SAVNET Architecture

draft-li-savnet-intra-domain-architecture

draft-wu-savnet-inter-domain-architecture

July 2023

Source Address Validation

- Source address validation (SAV) is important for defending against source address spoofing attacks

- Since 2014, the MANRS initiative is calling on network operators to implement SAV as close to the source as possible

- When an access network does not deploy SAV at the source (e.g., SAVI), intra- and inter-domain SAVs help block spoofed packets

- Access SAV techniques are not in the analysis scope: such as RADIUS/DIAMETER, SAVI (e.g., IP Source Guard), Cable Source-Verify, etc.

Existing SAV Mechanisms

- ACL-based ingress filtering [RFC2827][RFC3704]
- Strict uRPF [RFC3704]
- Loose uRPF [RFC3704]
- FP-uRPF [RFC3704]
- VRF-uRPF [RFC8704]
- EFP-uRPF [RFC8704]
- Source-based RTBH filtering [RFC5635]

Common features: Primarily based on routing information (i.e., FIB/RIB) or manual configuration for generating SAV rules

Gap Analysis

- Gap 1: Have operational challenges in dynamic or complex networks
  - i) Manual updates induce high operational overhead (e.g., ACL for inbound filtering)
  - ii) They cannot work in all directions (i.e. interfaces) or scenarios
- Gap 2: Have improper block or improper permit problems due to asymmetric routing
  - Route: prefix P1 has next-hop Intf. 1
  - Reverse path: prefix P1 will come from Intf. 2
- More details in:
  - draft-ietf-savnet-intra-domain-problem-statement
  - draft-ietf-savnet-inter-domain-problem-statement

Design Goals

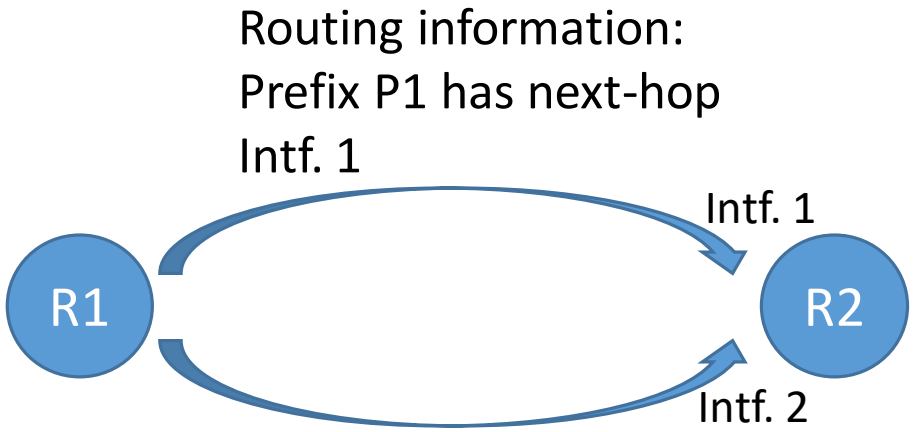
- Goal 1: Automatic Update
  - The routers after initial configurations can adapt to dynamic routing changes automatically, so that the operational overhead can be controlled.
- Goal 2: Accurate Validation
  - The real incoming interfaces of source prefixes need to be completely learned, and improper block can be avoided. By trying to exclude non-real incoming interfaces from the valid interface group, improper permit can be reduced.
- Analysis:
  - Routing information can be automatically updated but is not enough for generating accurate SAV rules.
  - The information specifically useful to SAV but may not useful for routing is needed for achieving the above goals.

SAV-Specific Information

- **SAV-specific information**: Explicitly or implicitly **indicate the accurate incoming direction of source addresses**, which helps routers generate accurate SAV rules. SAV-specific information is **specialized for SAV**.
- Examples of SAV-specific information
  - SAV rule, e.g., <prefix, valid interfaces>
  - Topology information, e.g., hidden prefixes
  - Forwarding information, e.g., real forwarding paths
- SAV-specific information can replace or supplement routing information when routers generate SAV rules.
- Both SAV-specific information and routing information are SAV-related information

Main Idea of SAVNET Architecture

- **Main idea**: Besides routing information, allow routers or ASes to advertise SAV-specific information for automatically generate accurate SAV rules



A simple example

Now-1: Generate SAV rule primarily based on routing information

- Automatic but not accurate

Now-2: Generate SAV rule based on manual configuration

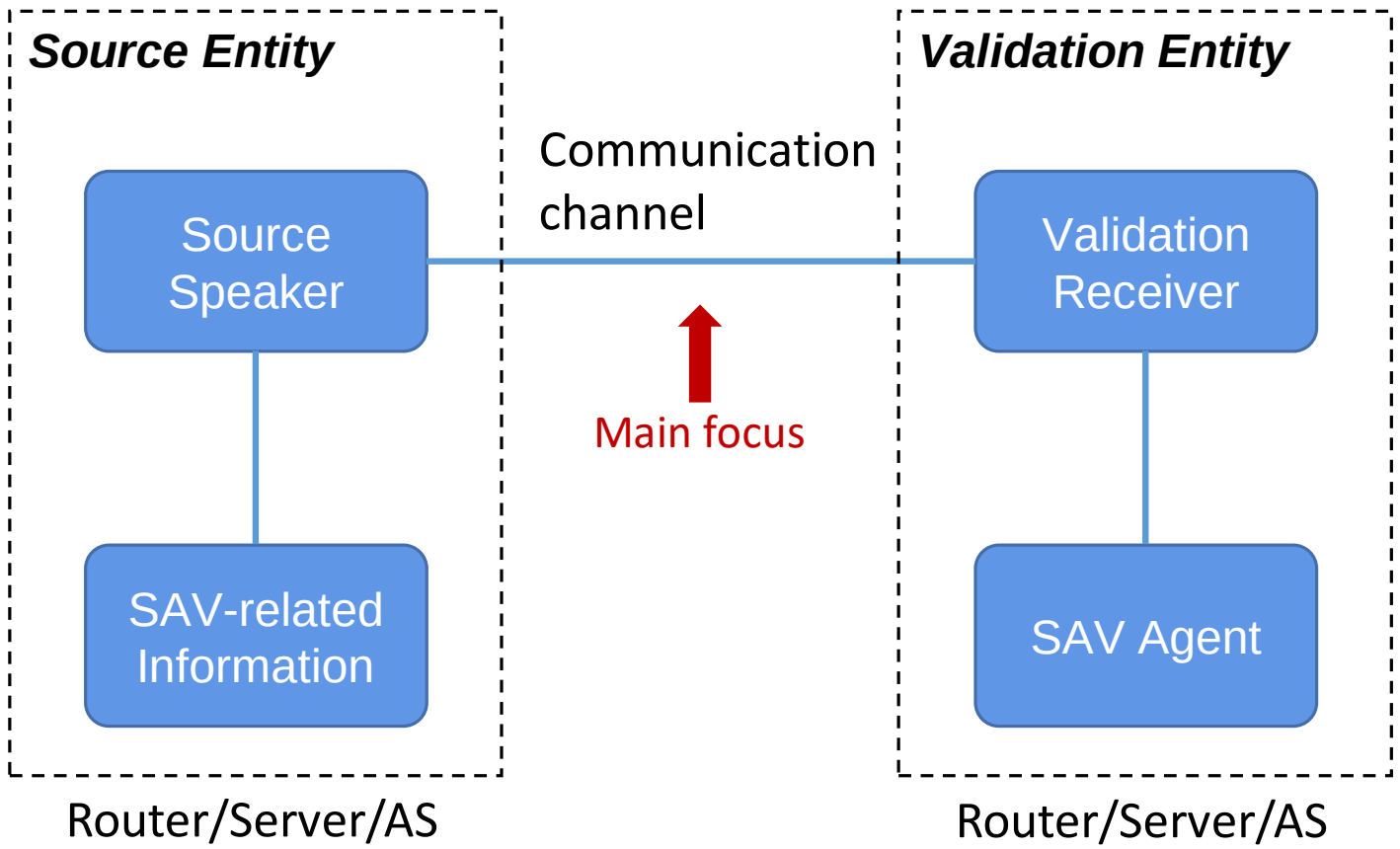
- Accurate but not automatic

Future: Generate SAV rules based on SAV- specific information

- Automatic and accurate

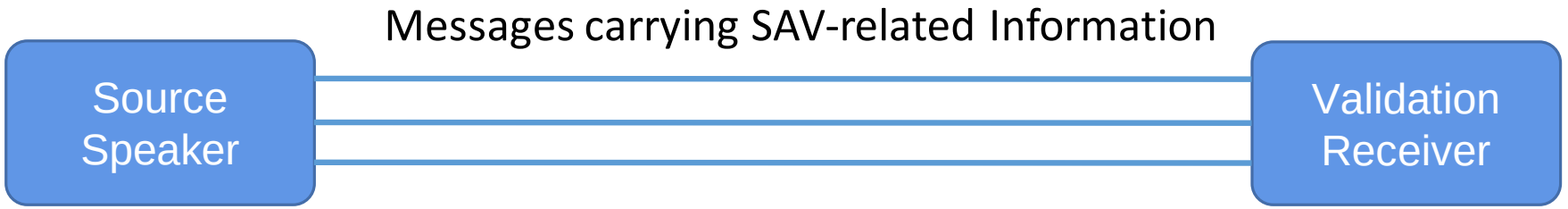
SAVNET Architecture

- **Source Entity**: Advertise SAV-related information
- **Validation Entity**: Generate SAV rules and/or conduct validation
- **Communication channel**: Connect two entities for transmitting SAV-related information
- A device can act as a Source Entity, a Validation Entity, or both of them.



Notes: Take the figure of intra-domain architecture for illustration

Messages carrying SAV-related Information

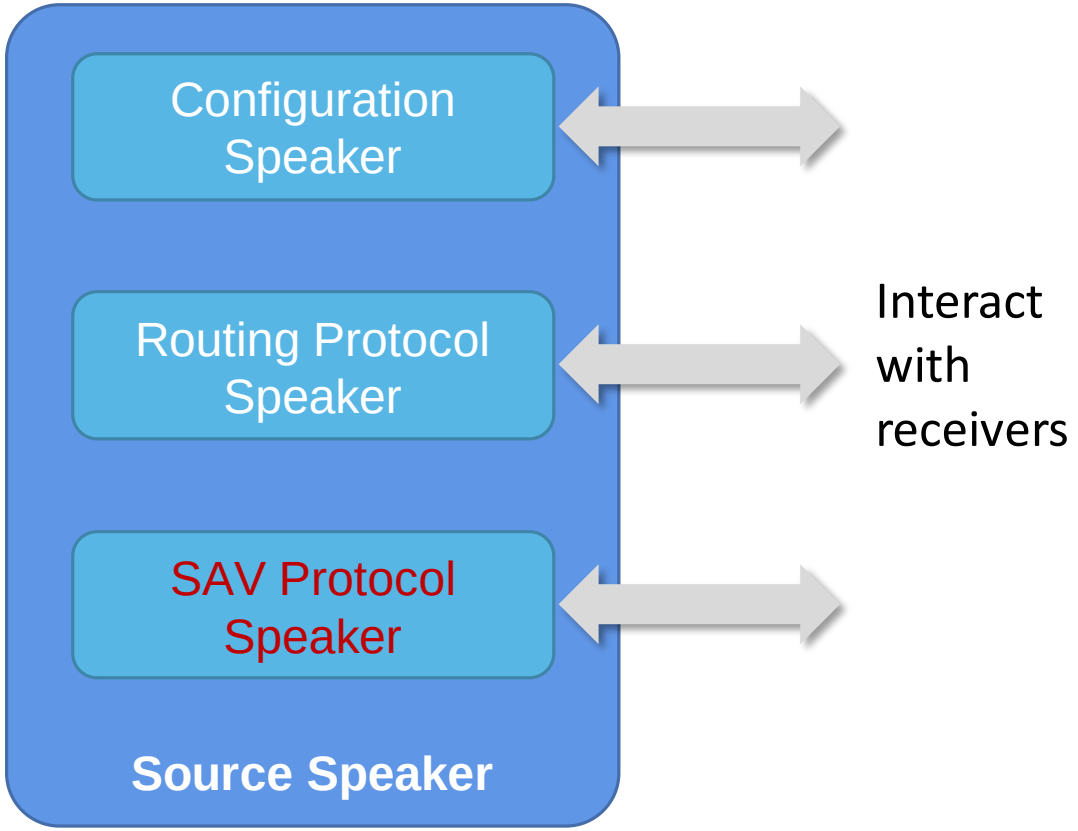


- **Messages carrying SAV-related Information**
  - SAV-specific information messages: Necessary for accurate SAV
  - Routing information messages: Necessary when SAV-specific information is not complete
- **Multiple sessions**:
  - The information can be delivered through multiple sessions of different protocols
  - A long-time session or a temporary one
  - Sufficient assurance of **transmission reliability and timeliness**
  - **Authentication** can be conducted before session establishment

How to Advertise Information

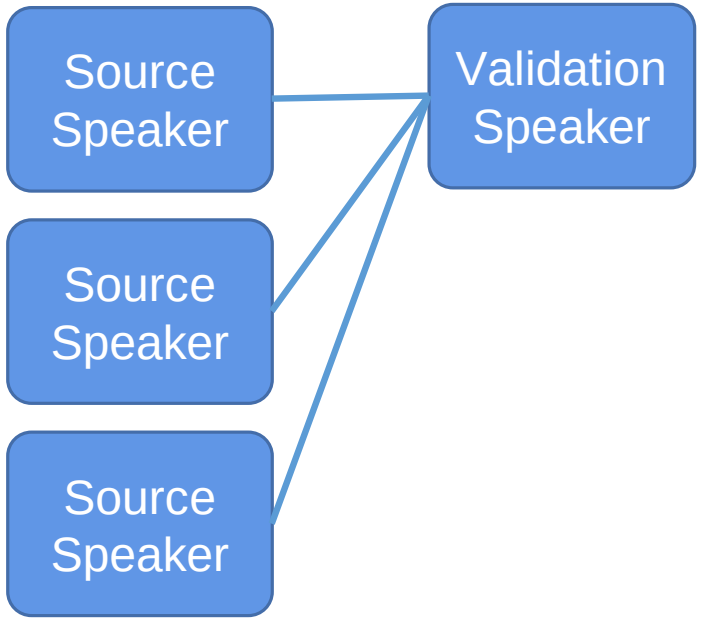
- Source Speaker/Validation Receiver

1. **Configuration Speaker/Receiver**
   - CLI, YANG, FlowSpec, and any other protocols for SAV
2. **Routing Protocol Speaker/Receiver**
   - OSPF, IS-IS, BGP, etc.
3. **SAV protocol Speaker/Receiver (new)**
   - Can be an extension to the routing protocol speaker
   - Used to advertise SAV-specific information

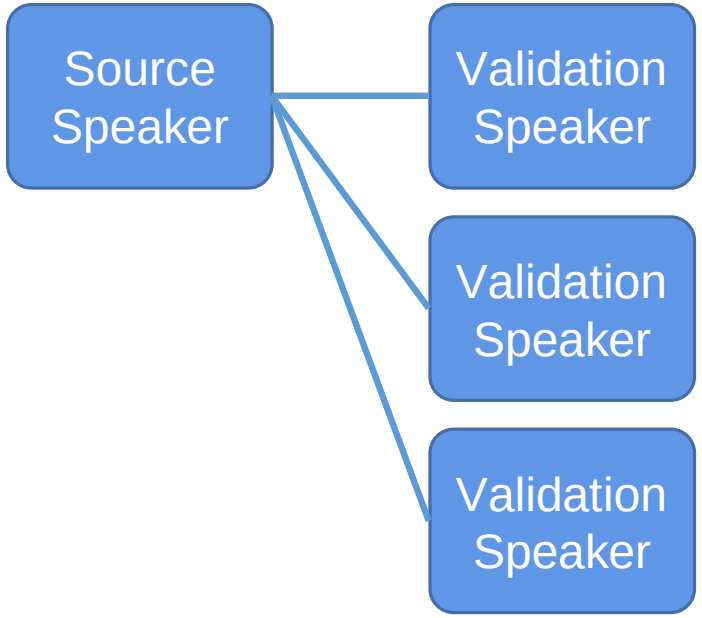


Connectivity Models

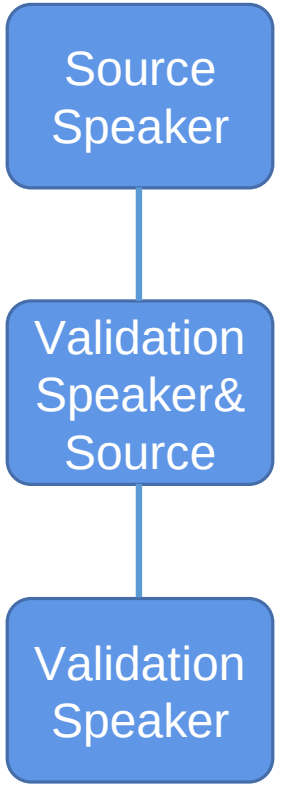
Model (a)



Model (b)

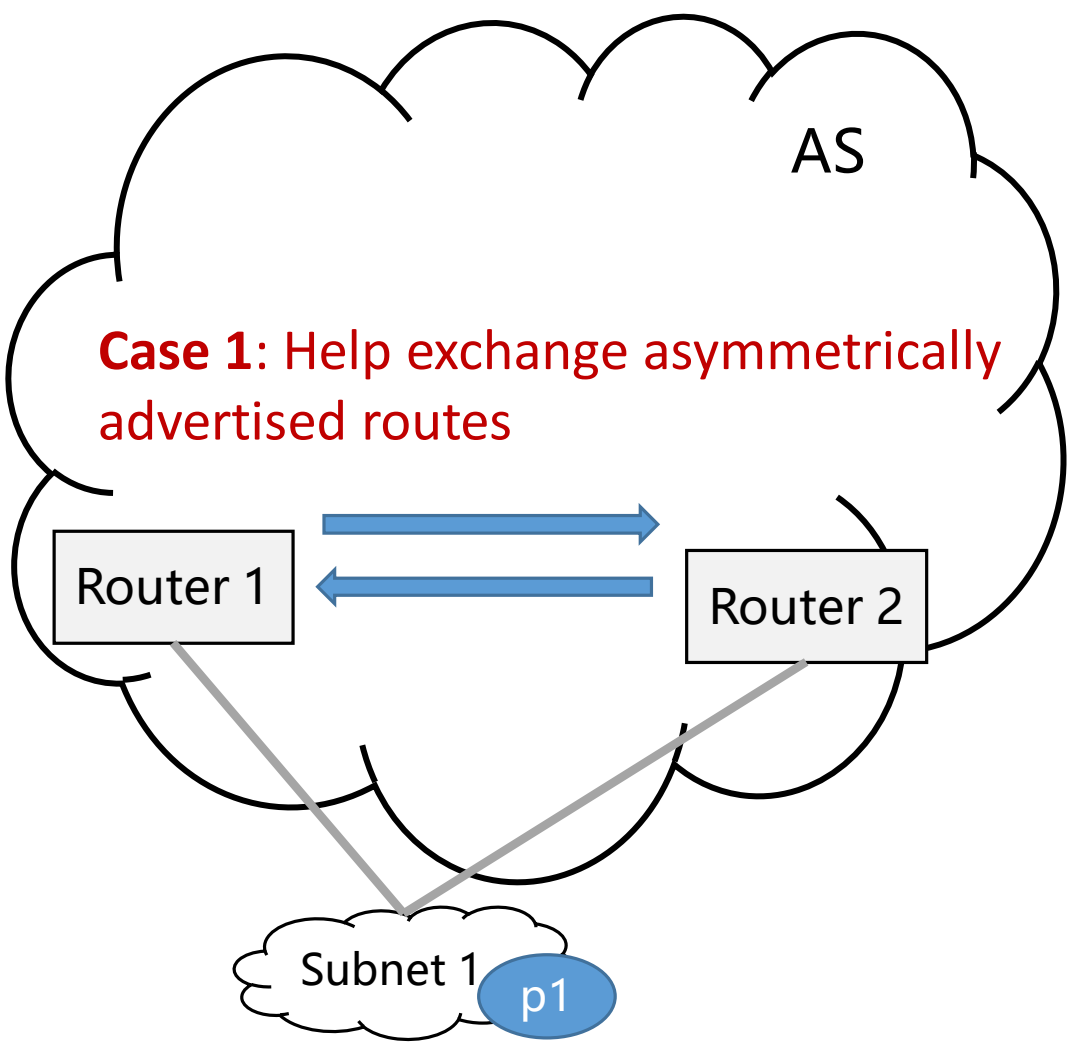


Model (c)

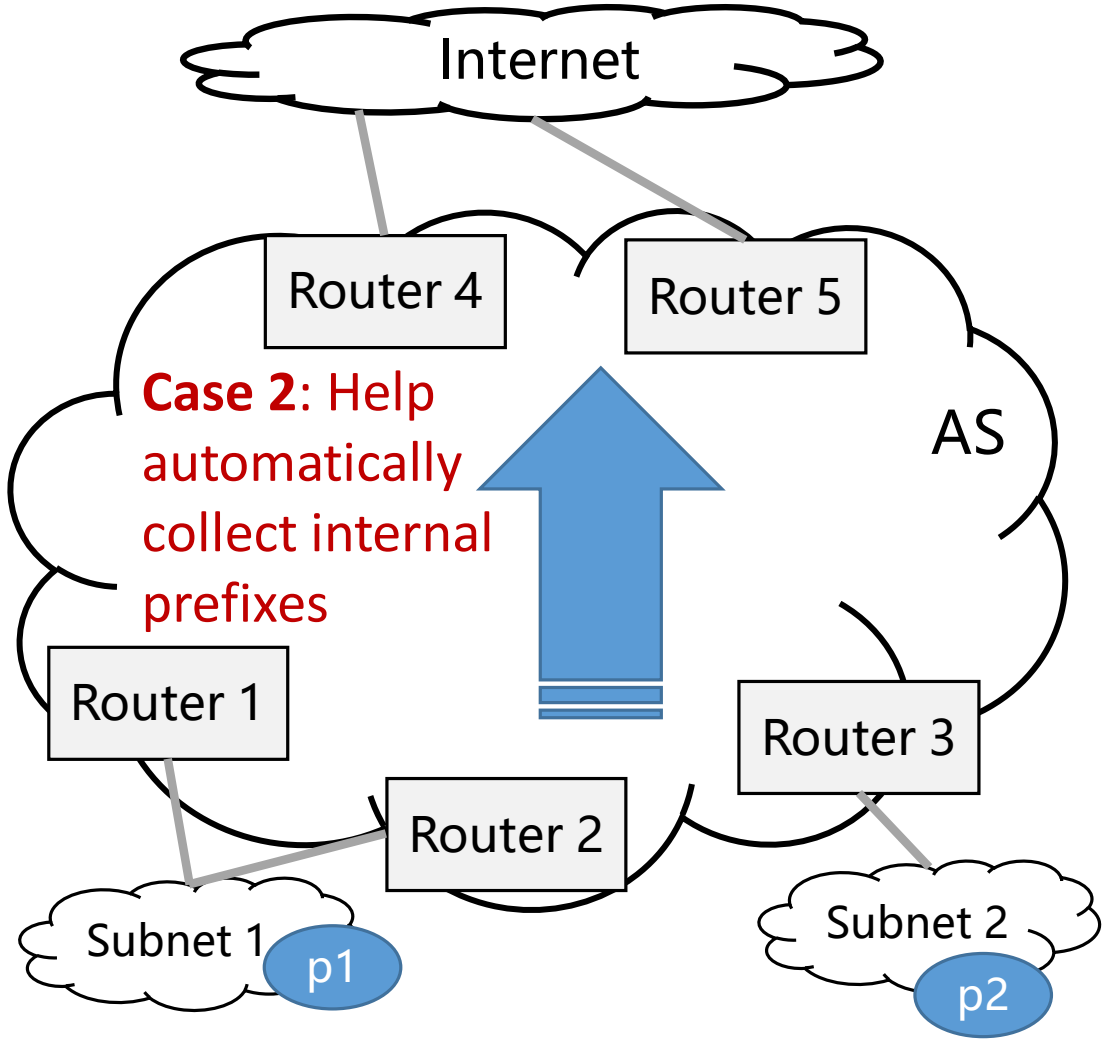


*** The combinations of the above are also supported**

Use Cases

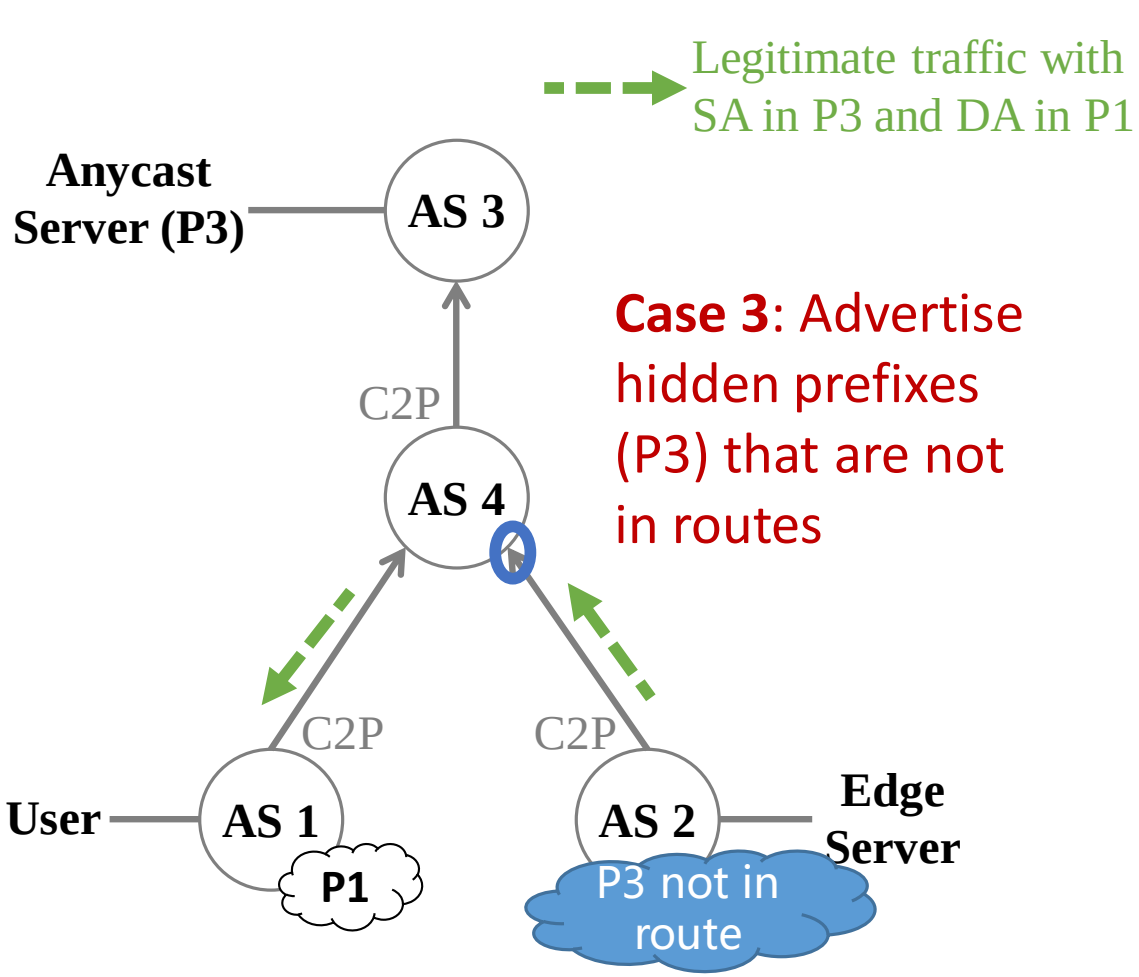


Asymmetric routing in the Multi-homed Subnet Scenario



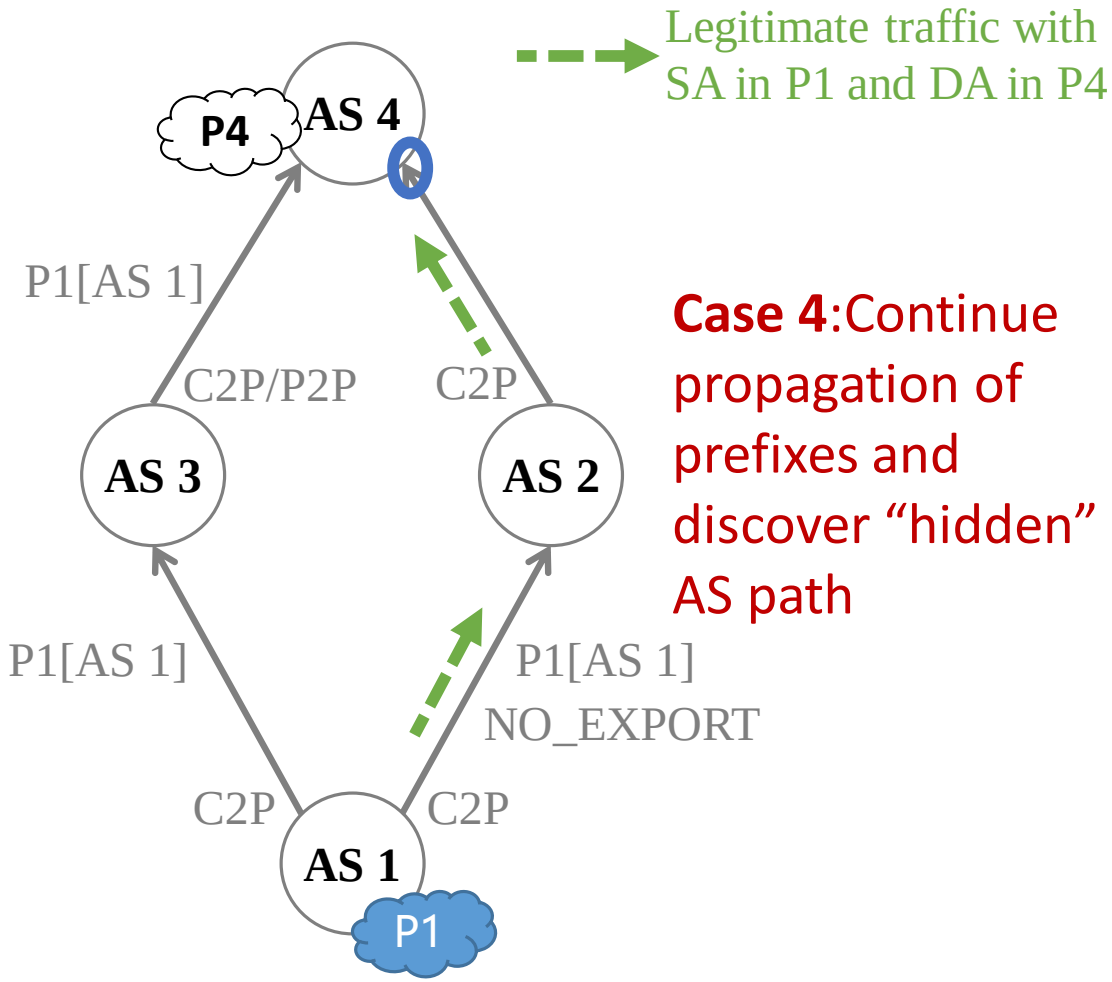
Blocking Internal Prefixes at Internet Interfaces

Use Cases



Case 3: Advertise hidden prefixes (P3) that are not in routes

A direct server return (DSR) scenario



Case 4:Continue propagation of prefixes and discover "hidden" AS path

Limited propagation of prefixes caused by NO_EXPORT

More Details in the Drafts

- Refer to draft-li-savnet-intra-domain-architecture and draft-wu-savnet-inter-domain-architecture
  - SAV Agent
  - Deployment Considerations
  - Convergence Considerations
  - Manageability Considerations
  - Security Considerations
  - Privacy Considerations

Architecture Implementation Considerations

- The architecture is protocol-independent.
- **Question**: Use which protocol to implement the architecture?
- Existing SAV mechanisms mainly depend on routing information. Extending routing protocols for carrying SAV-specific information is an intuitive method.
  - Routing protocol is the intuitive choice compared to existing Internet protocols
- How about a new protocol?
  - High efficiency like efficient packet encapsulation
  - But, too much repetitive design, such as communication, negotiation, neighbor maintaining, and quality properties.
  - Also, a new protocol is hard to deploy among ASes.

BGP Extensions for SAVNET?

- Why BGP:
  - Wide application scenarios and can work within an AS or among ASes
  - Easy to extend and provide good service isolation
  - Reuse existing basic design and quality attributes to reduce design and development workload and facilitate application
  - Explicit update and withdrawal without periodic flooding
- How:
  - Much work to do: how to carry, deployment problems, convergence challenges, manageability obstacles, security problems, privacy concerns, etc.
  - Need a detailed discussion on specific extension designs

Conclusion

- Give a brief introduction to the SAVNET architecture as well as some considerations.
- Since the work can be relevant to routing protocols like BGP, we would like to sync progress to IDR WG and solicit comments.
- Any comments are welcome. Also welcome to leave your comments in the idr or savnet mailing list.

Acknowledgements for Architecture Drafts

- Many thanks to the valuable comments from:
  - Igor Lubashev
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Thanks!