

About me



- **Farzad Heydari Goojani**
 - Training, Support & Consultant
 - Over 5000 hours teaching networks
 - 15 years experience in IT
 - Achieved many international certificates
(MTCNA,MTCUME,CCNA,CCNP,CCIE written,LPIC1,ITIL,HP-UX)



Heydari.Farzad@gmail.com

Agenda

- **BGP Introduction**
- **eBGP peering on RouterOS**
- **Issues When Redundancy Exists Between eBGP Neighbors**
- **BGP peering with loopback interface**



BGP

Border Gateway Protocol



Heydari.Farzad@gmail.com

Public IP Address Assignment

- **Step 1**
- ICANN and IANA group public IPv4 addresses by major geographic region.
- **Step 2**
- IANA allocates those address ranges to Regional Internet Registries (RIR).

Public IP Address Assignment

Regional Internet Registries (RIR)



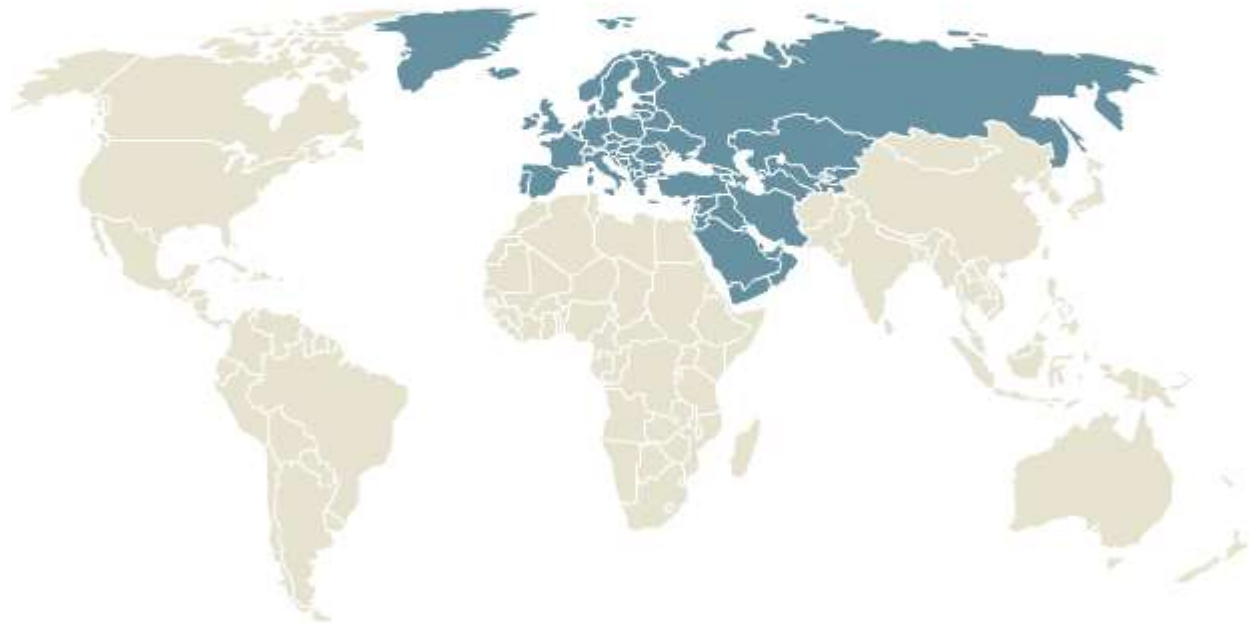
Public IP Address Assignment

Regional Internet Registries (RIR)



Public IP Address Assignment

Regional Internet Registries (RIR)



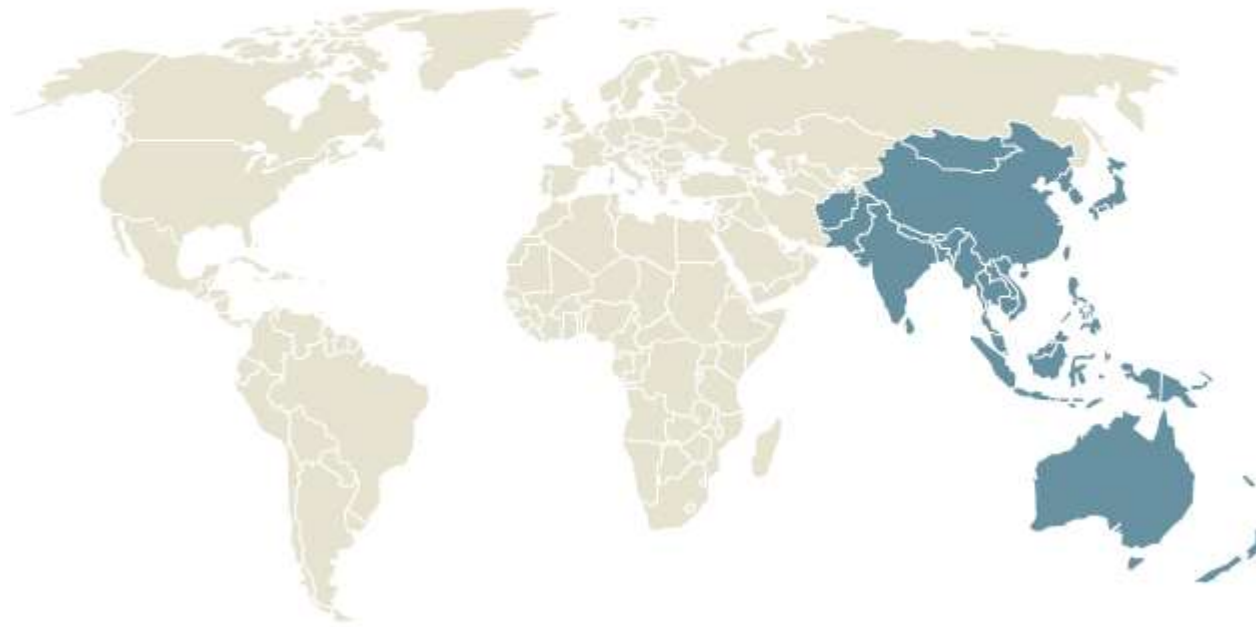
Public IP Address Assignment

Regional Internet Registries (RIR)



Public IP Address Assignment

Regional Internet Registries (RIR)



Introduction to BGP

Differences between BGP & IGPS

- BGP does not require neighbors to be attached to the same subnet.

BGP routers use a TCP connection (port 179) between the routers to pass BGP messages.

- Instead of choosing the best route just by using an integer metric, BGP uses a more complex process, using a variety of information, called *BGP path attributes*, which are exchanged in BGP routing updates much like IGP metric information.

Introduction to BGP

AS Numbers

The integer *BGP AS Numbers* uniquely identifies one organization that considers itself autonomous from other organizations.

Each company network connects to the Internet can be considered to be an autonomous system and can be assigned a *BGP ASN*.

(IANA/ICANN also assigns globally unique ASNs.)

Additionally, each ISP has an ASN, or possibly several, depending on the size of the ISP.

Introduction to BGP

BGP ASNs and the AS SEQ Path Attribute

Note

By default, if no BGP PAs have been explicitly set, BGP routers use the **BGP AS_PATH** (autonomous system path) PA when choosing the best route among many competing routes.

Introduction to BGP

AS Path

When a router uses BGP to advertise a route, the prefix/length is associated with a set of PAs, including the AS_Path.

The AS_Path says:

“If you use this path (route), the path will go through this list of ASNs.”

Introduction to BGP

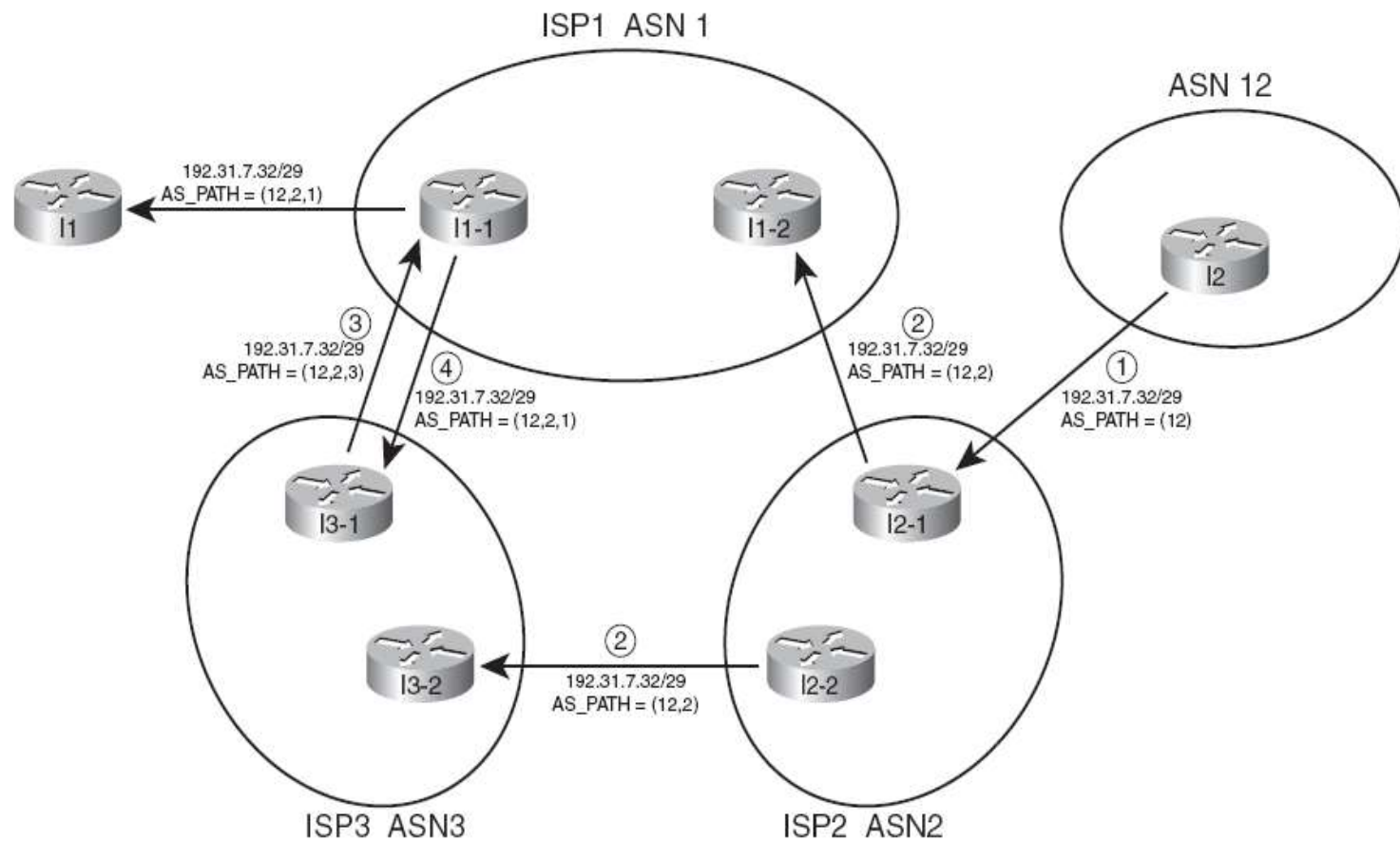
AS Path

BGP uses the AS_Path to:

- Choose the best route for a prefix based on the shortest AS_Path (fewest number of ASNs listed).
- Prevent routing loops.

Introduction to BGP

AS Path



Introduction to BGP

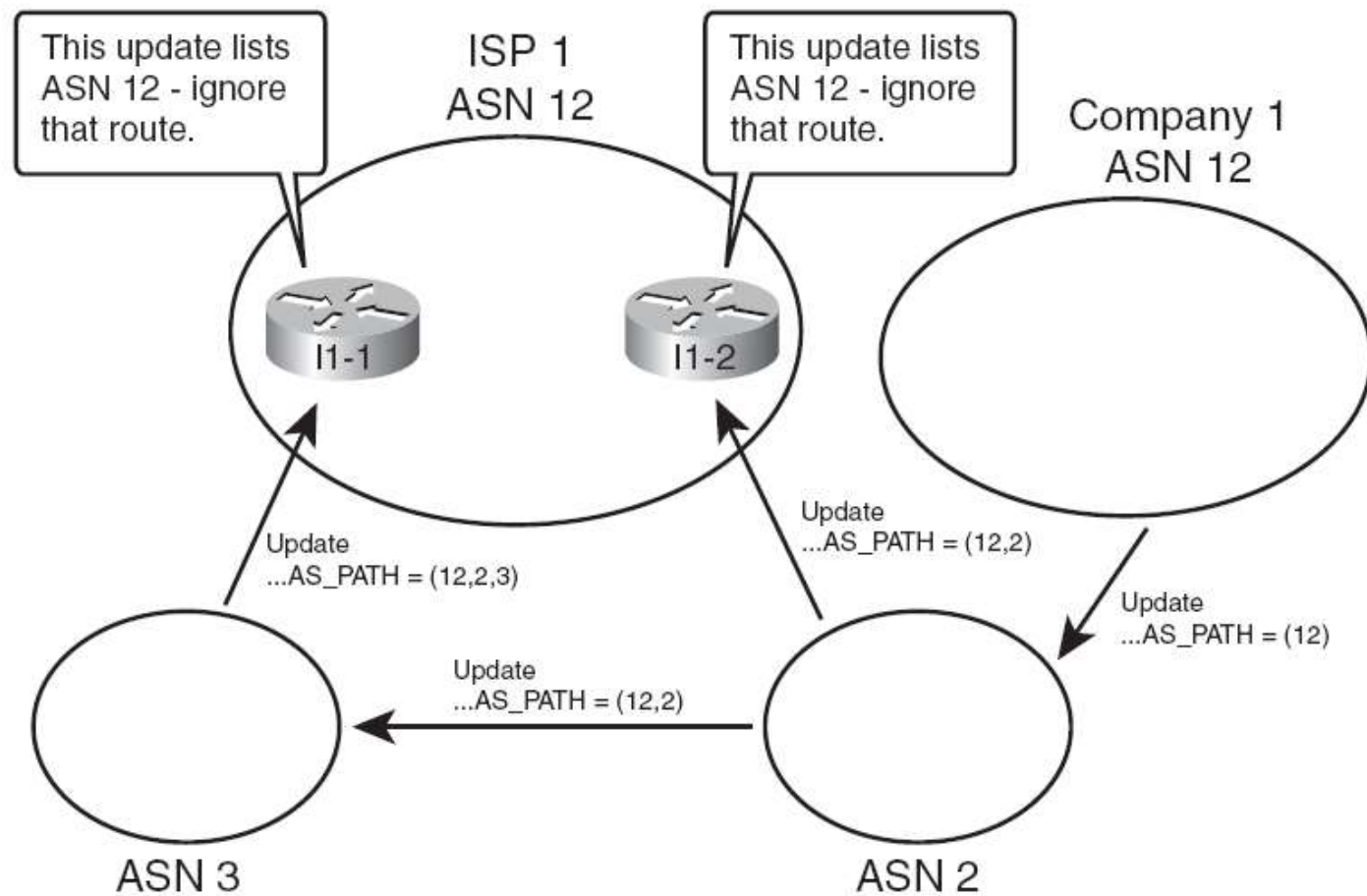
Preventing routing loops in BGP

The *ASNs* listed in the *AS_Path* will do that.

When a BGP router receives an update, and a route advertisement lists an *AS_Path* with *its own ASN*, the router *ignores* that route.

Introduction to BGP

Preventing routing loops in BGP



Introduction to BGP

IANA administers the assignment of unique values of *ASNs*

If *ASNs* are duplicated, the BGP loop prevention process can actually prevent parts of the Internet from learning about a route.

Introduction to BGP

Internal and External BGP

BGP defines two classes of neighbors (peers):

Internal BGP (iBGP)

BGP neighbor is in the same ASN.

When advertising , a BGP router does not update the AS_Path PA.

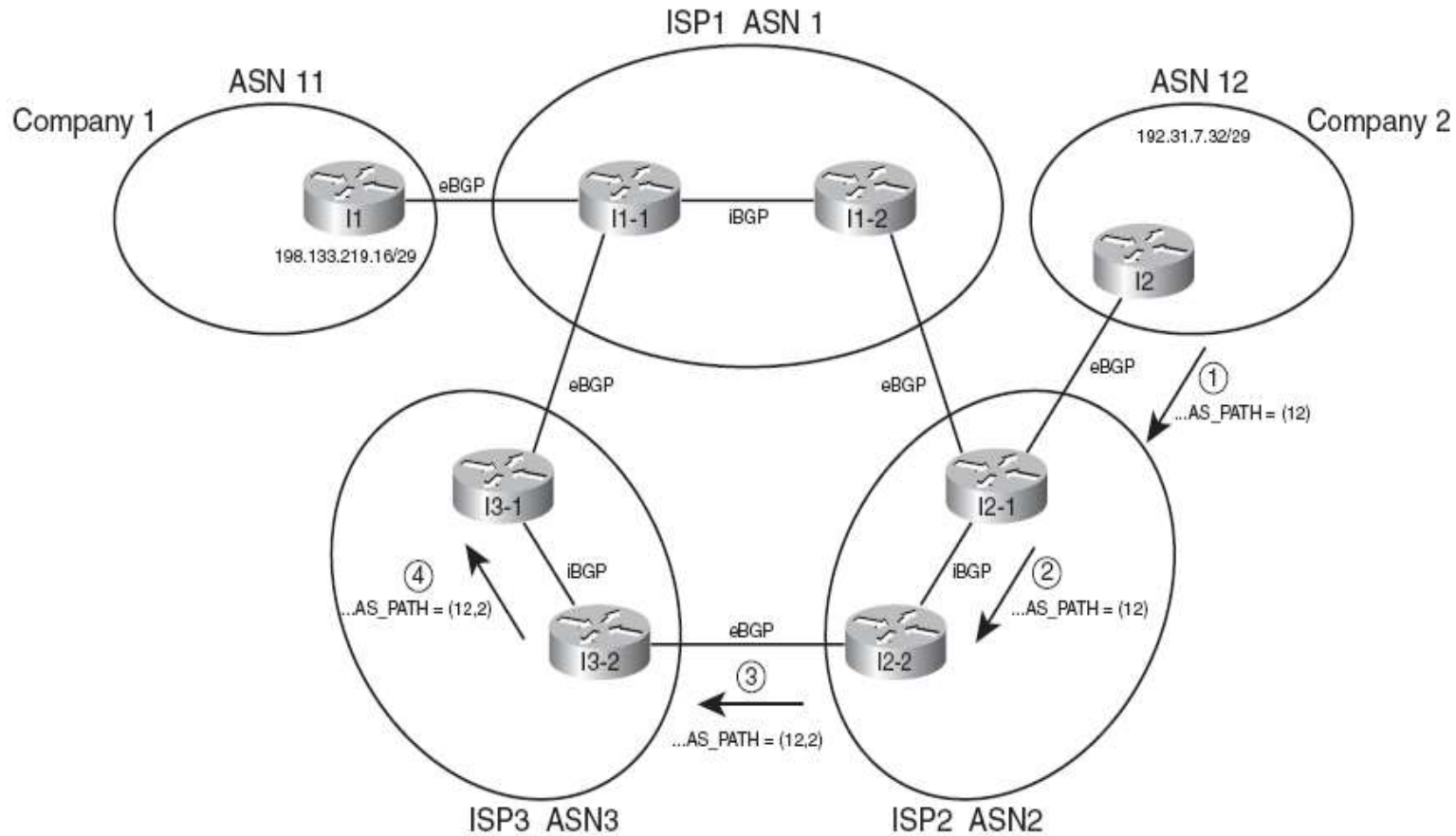
External BGP (eBGP)

BGP neighbor is in the different ASN.

When advertising , a BGP router updates the AS_Path PA.

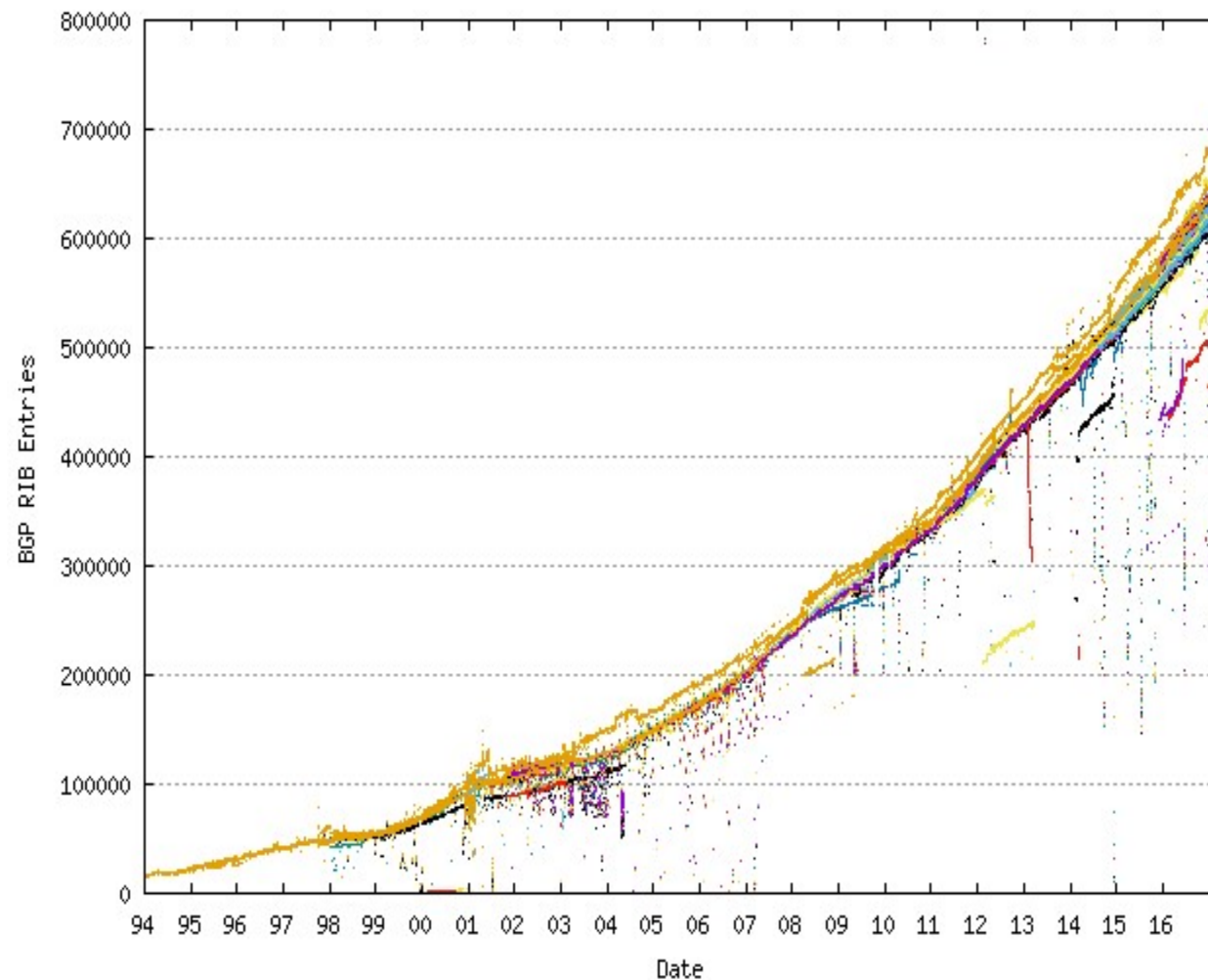
Introduction to BGP

Internal and External BGP





BGP table growth on the Internet.



Heydari.Farzad@gmail.com



Part II

External BGP

External BGP

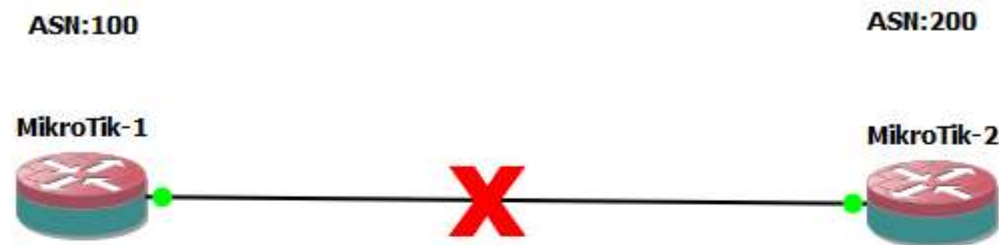
- BGP first forms a neighbor relationship with peers.
- BGP then learns information from its neighbors, placing that information in the BGP table.
- Finally, BGP analyzes the BGP table to choose the best working route for each prefix in the BGP table, placing those routes into the IP routing table.

Requirements for Forming eBGP Neighborships

- Each router must be part of a **TCP connection** with the other router, with the remote router's IP address used in that TCP connection matching what the local router configures in a BGP neighbor remote-as .

BGP peer first form a TCP connection; later, BGP messages flow over that connection, which allows BGP routers to know when the messages arrived at the neighbor, and when they did not.

BGP peer with single link



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Redundancy Between BGP



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Issues When Redundancy Exists Between eBGP Neighbors

Solutions

1. Configure two peers on each router, one for each of the neighbor's interface IP addresses.

If one link fails, the other neighborhood can remain up and working.

However, both neighborhoods exchange BGP routes, consuming bandwidth and more memory in the BGP table.

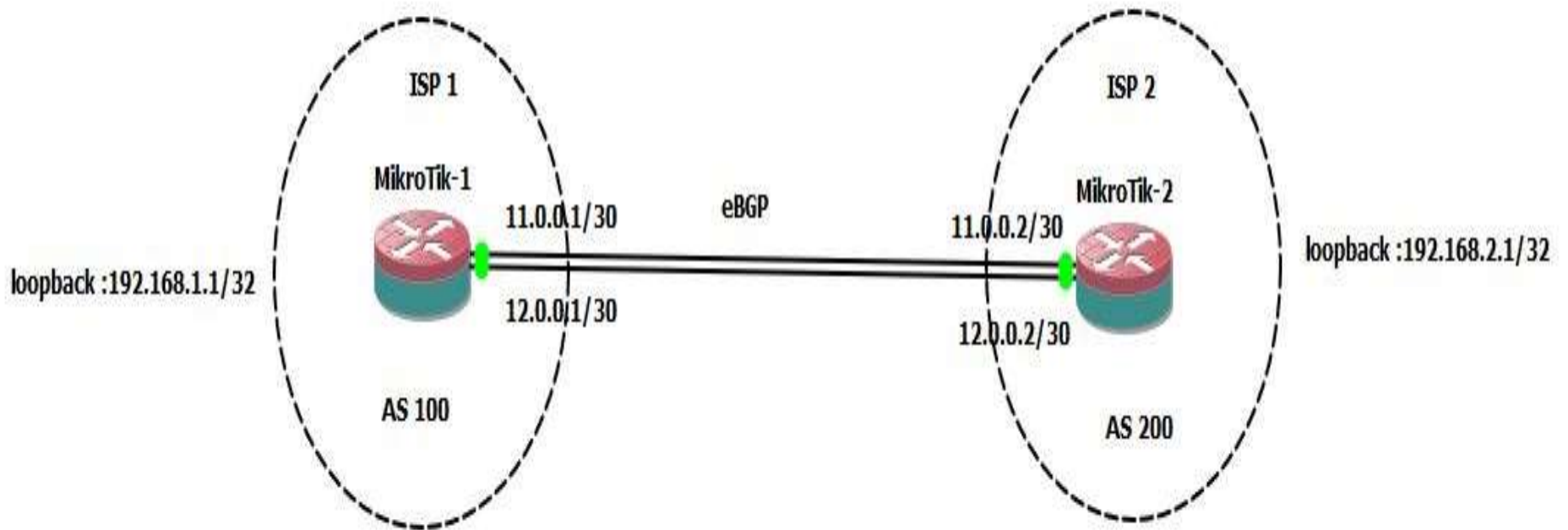
Solutions

2. use bridge interfaces(loopback) as the TCP connection endpoints

The two routers each configure a loopback interface and IP address, and use those loopback IP addresses as the source of their single BGP TCP connection.

If one of the multiple links fails, the loopback interface does not fail.

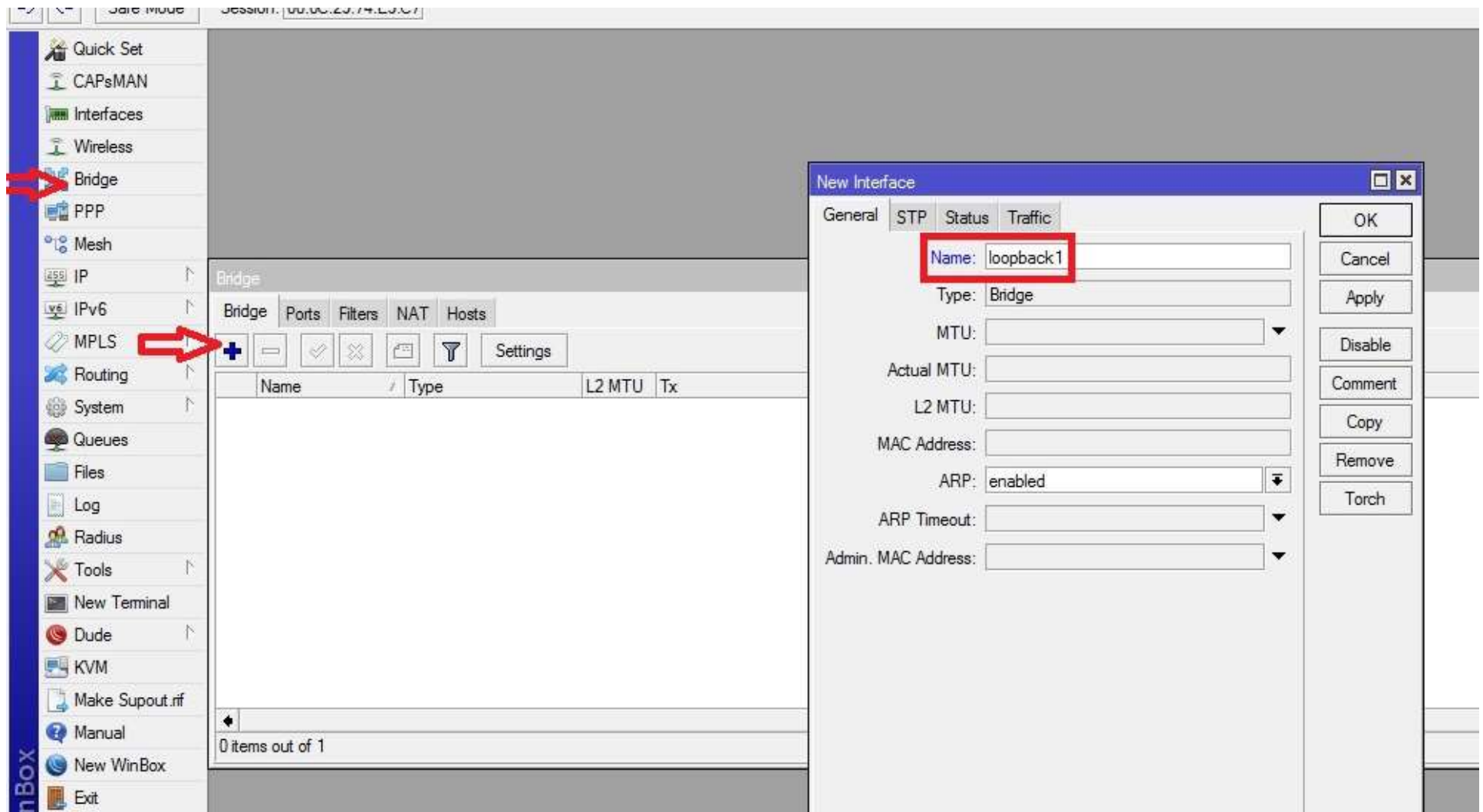
eBGP Neighbor Configuration with loopback



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Step 1

Make a loopback interface.



Step 2

Configure an IP address on a loopback interface on each router.

The screenshot displays the Mikrotik WinBox interface. On the left sidebar, the 'IP' menu item is highlighted with a red arrow. The main window shows the 'Address List' table with one entry: 11.0.0.1/8 on interface ether1. A red arrow points to the '+' button in the 'Address List' toolbar. To the right, the 'New Address' dialog box is open, showing the configuration for a new address: 192.168.1.1/32 on interface loopback1. The 'Interface' dropdown is set to 'loopback1'. The 'Status' at the bottom of the dialog is 'enabled'.

Address List

Address	Network	Interface
11.0.0.1/8	11.0.0.0	ether1

1 item

New Address

Address: 192.168.1.1/32

Network: [dropdown]

Interface: loopback1

OK Cancel Apply Disable Comment Copy Remove

enabled

Step3

Configure the BGP on router 1

The screenshot shows the Mikrotik WinBox interface. On the left sidebar, the 'Routing' menu item is highlighted with a red arrow. In the main window, the 'BGP' tab is active, and the 'Instances' sub-tab is selected, also indicated by a red arrow. A table lists the BGP instances:

Name	AS	Router ID
default	65530	

Below the table, it says '1 item (1 selected)'. A red arrow points from the 'default' instance to the 'BGP Instance <default>' configuration dialog box. In this dialog, the 'AS' field is set to '100' and the 'Router ID' field is set to '1,1,1,1', both of which are highlighted with red boxes. Other fields like 'Name' (default), 'Out Filter', 'Confederation', 'Confederation Peers', 'Cluster ID', and 'Routing Table' are visible. Checkboxes for 'Redistribute Connected', 'Redistribute Static', 'Redistribute RIP', 'Redistribute OSPF', 'Redistribute Other BGP', 'Client To Client Reflection' (checked), and 'Ignore AS Path Length' are also present. Buttons for 'OK', 'Cancel', 'Apply', 'Disable', 'Comment', 'Copy', and 'Remove' are on the right.

Step3

Configure the BGP on router 2

The screenshot displays a network configuration interface. On the left is a sidebar menu with various options: PPP, Mesh, IP, IPv6, MPLS, Routing (highlighted with a red arrow), System, Queues, Files, Log, Radius, Tools, New Terminal, Dude, KVM, Make Supout.tif, Manual, New WinBox, and Exit.

The main area shows the BGP configuration for router 2. A red arrow points to the 'Instances' tab. Below the tabs, a table lists the BGP instances:

Name	AS	Router ID
default	200	2.2.2.2

Below the table, it indicates '1 item (1 selected)'. A dialog box titled 'BGP Instance <default>' is open, showing the configuration for the selected instance. The dialog has the following fields and options:

- Name: default
- AS: 200
- Router ID: 2.2.2.2
- Redistribute Connected: ☐
- Redistribute Static: ☐
- Redistribute RIP: ☐
- Redistribute OSPF: ☐
- Redistribute Other BGP: ☐
- Out Filter:
- Confederation:
- Confederation Peers:
- Cluster ID:
- Routing Table:
- Client To Client Reflection: ☒
- Ignore AS Path Length: ☐

The dialog also includes buttons for OK, Cancel, Apply, Disable, Comment, Copy, and Remove. The status at the bottom of the dialog is 'enabled'.

Step 4

Configure the BGP peer on each router to refer to the other router's loopback IP address.

The screenshot shows the Mikrotik WinBox interface. On the left, the 'BGP' menu is expanded, and the 'Peers' tab is selected. The 'New BGP Peer' dialog is open, showing the following configuration:

- Name: peer1
- Instance: default
- Remote Address: 192.168.2.1
- Remote Port: (empty)
- Remote AS: 200
- TCP MD5 Key: (empty)
- Nexthop Choice: default
- ☐ Multihop
- ☐ Route Reflect
- Hold Time: 180 s
- Keepalive Time: (empty)
- TTL: default
- Max Prefix Limit: (empty)
- Max Prefix Restart Time: (empty)
- In Filter: (empty)
- Out Filter: (empty)

The 'Remote Address' and 'Remote AS' fields are highlighted with red boxes. The 'Peers' tab in the left sidebar is also highlighted with a red box.

Step 4

Configure the BGP peer on router 2 to refer to the other

The screenshot displays the Mikrotik WinBox interface. On the left, the 'Tools' menu is open, and a red arrow points to the 'Peers' option under the 'BGP' section. The main window shows the 'New BGP Peer' dialog box with the 'General' tab selected. The following fields are highlighted with red boxes:

- Name: peer1
- Instance: default
- Remote Address: 192.168.1.1
- Remote AS: 100

The dialog box also includes fields for Remote Port, TCP MD5 Key, Nexthop Choice (default), Hold Time (180 s), Keepalive Time, TTL (default), Max Prefix Limit, Max Prefix Restart Time, In Filter, Out Filter, AllowAS In, and a checkbox for Remove Private AS. Buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, Refresh, Refresh All, Resend, and Resend All are located on the right side of the dialog.

Step 5

Tell BGP on each router to use the loopback IP address as the source IP address.

The screenshot displays a network management interface with a BGP configuration window. On the left, the 'BGP' section has tabs for 'Instances', 'Peers', 'Networks', 'Aggregates', 'VPN4 Routes', and 'Advertisements'. The 'Instances' tab is selected, and a red arrow points to it. Below the tabs is a table with columns: Name, Instance, Remote Address, Remote AS, M..., R..., and TTL. The table contains one entry: 'peer1' with Instance 'default', Remote Address '192.168.2.1', Remote AS '200', M... 'yes', R... 'no', and TTL 'd...'. A red arrow also points to the 'peer1' entry. On the right, the 'BGP Peer <peer1>' configuration window is open. It has tabs for 'General', 'Advanced', and 'Status'. The 'General' tab is selected, and a red arrow points to it. In the 'General' tab, the 'Update Source' is set to 'Loopback1', which is highlighted with a red box. Other options include 'Address Families' (with checkboxes for ip, ipv6, l2vpn, vpn4, l2vpn-cisco) and 'Cisco VPLS NLRI Length Format' (set to 'auto bits'). On the far right of the configuration window are buttons for 'OK', 'Cancel', 'Apply', 'Disable', 'Comment', 'Copy', 'Remove', 'Refresh', 'Refresh All', 'Resend', and 'Resend All'.

BGP Peer <peer1>

General Advanced Status

Address Families: ☒ ip ☐ ipv6 ☐ l2vpn ☐ vpn4 ☐ l2vpn-cisco

Update Source: Loopback1

Cisco VPLS NLRI Length Format: auto bits

OK Cancel Apply Disable Comment Copy Remove Refresh Refresh All Resend Resend All

BGP

Instances Peers Networks Aggregates VPN4 Routes Advertisements

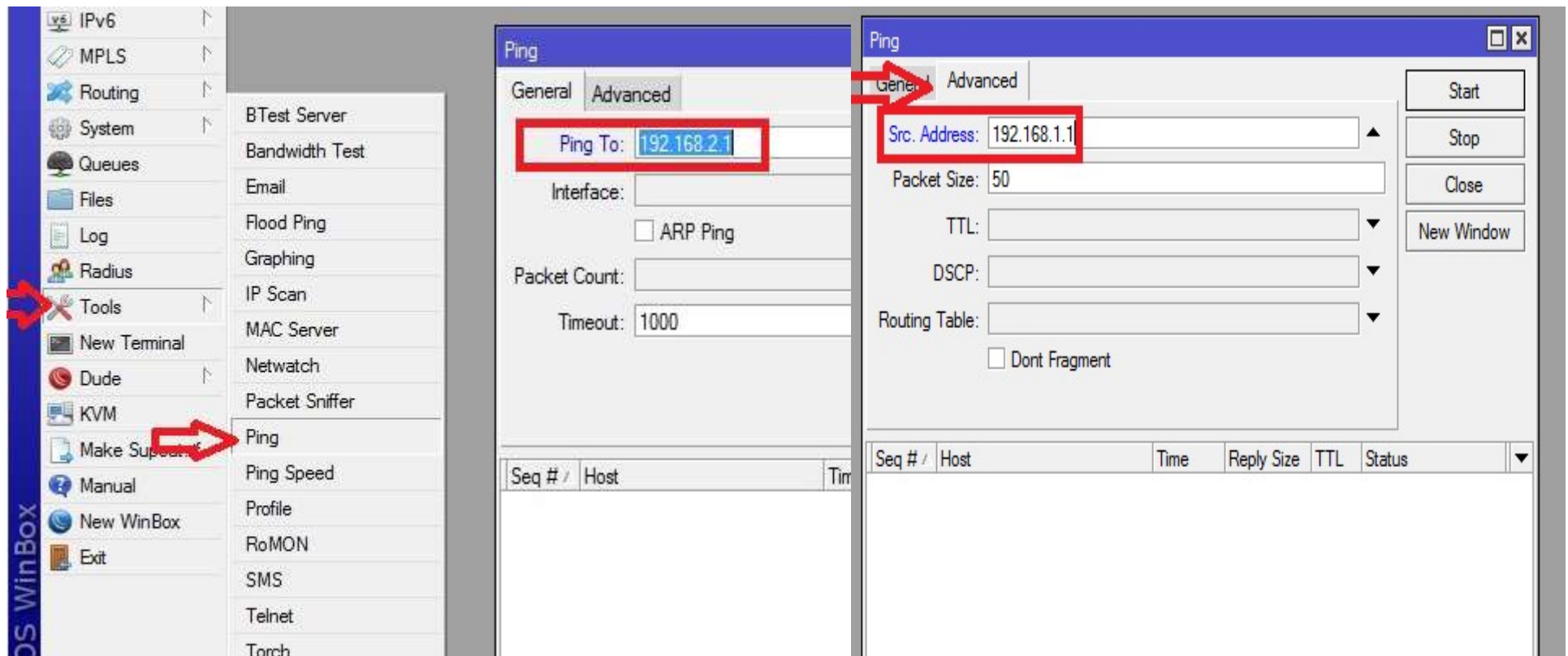
Refresh Refresh All Resend Resend All

Name	Instance	Remote Address	Remote AS	M...	R...	TTL
peer1	default	192.168.2.1	200	yes	no	d...

1 item (1 selected)

Step 6

Make sure each router has IP routes so that they can forward packets to the loopback interface IP address of the other router.



Note

If using static routes, make sure to configure the routes so that all redundant paths would be used.

If using an IGP, make sure the configuration allows the two routers to become IGP neighbors over all redundant links.

Step 7

Configure eBGP multihop.

By default, when building packets to send to an eBGP peer, RouterOS sets the IP Time-To-Live (TTL) field in the IP header to a value of 1.

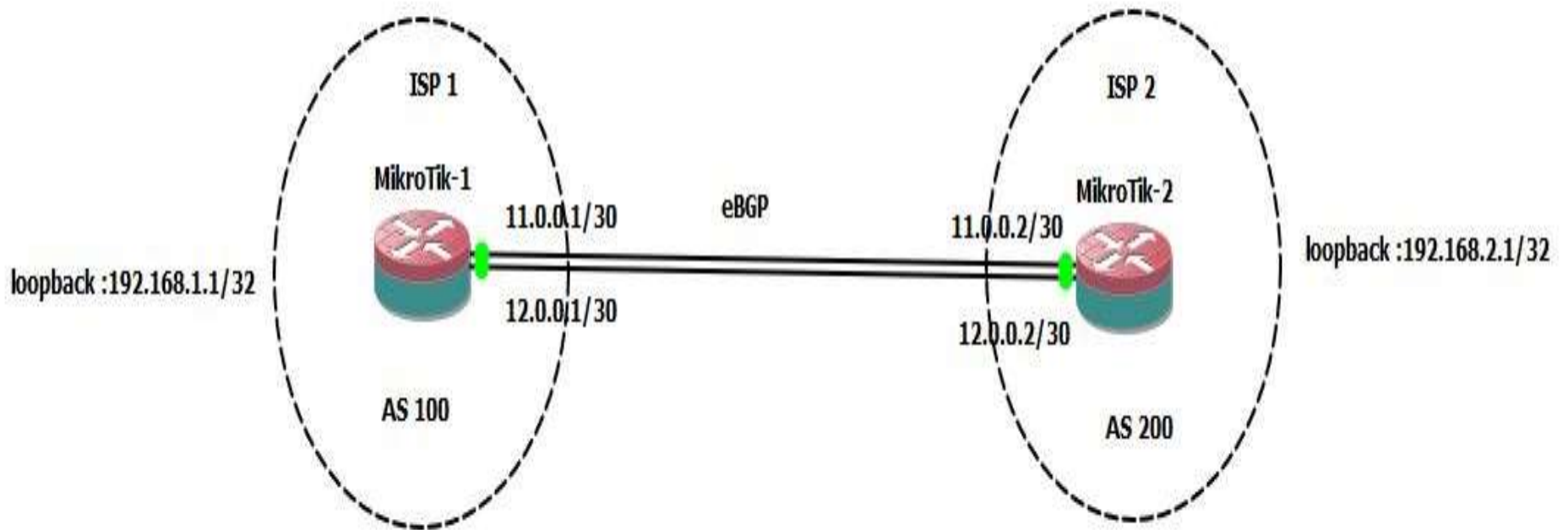
With this default action, the eBGP neighborhood fails to complete when using loopback interface IP addresses.

The screenshot shows the Mikrotik WinBox interface for configuring a new BGP peer. The left sidebar has a 'BGP' section with tabs for 'Instances', 'Peers', 'Networks', and 'Aggregates'. The 'Instances' tab is selected, and a red arrow points to it. The main window is titled 'New BGP Peer' and has three tabs: 'General', 'Advanced', and 'Status'. The 'General' tab is active. The configuration fields are as follows:

- Name: peer1
- Instance: default
- Remote Address: 192.168.2.1
- Remote Port: (empty)
- Remote AS: 200
- TCP MD5 Key: (empty)
- Nexthop Choice: default
- ☒ Multihop
- ☐ Route Reflect
- Hold Time: 180 s
- Keepalive Time: (empty)
- TTL: default
- Max Prefix Limit: (empty)

Red arrows point to the 'Multihop' checkbox and the 'TTL' field. The right sidebar contains buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, Refresh, Refresh All, Resend, and Resend All.

eBGP Neighbor Configuration with loopback



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Verifying eBGP Neighbor Status

Instances VRFs Peers Networks Aggregates VPN4 Routes Advertisements											
<div><div>+</div><div>=</div><div>✓</div><div>✗</div><div>📄</div><div>🔍</div><div>Refresh</div><div>Refresh All</div><div>Resend</div><div>Resend All</div></div>											
Name	Instance	Remote Address	Remote AS	M...	R...	TTL	Remote ID	Uptime	Prefix Co.	State	
peer1	default	192.168.2.1	200	yes	no	d...	2.2.2.2	00:02:01		established	

External BGP

BGP Internals and Verifying eBGP Neighbors

State	Typical Reasons
Idle	The BGP process is either administratively down or awaiting the next retry attempt.
Connect	The BGP process is waiting for the TCP connection to be completed. You cannot determine from this state information whether the TCP connection can complete.
Active	The TCP connection has been completed, but no BGP messages have been sent to the peer yet.
Opensent	The TCP connection exists, and a BGP Open message has been sent to the peer, but the matching Open message has not yet been received from the other router.
Openconfirm	An Open message has been both sent to and received from the other router. The next step is to receive a BGP Keepalive message (to confirm all neighbor-related parameters matched) or BGP Notification message (to learn there is some mismatch in neighbor parameters).
Established	All neighbor parameters match, the neighbor relationship works, and the peers can now exchange Update messages.

Verifying eBGP peer Status

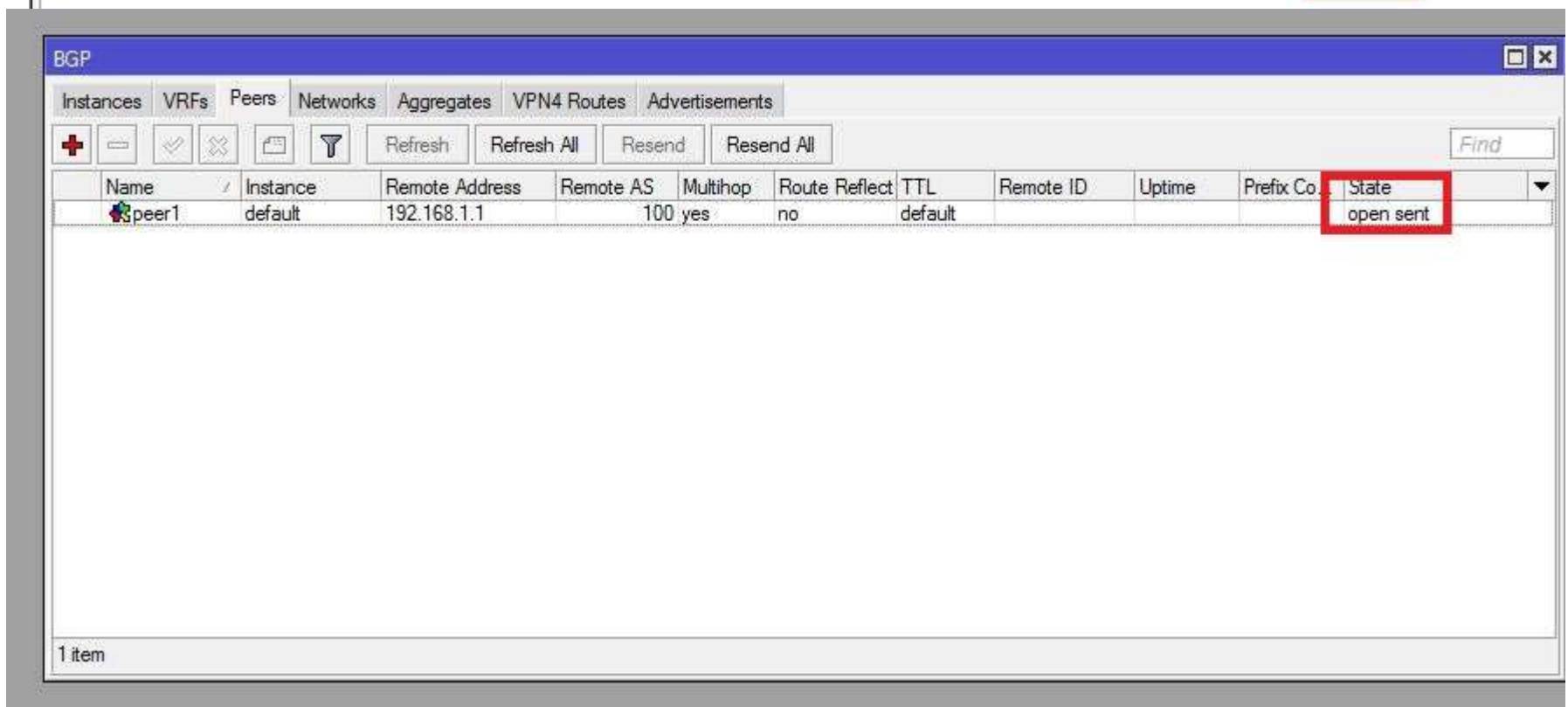
State

either lists the BGP peer state



The screenshot shows the 'BGP' window with the 'Peers' tab selected. The table lists one peer, 'peer1', with a state of 'idle'. The 'State' column is highlighted with a red box.

Name	Instance	Remote Address	Remote AS	Multihop	Route Reflect	TTL	Remote ID	Uptime	Prefix Co.	State
peer1	default	192.168.1.1	100	yes	no	default				idle



The screenshot shows the 'BGP' window with the 'Peers' tab selected. The table lists one peer, 'peer1', with a state of 'open sent'. The 'State' column is highlighted with a red box. The status bar at the bottom indicates '1 item'.

Name	Instance	Remote Address	Remote AS	Multihop	Route Reflect	TTL	Remote ID	Uptime	Prefix Co.	State
peer1	default	192.168.1.1	100	yes	no	default				open sent

1 item

ANY
QUESTIONS
?



Contact: Heydari.Farzad@gmail.com