draft-li-savnet-intra-domain-architecture-05, IETF SAVNET WG

Intra-domain Source Address Validation (SAVNET) Architecture

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November 8, 2023

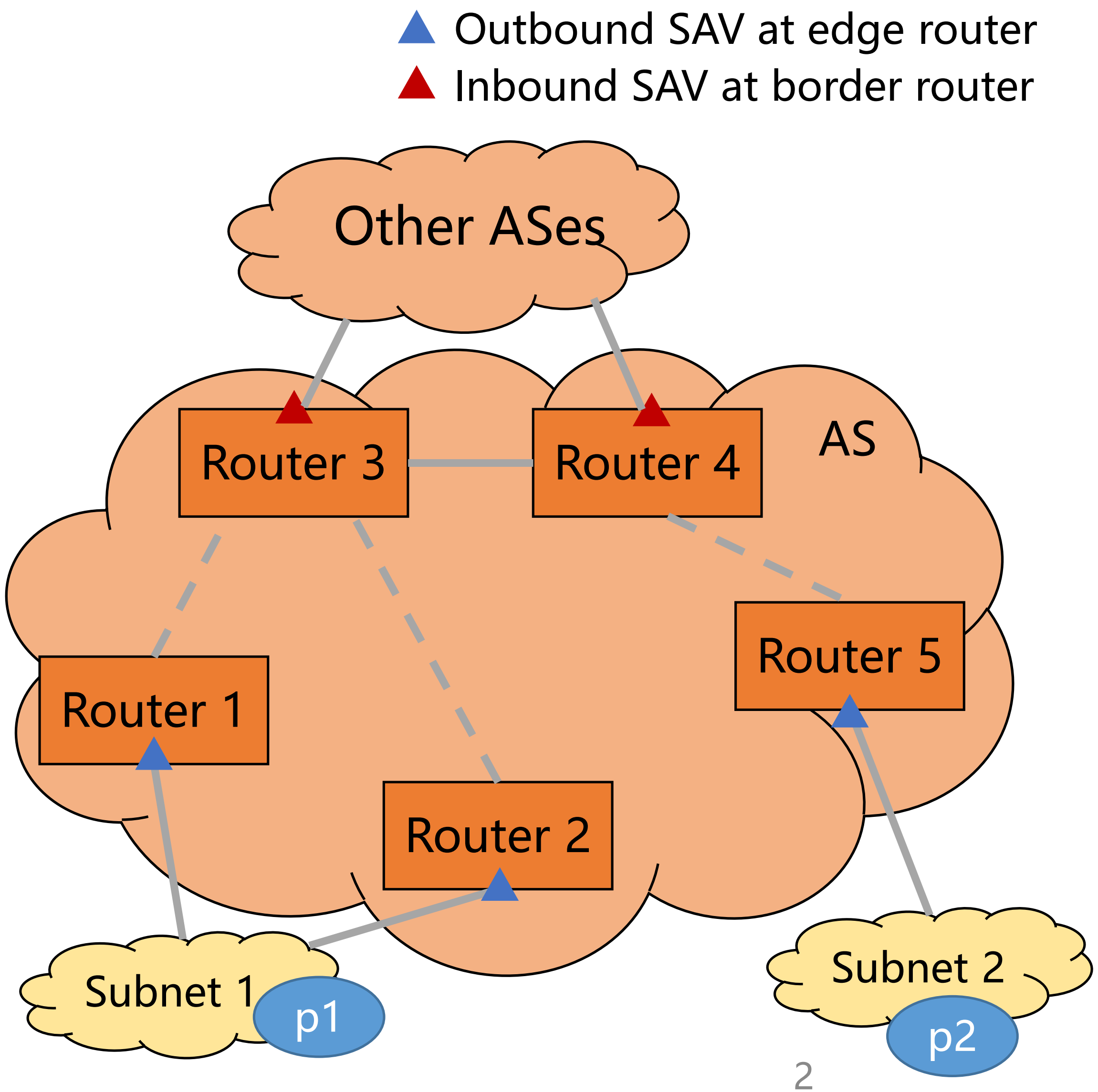
Two Goals of Intra-domain SAV

□ Goal #1: Outbound traffic validation

◆**Edge routers** should block illegitimate packets **coming from the AS's intra-domain subnets** which **forge source addresses of other subnets** (either within the AS or other ASes)

□ Goal #2: Inbound traffic validation

◆**Border routers** should block illegitimate packets **coming from other ASes** which **forge internal source addresses**



Review of Intra-domain SAV Problem Statement

- □ Problems of existing intra-domain SAV mechanisms[1]
  - ◆ACL-based SAV requires high operational overhead
  - ◆uRPF-based SAV has improper block or improper permit problems
- □ Requirements of the new intra-domain SAV mechanism[1]
  - ◆Automatic update
  - ◆Accurate validation
  - ◆Incremental/partial deployment
  - ◆Convergence
  - ◆Security

[1]: draft-ietf-savnet-intra-domain-problem-statement-02

Background of Intra-domain SAVNET Architecture

- □ Intra-domain SAVNET architecture aims to achieve accurate SAV in an intra-domain network by an automatic way
  - ◆Address the problems of existing intra-domain SAV mechanisms
  - ◆Meet the requirements proposed in [draft-ietf-savnet-intra-domain-problem-statement]
- □ Historical versions
  - ◆draft-li-savnet-intra-domain-architecture-00, IETF 115 SAVNET WG
  - ◆draft-li-savnet-intra-domain-architecture-01, IETF 116 SAVNET WG
  - ◆draft-li-savnet-intra-domain-architecture-02, June 1, 2023
  - ◆**draft-li-savnet-intra-domain-architecture-03, IETF 117 SAVNET WG**
  - ◆draft-li-savnet-intra-domain-architecture-04, Oct. 20, 2023
  - ◆**draft-li-savnet-intra-domain-architecture-05, IETF 118 SAVNET WG**

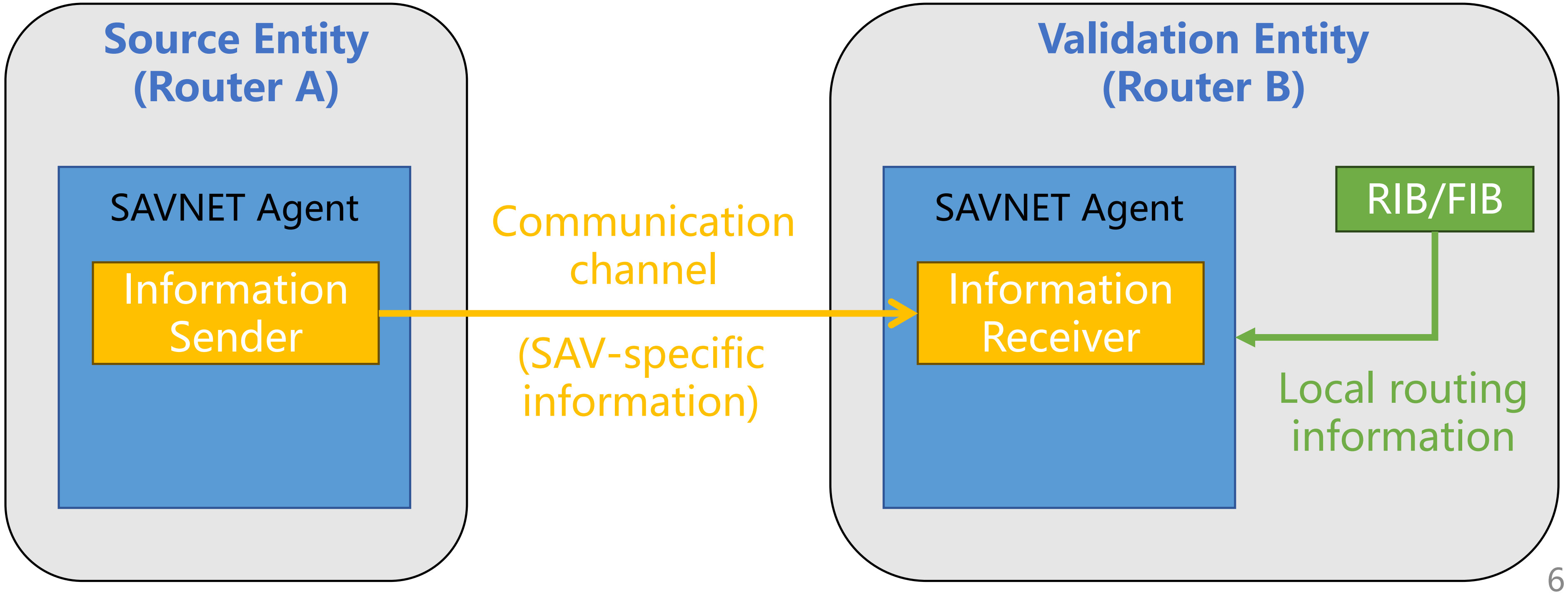
Main Updates Compared to Version-03

- □ Updates in Intra-domain SAVNET Architecture section
  - ◆Clarify the content of SAV-specific information
  - ◆Introduce the SAV rule generation process for edge router and border router, respectively
- □ Updates in Use Cases section
  - ◆Use the two use cases proposed in [draft-ietf-savnet-intra-domain-problem-statement] to illustrate intra-domain SAVNET can achieve more accurate validation and support automatic update
- □ Add a new section
  - ◆Describe how intra-domain SAVNET meet the five design requirements proposed in [draft-ietf-savnet-intra-domain-problem-statement]

Key Idea of Intra-domain SAVNET Architecture

□ Exchange SAV-specific information among intra-domain routers automatically

□ Generate SAV rules in routers based on both SAV-specific information and local routing information

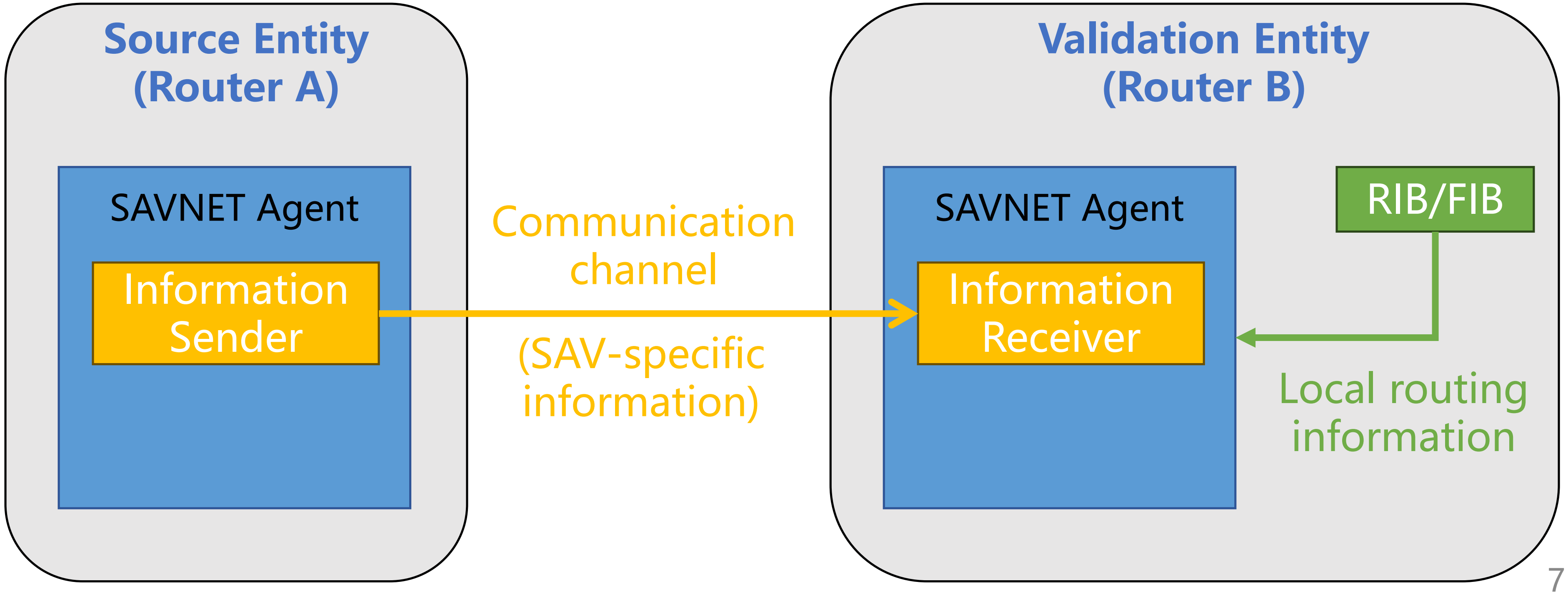


Source Entity and Validation Entity

An intra-domain router can act as one or two roles: source entity or/and validation entity

Source entity sends its SAV-specific information to other routers

Validation entity receives SAV-specific information from other routers and generates SAV rules based on SAV-related information



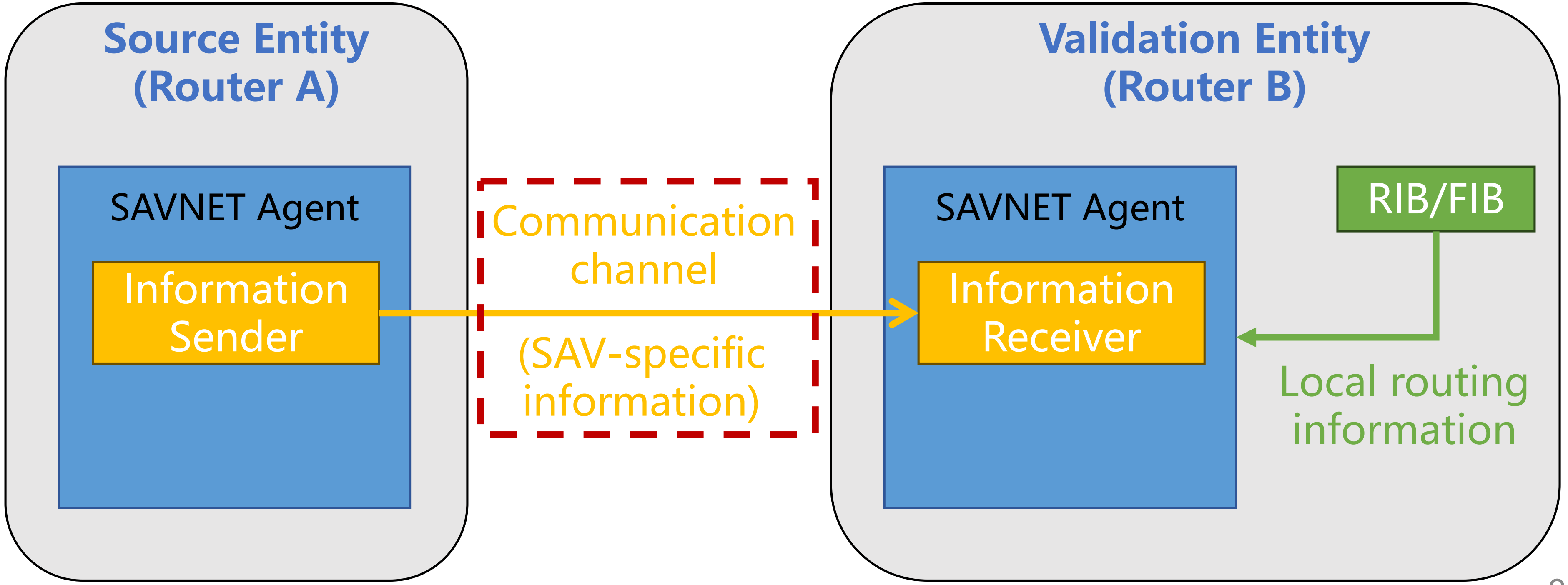
SAV-specific Information

- □ SAV-specific information is specialized for SAV rule generation
  - ◆It carries necessary information which cannot be learned from local routing information especially in asymmetric routing scenarios, helping generate accurate SAV rules
- □ Examples of SAV-specific information in intra-domain SAVNET
  - ◆The router’s locally known source prefixes of its connected subnets
  - ◆The ownership of source prefixes, e.g., belonging to a single-homed subnet or belonging to a multi-homed subnet
  - ◆The type of source prefixes, e.g., anycast prefix, hidden prefix, etc.
- □ A new mechanism (namely, SAV-specific information communication mechanism) is needed to communicate SAV-specific information

SAV-specific Information Communication Mechanism

□ Building the communication channel and propagating SAV-specific information from source entity to validation entity

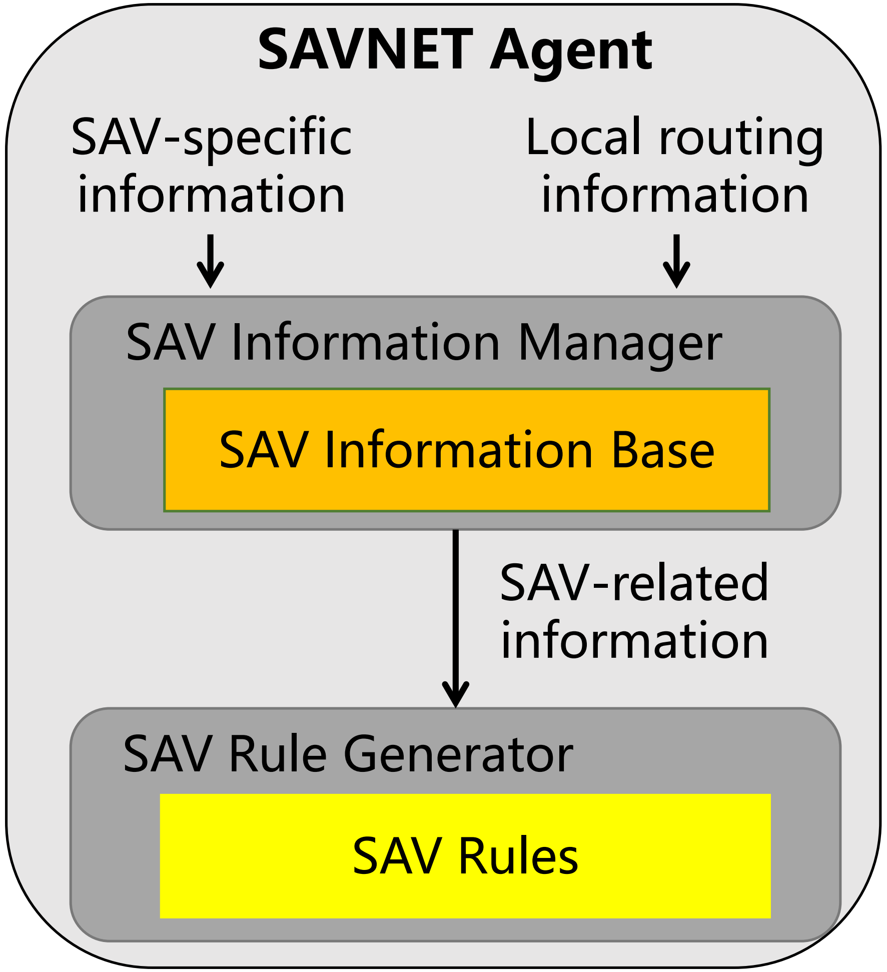
- ◆Automatic update in a timely manner
- ◆Session authentication before session establishment



SAV Rule Generation

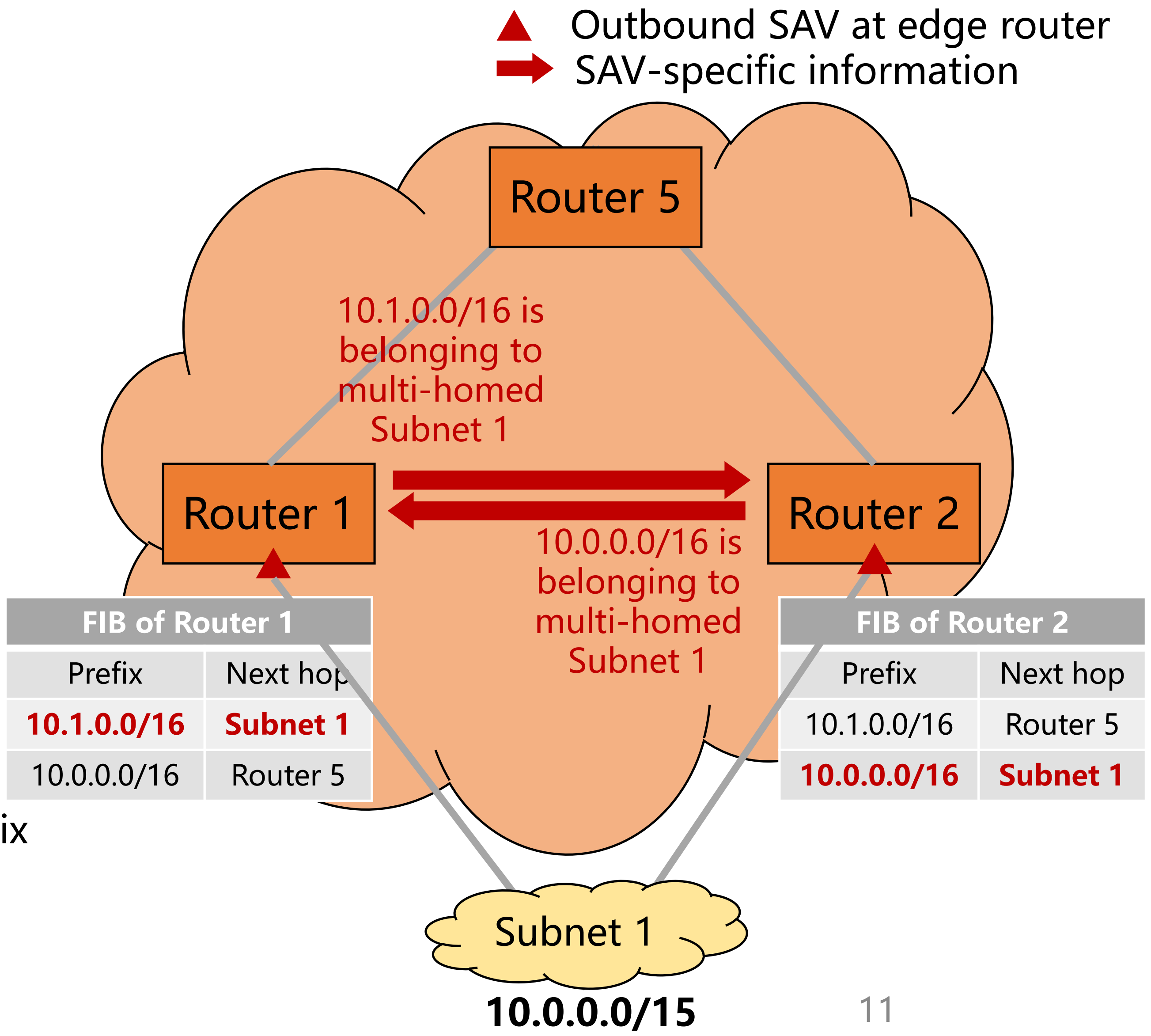
- □ Edge routers generate SAV rules and perform outbound SAV
  - ◆Obtain the complete source prefixes of each connected subnet based on SAV-specific information and local routing information
- □ Border routers generate SAV rules and perform inbound SAV
  - ◆Obtain internal source prefixes of the AS based on SAV-specific information and local routing information

Validation Entity



Use Case #1: Outbound SAV at Edge Routers

- **Outbound traffic validation in asymmetric routing scenario[1]**
  - Edge routers 1 and 2 only learn part of source prefixes of Subnet 1 from local routing information in the asymmetric routing scenario
- If using strict uRPF
  - Improper block
- If using intra-domain SAVNET
  - **Accurate & Automatic outbound SAV**
    - Routers 1 and 2 obtain the complete source prefix of Subnet 1 by exchanging their locally known source prefixes of Subnet 1



▲ Outbound SAV at edge router
➡ SAV-specific information
Router 5
Router 1
Router 2
10.1.0.0/16 is belonging to multi-homed Subnet 1
10.0.0.0/16 is belonging to multi-homed Subnet 1
Subnet 1
10.0.0.0/15

FIB of Router 1

Prefix	Next hop
10.1.0.0/16	**Subnet 1**
10.0.0.0/16	Router 5

FIB of Router 2

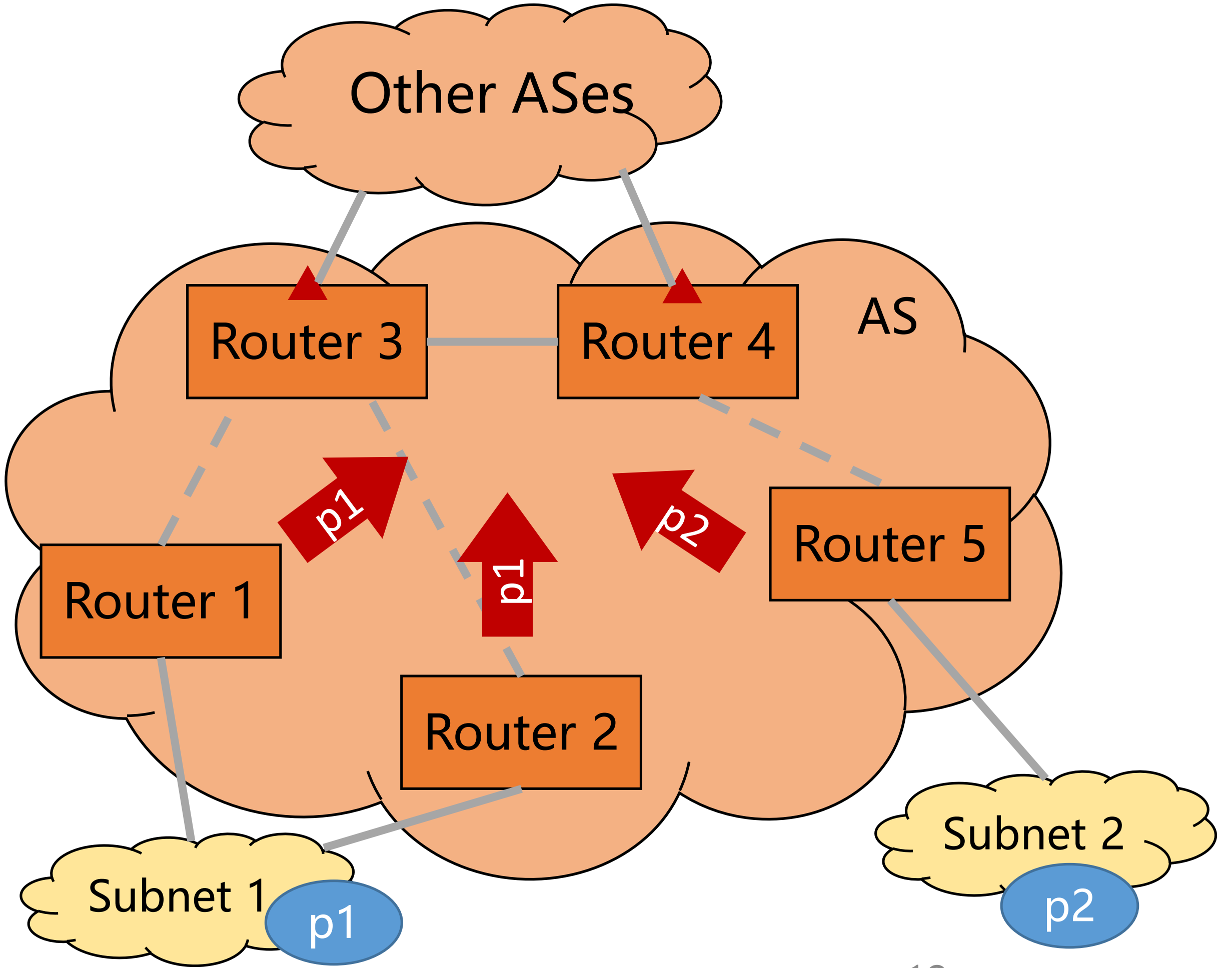
Prefix	Next hop
10.1.0.0/16	Router 5
10.0.0.0/16	**Subnet 1**

[1]: draft-ietf-savnet-intra-domain-problem-statement-02

Use Case #2: Inbound SAV at Border Routers

- **Inbound traffic validation**[1]
  - Border routers 3 and 4 should block inbound packets with source address of internal source prefixes at border routers
- If using ACL-based SAV
  - Manual update when internal prefixes or network topology change dynamically
- If using loose uRPF
  - Large amount of improper permit
- If using intra-domain SAVNET
  - **Accurate & Automatic inbound SAV**
    - Routers 3 and 4 obtain the complete internal source prefix based on SAV-specific information sent by Routers 1, 2, and 5

▲ Inbound SAV at border router
➡ SAV-specific information



[1]: draft-ieft-savnet-intra-domain-problem-statement-02

Use Case #2: Inbound SAV at Border Routers

- □ **Inbound traffic validation**[1]
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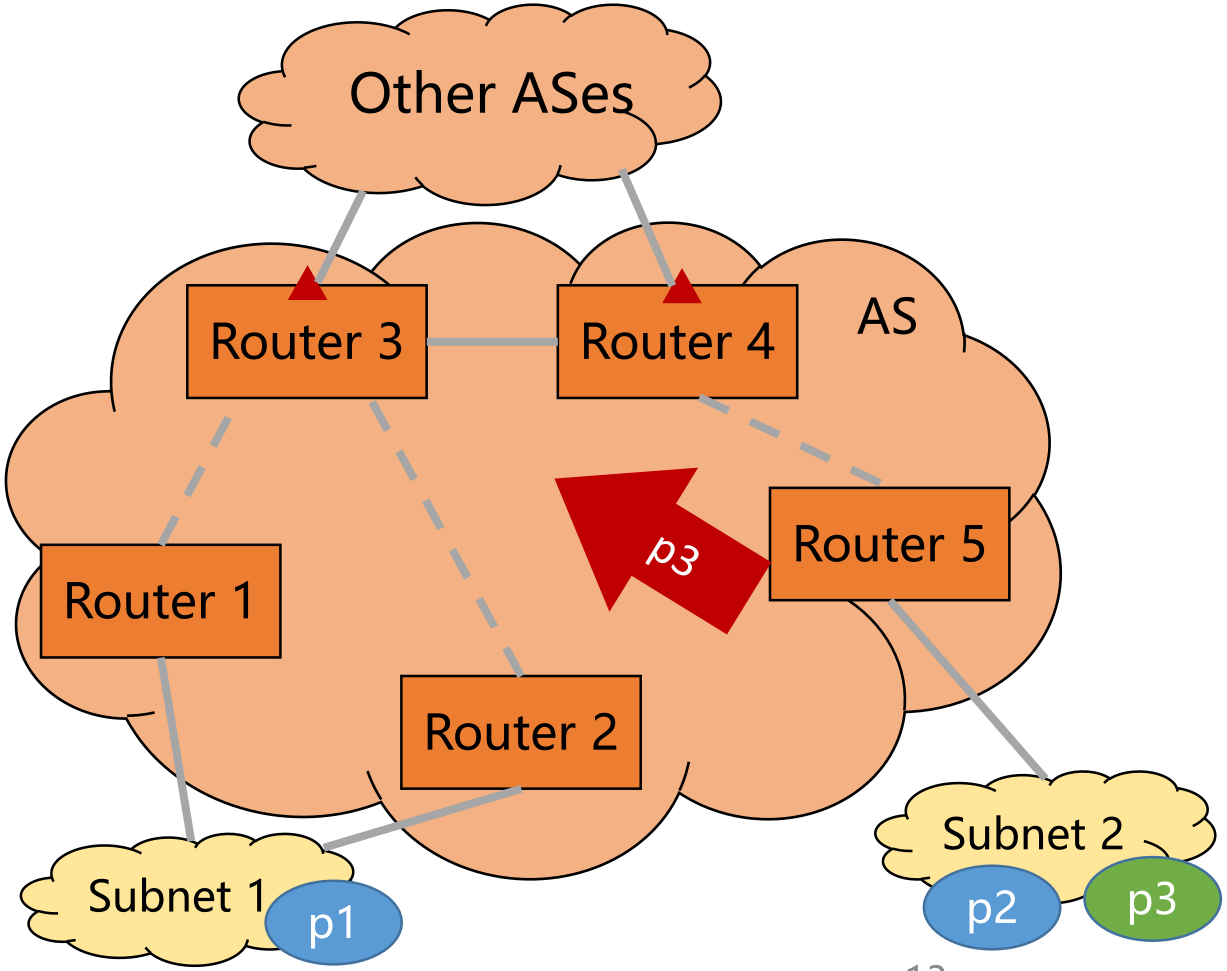
- □ If using ACL-based SAV
  - ◆Manual update when internal prefixes or network topology change dynamically
- □ If using loose uRPF
  - ◆Large amount of improper permit
- □ If using intra-domain SAVNET
  - ◆**Accurate & Automatic inbound SAV**
    - ➢Routers 3 and 4 obtain the complete internal source prefix based on SAV-specific information sent by Routers 1, 2, and 5

[1]: draft-ietf-savnet-intra-domain-problem-statement-02

▲ Inbound SAV at border router

➡ SAV-specific information update



Accurate Validation & Automatic Update

Use Cases #1 and #2 illustrate that intra-domain SAVNET can **achieve more accurate validation and support automatic update**

- □ Compared with uRPF-based SAV which solely uses local routing information,
  - ◆Intra-domain SAVNET generates SAV rules by using both local routing information and SAV-specific information exchanged among routers, resulting in more accurate SAV validation in asymmetric routing scenarios
- □ Compared with ACL-based SAV which requires manual updates,
  - ◆Intra-domain SAVNET generates SAV rules automatically in a distributed way and allows routers to exchange the changes of SAV-specific information among each other automatically

Incremental/Partial Deployment

- □ Edge routers and border routers deploying intra-domain SAVNET is enough
- □ If only partial edge routers and border routers deploy intra-domain SAVNET, they can still block spoofing traffic by exchanging SAV-specific information
  - ◆Outbound SAV: as long as edge routers connected to the same subnet exchange SAV-specific information, that subnet can be prevented from spoofing other subnets
  - ◆Inbound SAV: if a border router only obtains partial internal source prefixes, it can still block inbound packets which forge those prefixes
  - ◆When SAV-specific information is missing, local routing information can be used to generate SAV rules
- □ More routers deploy intra-domain SAVNET, more benefits

Convergence

- When SAV-related information changes,
  - Source entity MUST send the updated SAV-specific information to validation entity **timely**
  - Validation entity MUST detect the changes of received SAV-specific information and local routing information in time and update SAV rules with the latest information
- Propagation speed of SAV-specific information is the main factor that affects the convergence of SAV rule generation
  - SAV-specific information can have a similar propagation speed as routing information
    - if SAV-specific information and routing information of an edge router can be advertised to other routers in a similar way
  - Depending on the design and implementation of the new intra-domain SAV solution

Security

- □ In some unlikely cases, some routers may do harm to other routers within the same domain
  - ◆Potential threats: entity impersonating, message blocking, message alteration, message replay, etc.
- □ The above security threats SHOULD be considered when designing the new intra-domain SAV solution
  - ◆Possible solutions: session authentication, message acknowledge, message integrity verification, duplication detection, etc.

Summary

Following this architecture, the new SAV solution can meet the requirements proposed in [draft-ieft-savnet-intra-domain-problem-statement]

□ Requirement #1: Accurate Validation

◆Generate SAV rules using both SAV-specific information and local routing information

□ Requirement #2: Automatic update

◆SAV-specific information exchange is triggered automatically when topology or prefix changes

□ Requirement #3: Incremental/partial Deployment

◆Block spoofing traffic when it is partially deployed in an intra-domain network

□ Requirement #4: Convergence

◆SAV-specific information and SAV rules can be updated in a timely manner

□ Requirement #5: Security

◆Possible security threats should be considered when designing the new SAV solution

Thanks!