# ASPA-based AS Path Verification Procedures - Examples

https://datatracker.ietf.org/doc/draft-ietf-sidrops-aspa-verification/

K. Sriram

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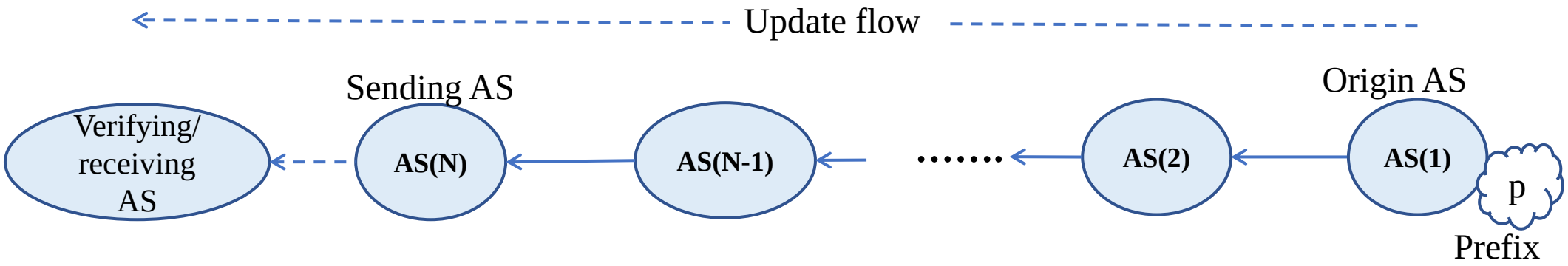
# AS_PATH representation for ASPA Verification



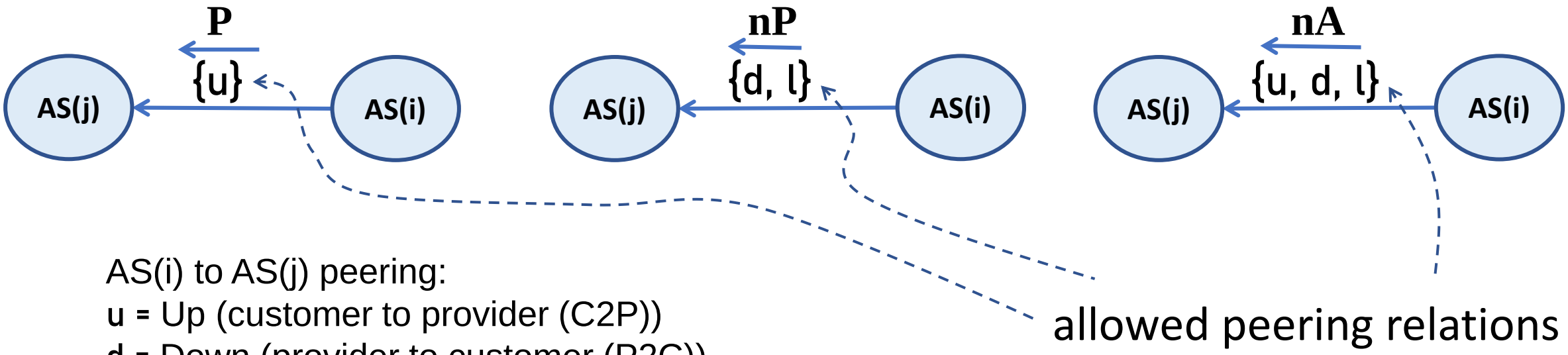

AS_PATH: {AS(N), AS(N-1), …., AS(2), AS(1)}

- Unique ASes
- AS(1) is the origin AS
- AS(N) is the most-recently added/sending AS

# ASPA Authorization Check Function for AS Pair

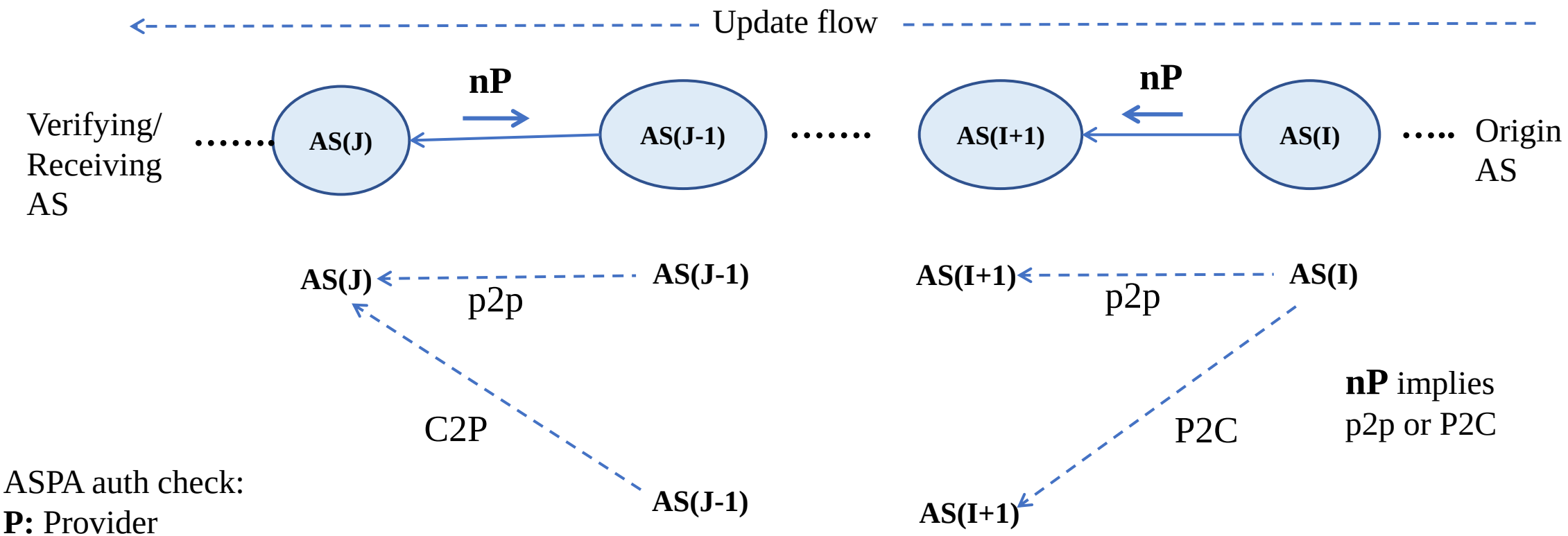
auth(AS(i), AS(j)) = {
- **P** if AS(i) attests AS(j) is a provider
- **nP** if AS(i) attests AS(j) is not a provider
- **nA** if AS(i) does not have an ASPA

**P**: Provider
**nP**: not Provider
**nA**: no Attestation




AS(i) to AS(j) peering:
u = Up (customer to provider (C2P))
d = Down (provider to customer (P2C))
l = Lateral (peer to peer (p2p))

# AS Path Verification: Invalid Outcome (any AS Path)



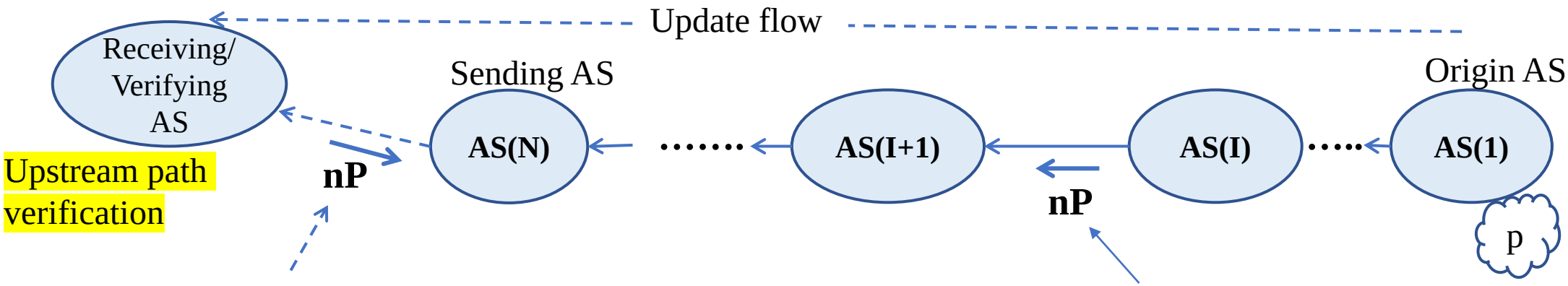

ASPA auth check:
**P:** Provider
**nP:** not Provider
**nA:** no Attestation

P2C = Provider-to-customer
C2P = Customer-to-provider
p2p = peer-to-peer (lateral peers)

- AS path is **Invalid** if any two hops in opposite directions (facing each other) are **nP** per ASPA ( $J - I \geq 2$ )
- Else, the AS_PATH is not Invalid (i.e., it is Valid or Unknown)

# Verification of Upstream Paths: Invalid Outcome

Upstream Path = Path Received from a Customer, Lateral Peer, Route Server Client, or Route Server



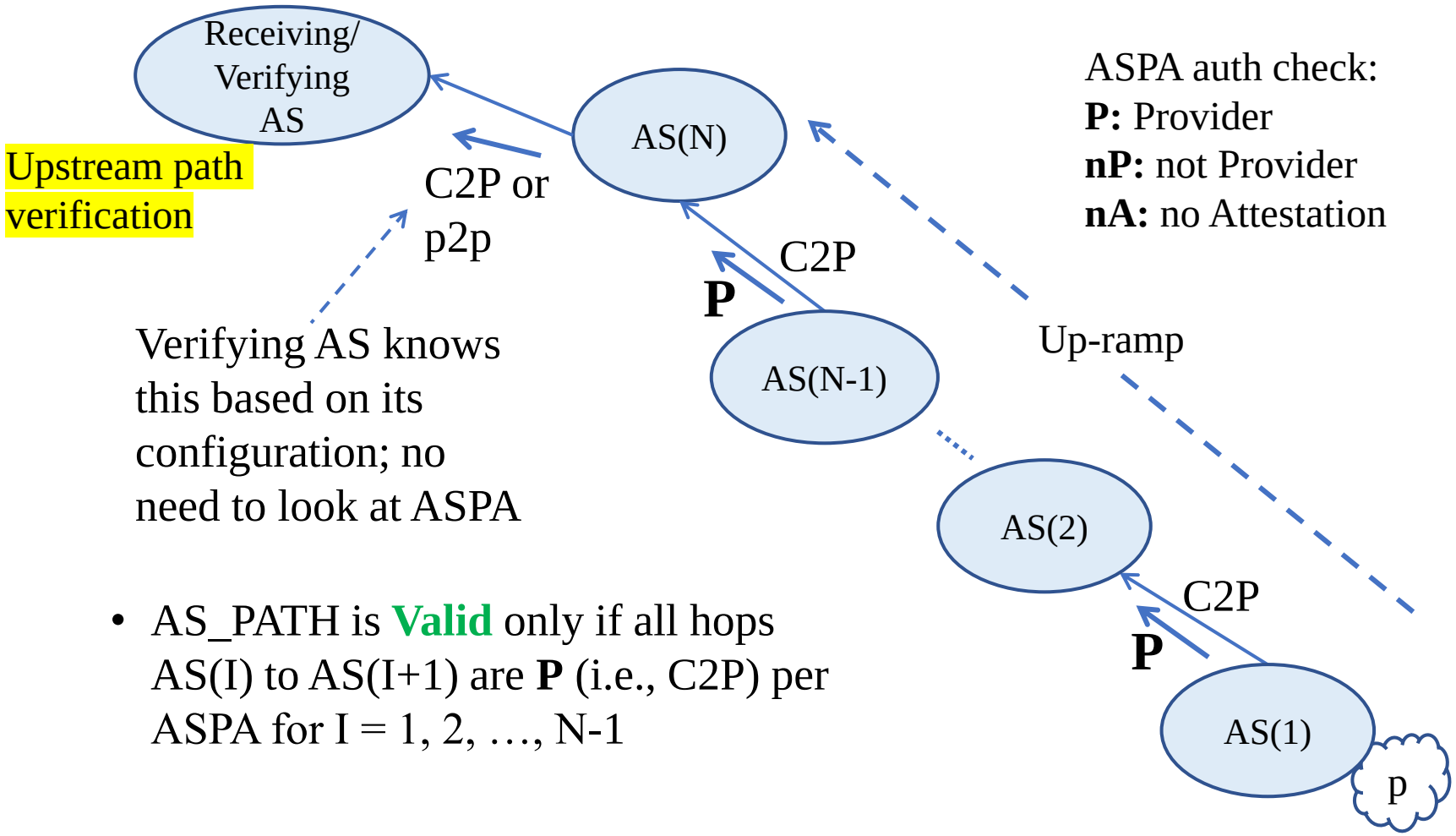

Verifying AS to AS(N) relationship is P2C or p2p (known based on the configuration at Verifying AS; no need to look at ASPA)

**nP** = P2C or p2p (based on ASPA)

ASPA auth check:
**P:** Provider
**nP:** not Provider
**nA:** no Attestation

- AS_PATH is **Invalid** if any one hop AS(I) to AS(I+1) is **nP** per ASPA for I = 1, 2, …, N-1
- Else, the AS_PATH is not Invalid (i.e., it is Valid or Unknown).

# Verification of Upstream Paths: Valid Outcome



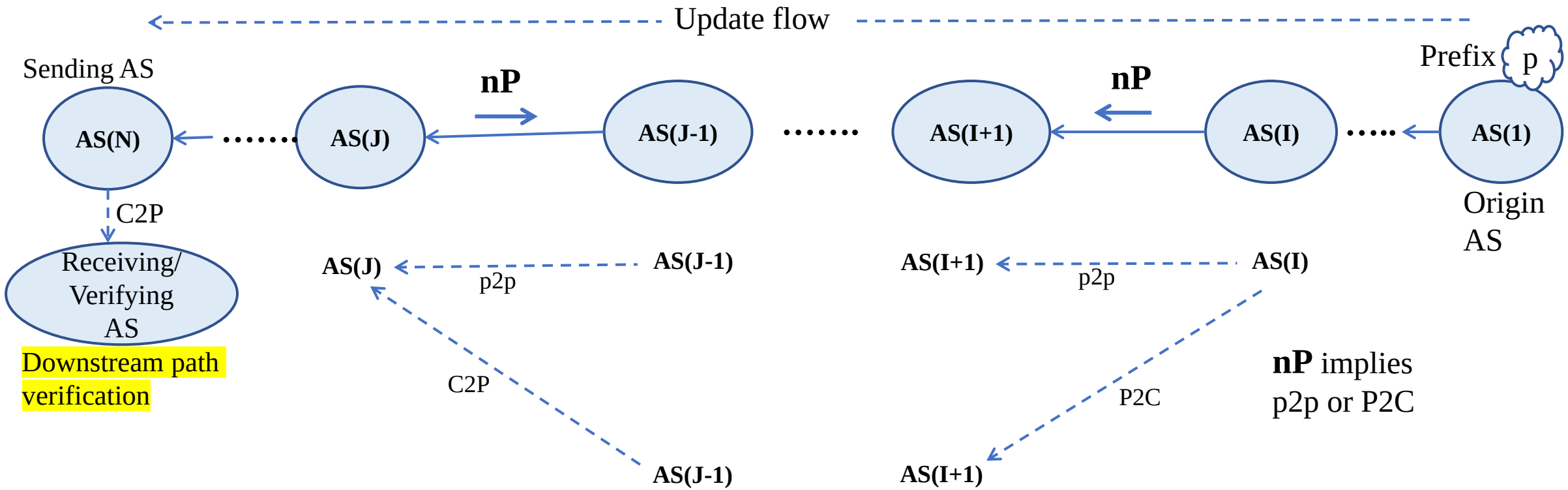

- AS_PATH is **Valid** only if all hops AS(I) to AS(I+1) are **P** (i.e., C2P) per ASPA for I = 1, 2, …, N-1

# Verification of Upstream Paths: Unknown Outcome

In partial deployment, an Unknown outcome occurs when the available ASPA's do not produce an Invalid (slide 5) or Valid (slide 6) outcome for the Upstream AS_PATH.

# Verification of Downstream Paths: Invalid Outcome

Downstream Path = Path Received from a Provider




ASPA auth check:
**P:** Provider
**nP:** not Provider
**nA:** no Attestation

AS(J)'s ASPA does not include AS(J-1) as provider

AS(I)'s ASPA does not include AS(I+1) as provider

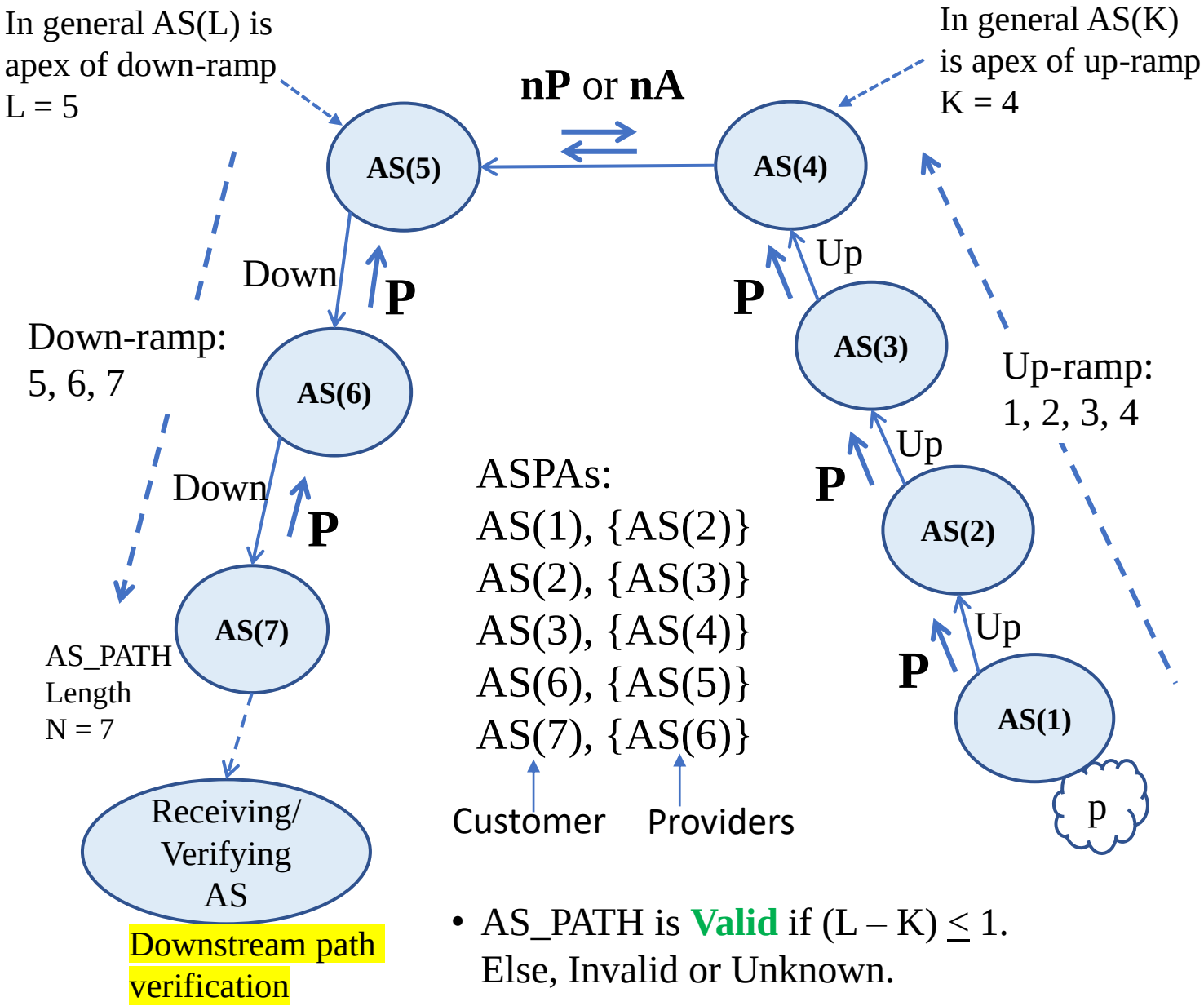
- AS_PATH is **Invalid** if any two hops in opposite directions (facing each other) are **nP** per ASPA ( $J - I \geq 2$ ).
- Else, the AS_PATH is Vaid or Unknown.

P2C = Provider-to-customer
C2P = Customer-to-provider
p2p = peer-to-peer (lateral peers)

# Verification of Downstream Paths: Valid Outcome

The only permissible path trajectories for **Valid** outcome are an inverted V or inverted V with one hop p2p at the apex. The right ramp (up-ramp) can be absent.

ASPA auth check:
**P:** Provider
**nP:** not Provider
**nA:** no Attestation




- AS_PATH is **Valid** if (L – K) ≤ 1. Else, Invalid or Unknown.

# Verification of Downstream Paths: Unknown Outcome

In partial deployment, an Unknown outcome occurs when the available ASPA's do not produce an Invalid (slide 8) or Valid (slide 9) outcome for the Downstream AS_PATH.