CS144
An Introduction to Computer Networks

Routing

BGP

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Border Gateway Protocol (BGP-4)
Basics

BGP is not a link-state or distance-vector routing protocol.

- Instead, BGP uses what is called a "Path vector"

BGP routers advertise complete paths (a list of AS's).

- Also called AS_PATH (this is the path vector)
- Example of path advertisement:

"The network 171.64/16 can be reached via the path {AS1, AS5, AS13}"

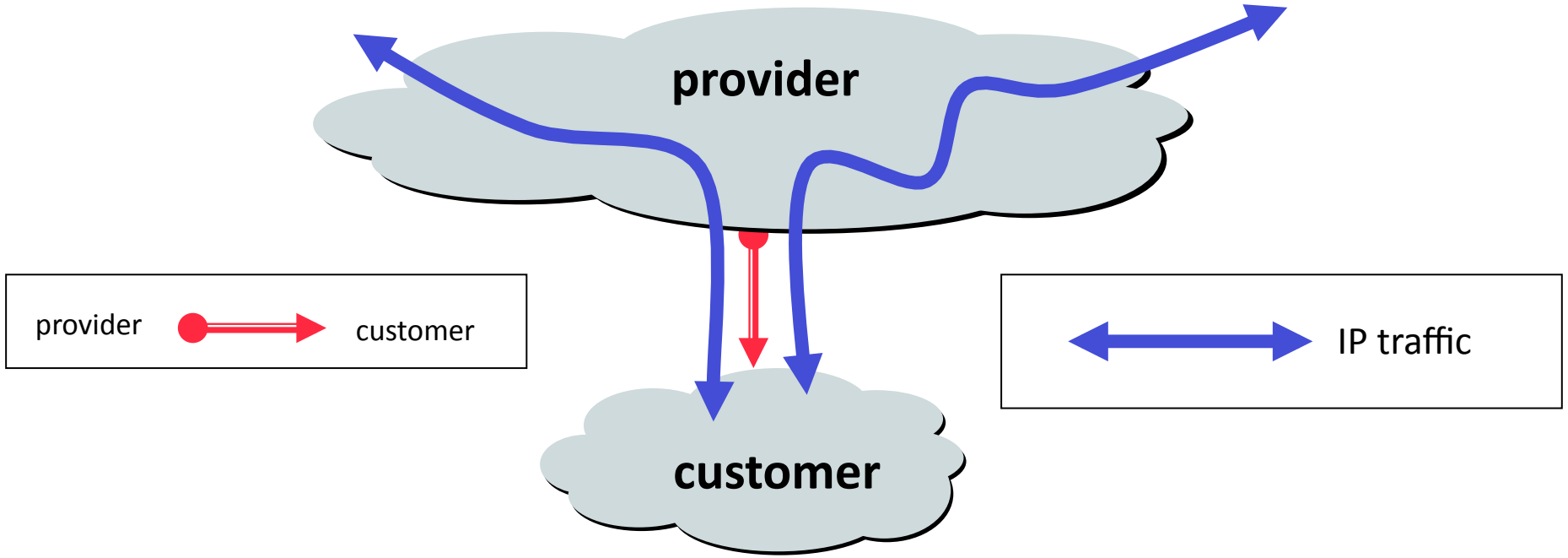
Paths with loops are detected locally and ignored.

Local policies pick the preferred path among options.

When a link/router fails, the path is "withdrawn".

Customers and Providers

Customers and Providers



Customer pays provider to carry its packets.

Customer-Provider Hierarchy

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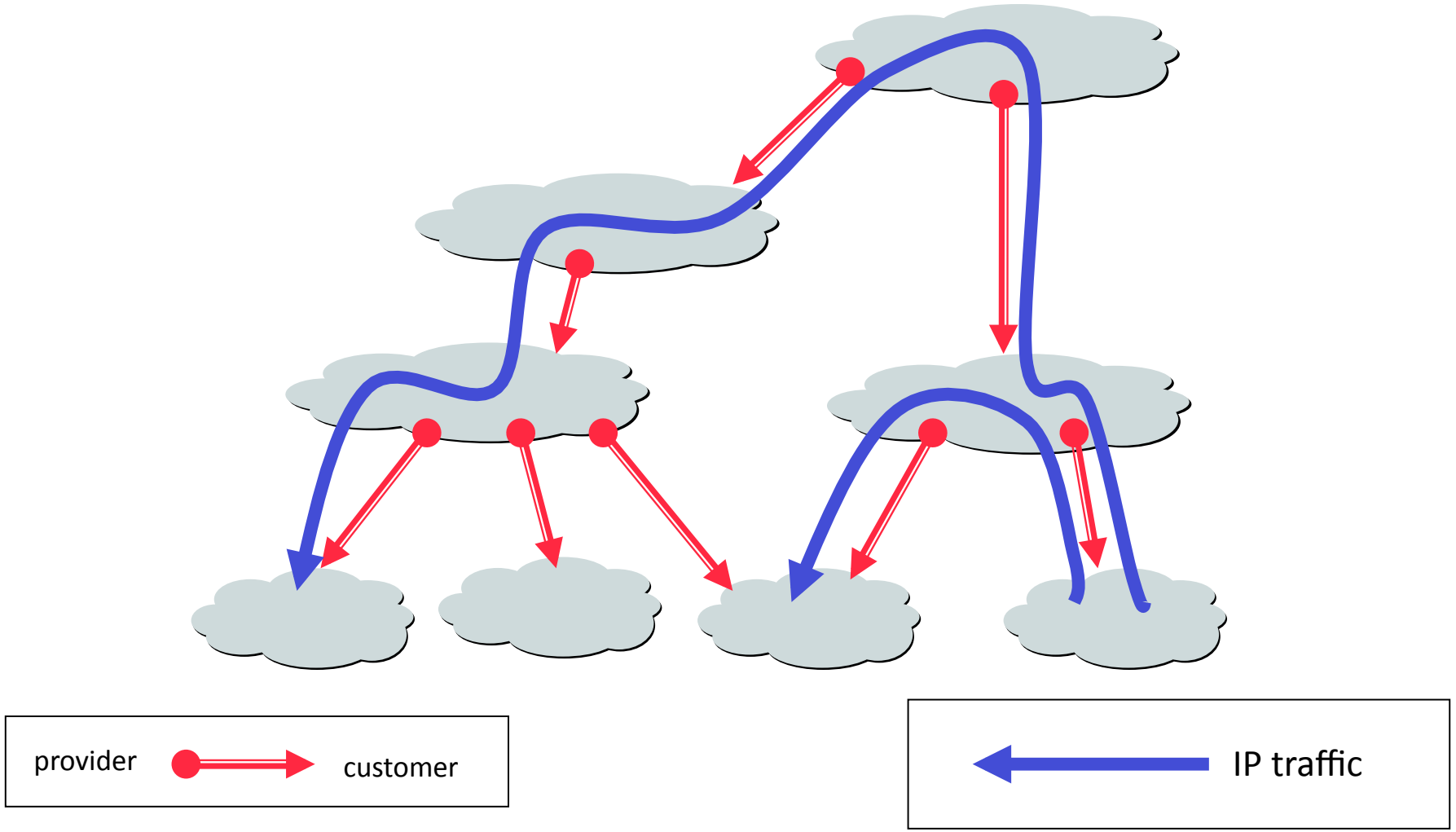
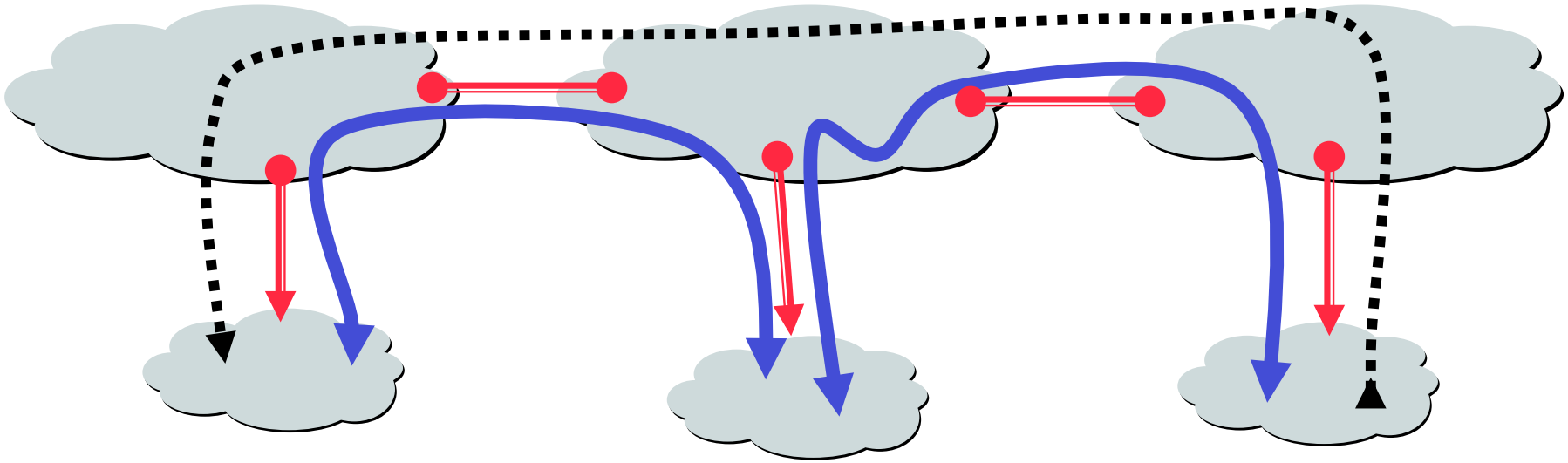
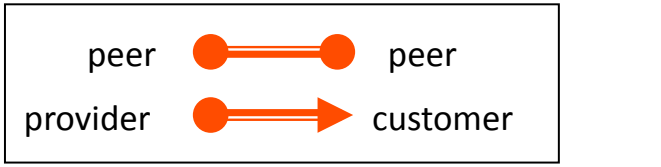


The Peering Relationship





traffic allowed

traffic NOT allowed

Peers provide transit between their respective customers

Peers do not provide transit between peers

Peers (often) do not exchange $$$

BGP Messages

Open : Establish a BGP session.

Keep Alive : Handshake at regular intervals.

Notification : Shuts down a peering session.

Update : Announcing new routes or withdrawing previously announced routes.

BGP announcement = prefix + path attributes

Path attributes

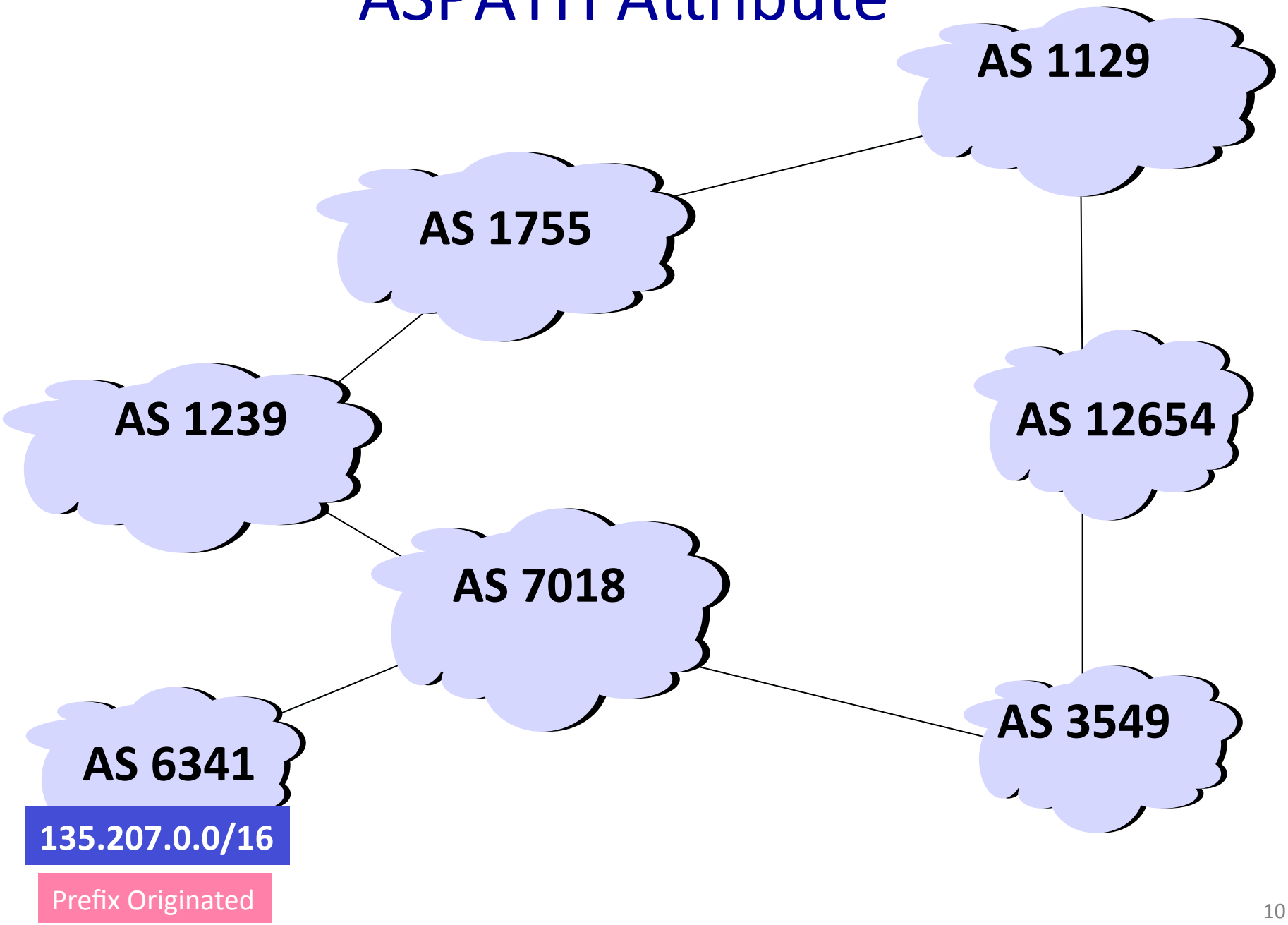
Include: next hop, AS Path, local preference, Multi-exit discriminator, …

Used to select among multiple options for paths.

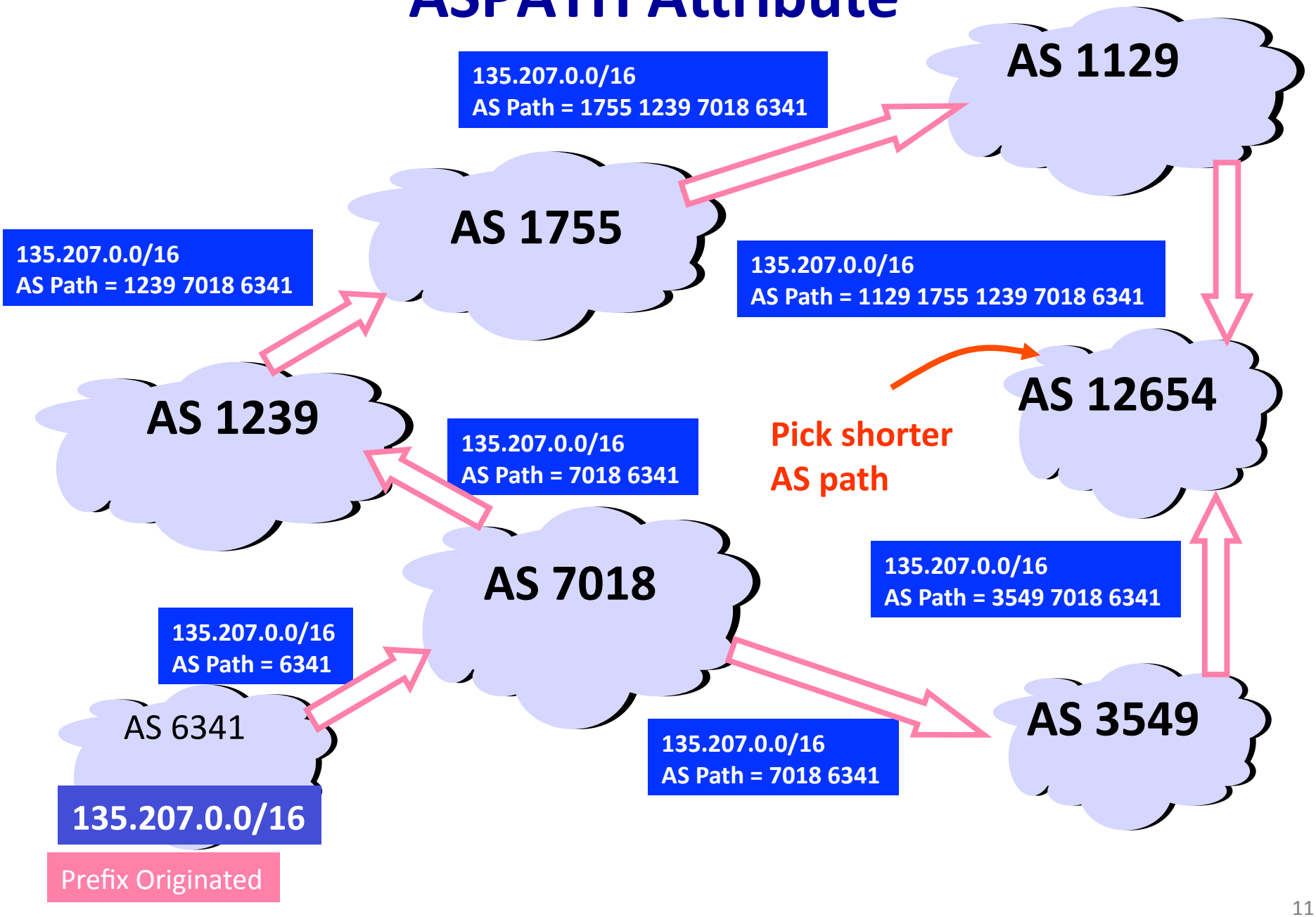
BGP Route Selection Summary

Highest Local Preference	Enforce relationships E.g. prefer customer routes over peer routes
Shortest ASPATH **Lowest MED** **i-BGP < e-BGP** **Lowest IGP cost to BGP egress**	Traffic Engineering
Lowest router ID	Throw up hands and break ties

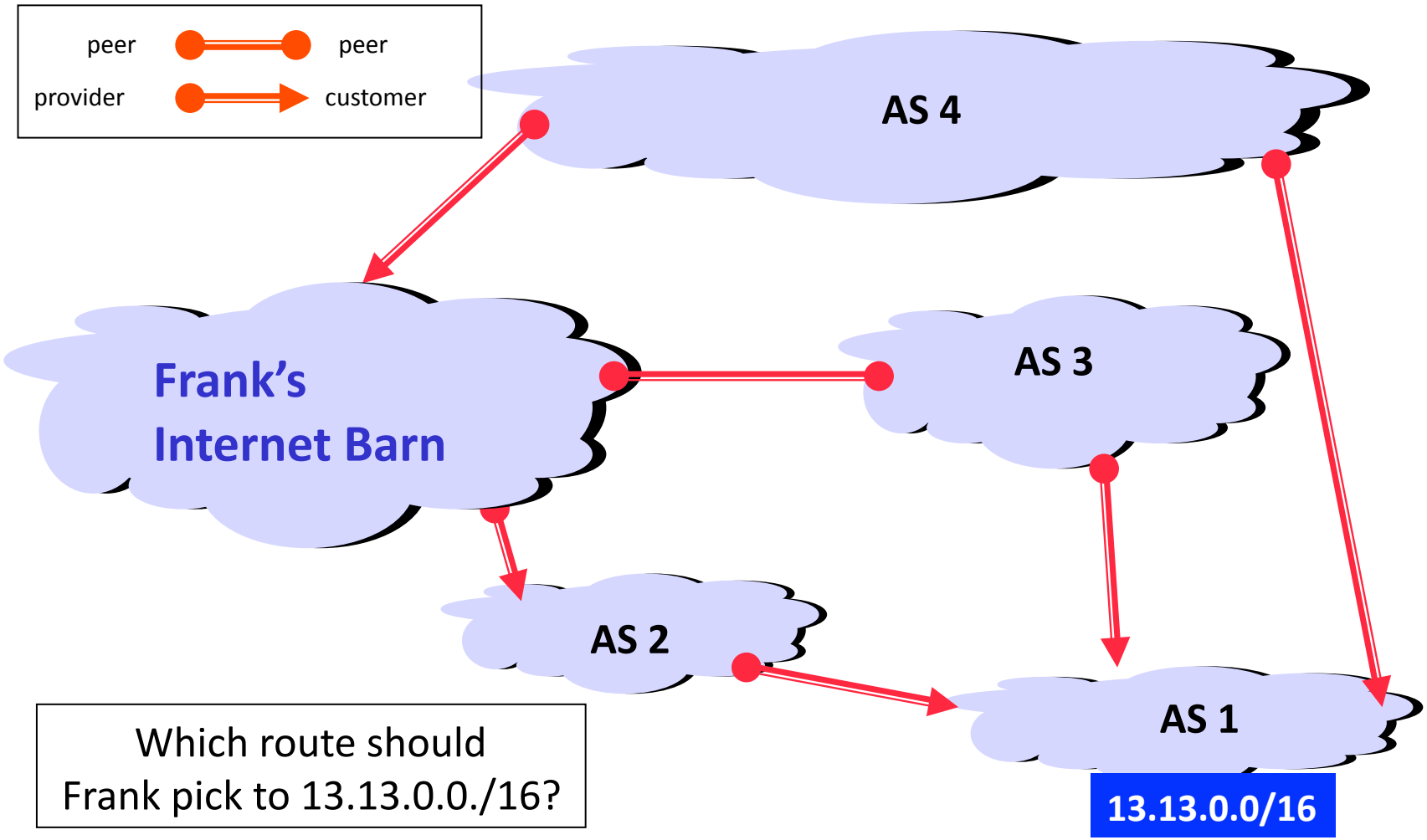
ASPATH Attribute



ASPATH Attribute

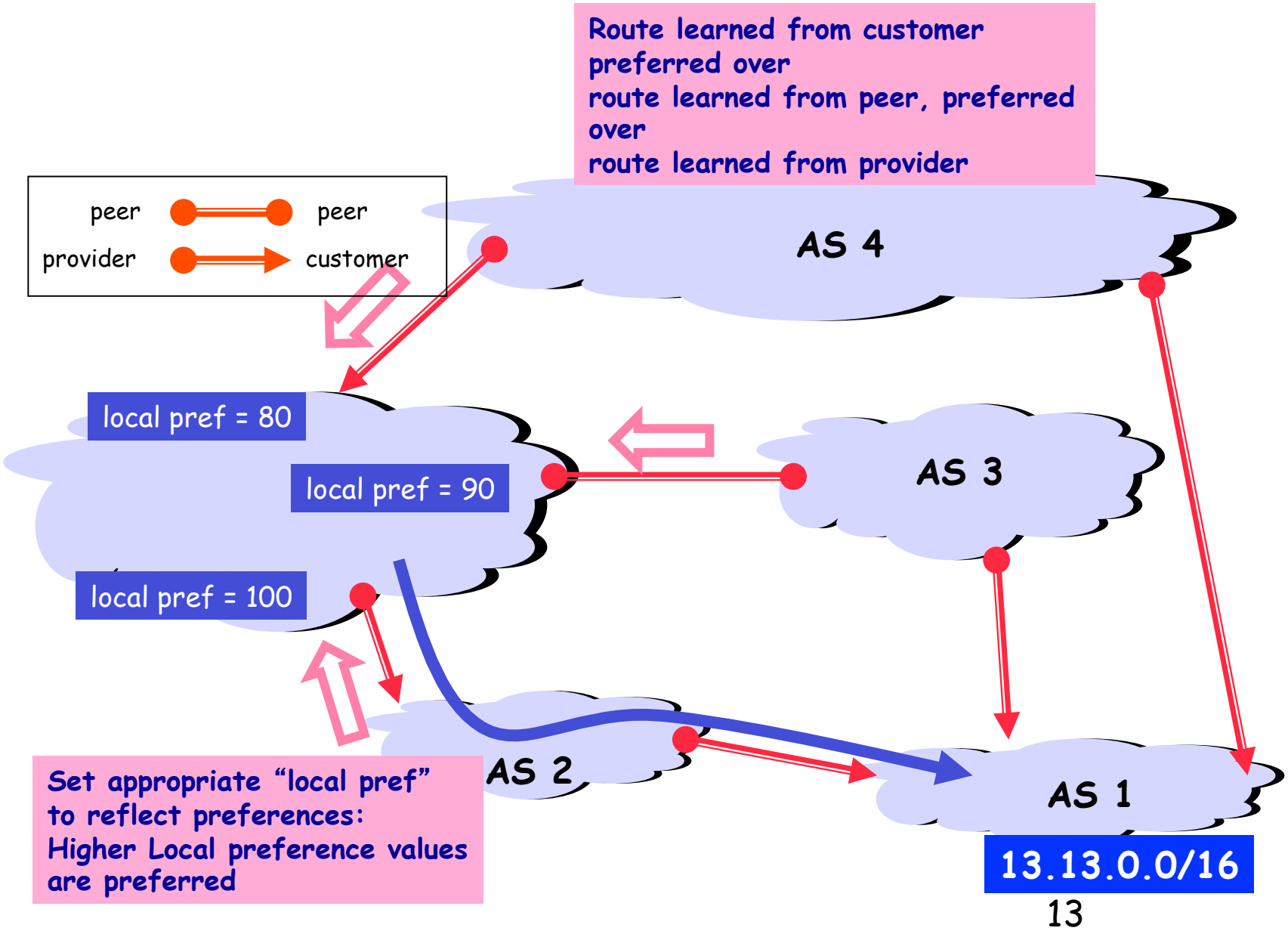


So Many Choices…



Which route should
Frank pick to 13.13.0.0./16?

Frank's Choices…



Summary

All AS's in the Internet must connect using BGP-4.

BGP-4 is a path vector algorithm, allowing loops to be detected easily.

BGP-4 has a rich andcomplex interface to let AS's choose a local, private policy.

Each AS decides a local policy for traffic engineering, security and any private preferences.