv6.
- Sends 'MT IPv6 Reach' TLVs.



**Capability Mismatch
= IPv6 Blackhole**

Nokia SR OS Default

- **Native (Single Topology)**
- Assumes IPv6 follows the IPv4 topology.
- Sends standard IPv6 Reach TLVs.

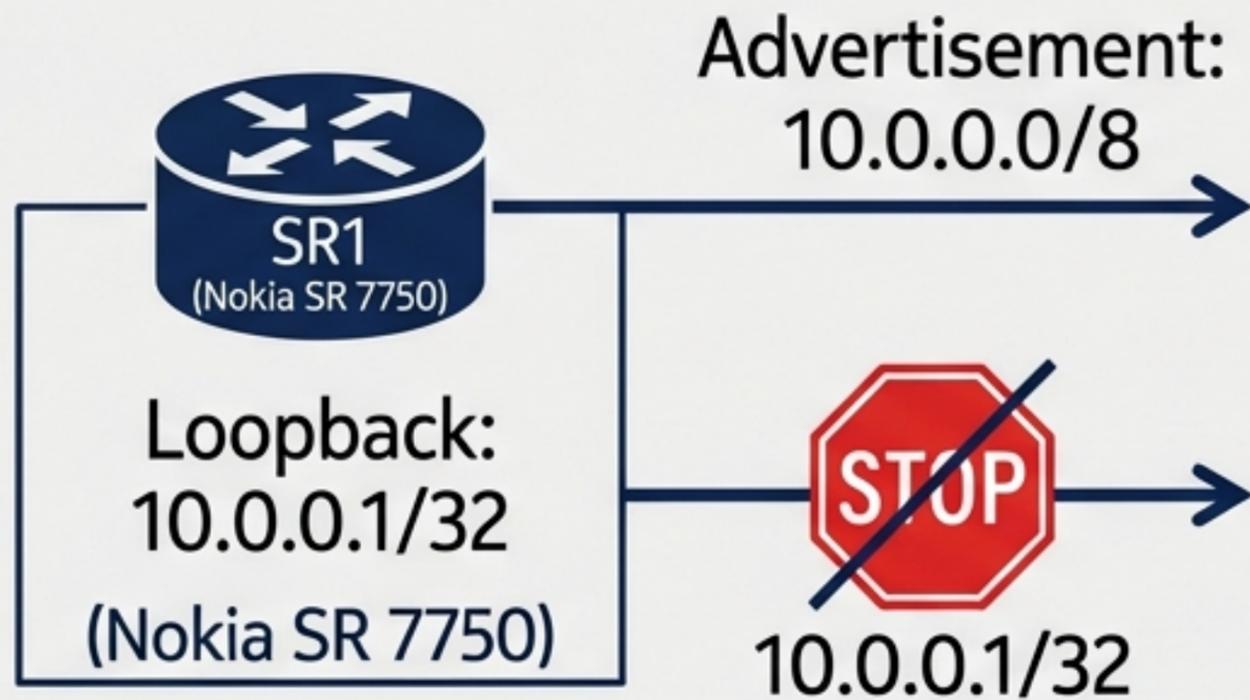
The Fix (Nokia Configuration)

```
configure router isis
  ipv6-routing mt
  multi-topology
  ipv6-unicast
exit
```

Scaling the Core: Summarisation Risks

Route summarisation reduces table size but introduces risks. Nokia SR OS suppresses *all* specific routes within a summary range, including its own system interface.

The Behavior



The Consequence

If the System IP (used for MPLS LSPs) is suppressed, the Label Switched Path cannot be built.

⚠ Rule: Always use leak policies to exempt Loopbacks from summary ranges on Nokia L1/L2 borders.

The Overlay: BGP RIB Visibility

Where did my local route go?

XR1: show bgp ipv4 unicast

```
XR1: show bgp ipv4 unicast
Network      Next Hop Weight
*> 192.0.2.64/26 0.0.0.0 32768 (Local)
```

Cisco displays locally originated routes in the standard RIB view.

SR1: show router bgp routes

```
SR1: show router bgp routes
No Data Available
```

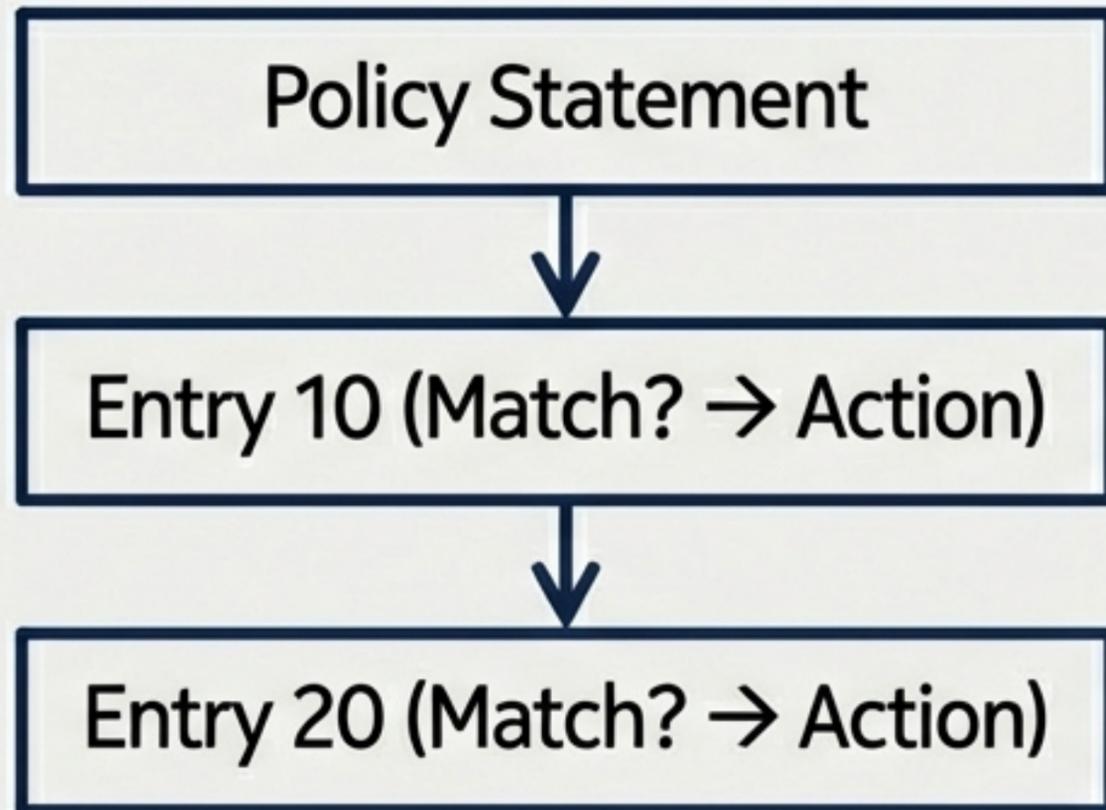
Nokia RIB-In view hides locally generated routes.

The Nokia Fix:

Use `show router bgp neighbor <peer> advertised-routes` to verify local generation.

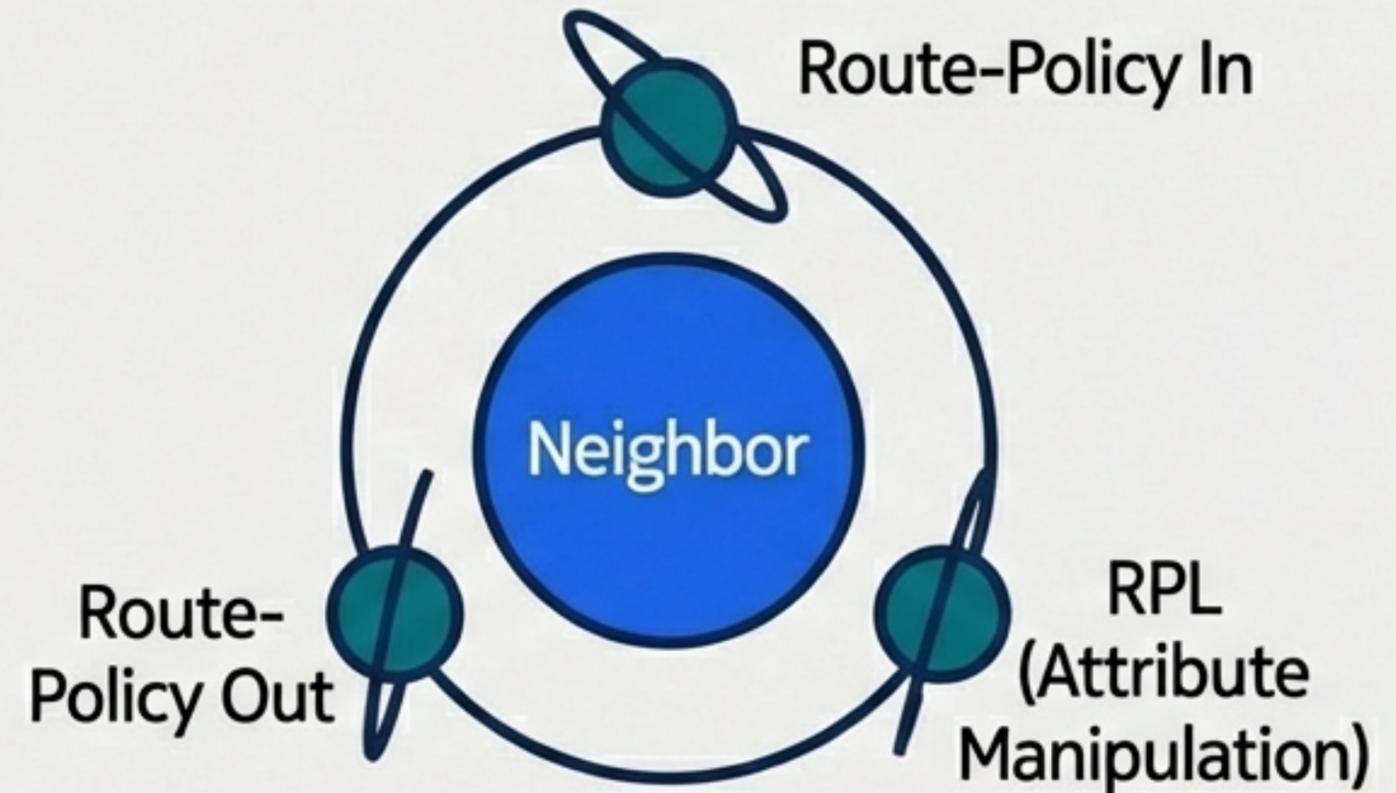
Policy Engines: Centralised vs. Decoupled

Nokia SR OS: Linear Logic



One Export / One Import policy per neighbor. Sequential processing.

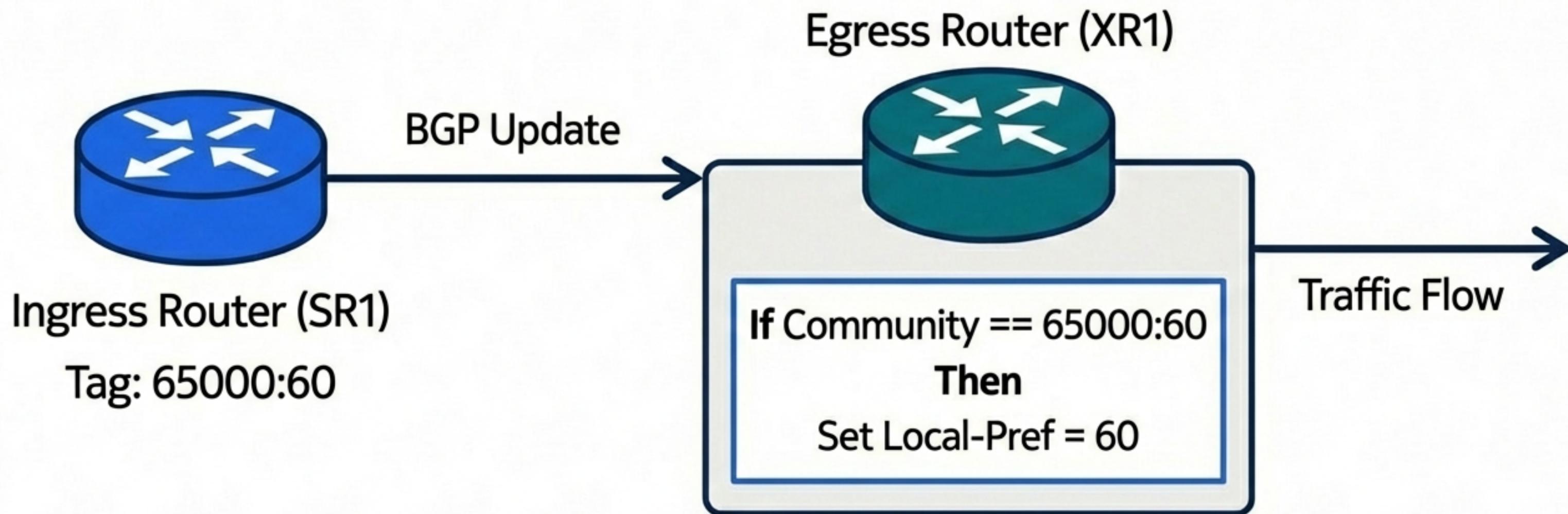
Cisco IOS XR: Modular Logic



Granular attach points per address-family and direction.

Traffic Engineering with BGP Communities

Implementing RFC 1998 for Customer Control



Configuration Note: Cisco IOS XR does not send communities to eBGP peers by default. You must explicitly configure `send-community-ebgp`.

Modern Transport: Segment Routing (SPRING)

Paradigm Shift: Removing LDP/RSVP signaling in favor of Source Packet Routing.

$$\text{Egress Label} = \text{Destination Node Index} + \text{Next-Hop Label Block Start}$$

Destination Index: 22 (XR1)
Next-Hop Block Start: 500000
Resulting Label: 500022

Label Block: Reserved range of labels (e.g., 500,000+).

Node SID: Unique global index per router.

Configuring Segment Routing

Nokia SR OS

****Explicit Definition Required****

```
config router
  mpls-labels
    sr-labels start 500000 end 524287
  ospf
    segment-routing
    prefix-sid-range global
```

Must manually reserve the label block from the dynamic pool.

Cisco IOS XR

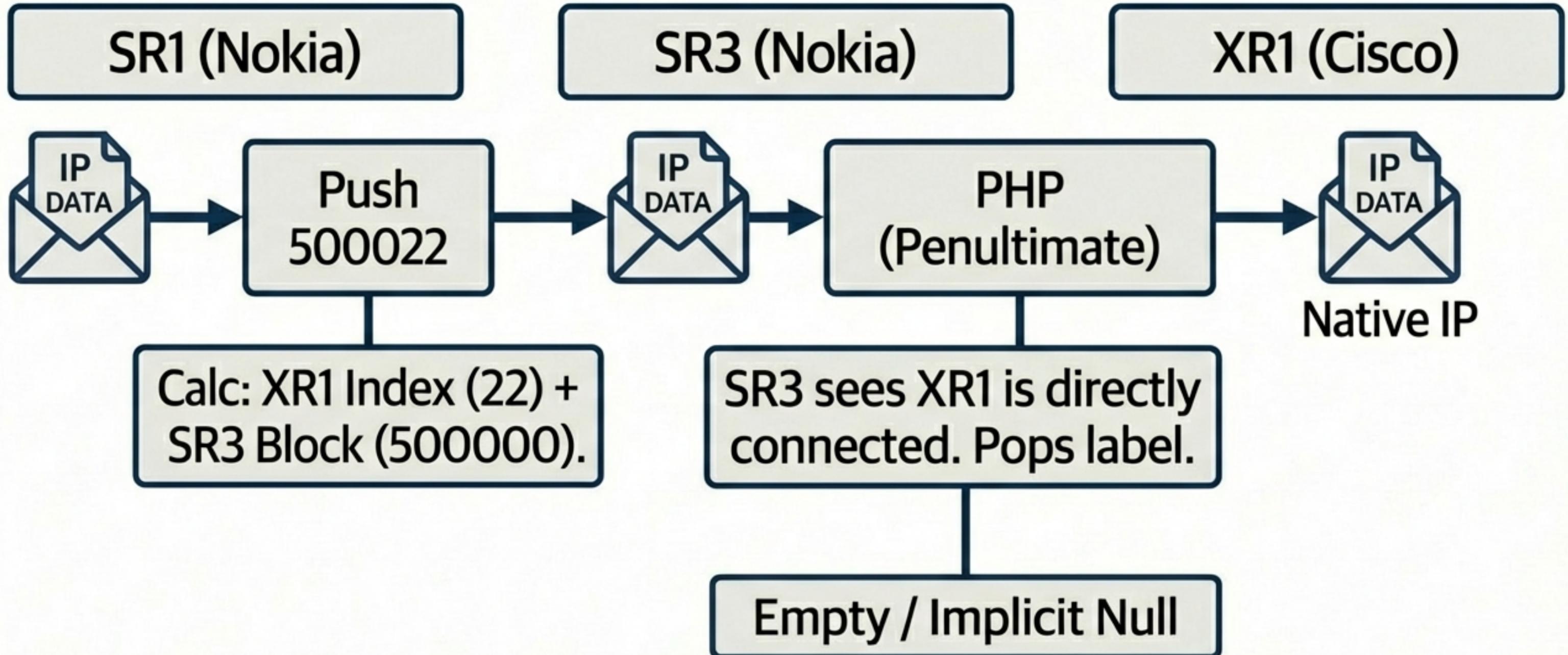
****Implicit / Automated****

```
router ospf CORE
  segment-routing mpls
  area 0
    interface Loopback0
      prefix-sid index 22
```

Label blocks are often automatic.
Simple activation.

The SR Data Plane: Packet Walk

Path: SR1 (Nokia) -> SR3 (Nokia) -> XR1 (Cisco)



Operational Verification & The LFIB

Checking the Forwarding Plane

Cisco LFIB

```
show mpls forwarding
```

Local Label	Outgoing Label	Prefix
-----	-----	-----
16011	500011	SR1-Loopback
24000	Pop SR Adj	Link-Local

Nokia Tunnel Table

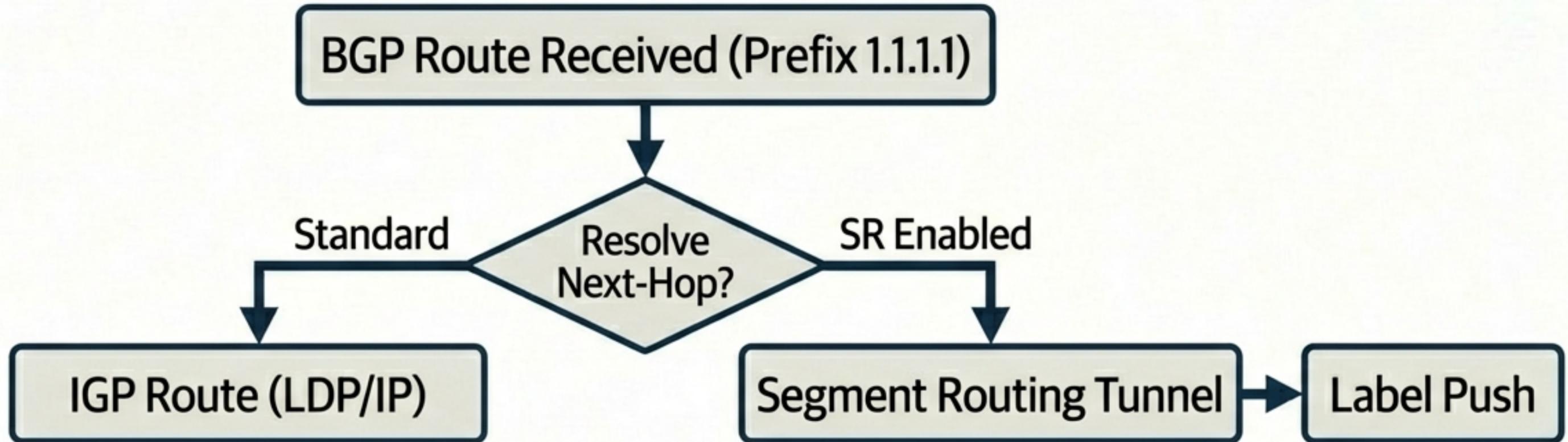
```
show router tunnel-table detail
```

```
Destination: 10.255.255.22/32  
Owner: sr-ospf  
Tunnel Label: 500022
```

Nokia separates SR tunnels from the standard MPLS LFIB view.
Use `tunnel-table` to verify.

Gluing the Layers: BGP Shortcut Resolution

Allowing BGP to use the Segment Routing Tunnels



Nokia Requirement: BGP will not use SR tunnels by default. You must enable the resolution filter.

```
next-hop-resolution shortcut-tunnel  
family ipv4  
resolution-filter sr-ospf
```

Architect's Summary: Key Integration Rules

- ✓ **BGP Visibility:** Nokia hides self-generated routes in the standard RIB. Always check **advertised-routes**.
- ✓ **ISIS Compatibility:** Cisco defaults to Multi-Topology for IPv6. Configure **ipv6-routing mt** on Nokia to match.
- ✓ **Route Aggregation:** Nokia summarisation suppresses specific system IPs. Use leak policies to protect MPLS endpoints.
- ✓ **Segment Routing:** Explicitly define Label Blocks on Nokia SR OS to reserve space from the dynamic pool.
- ✓ **Global Indexes:** Ensure Node SIDs are unique across the entire multi-vendor domain.