

About me



- **Farzad Heydari Goojani**
 - Training, Support & Consultant
 - Over 5000 hours teaching networks
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Agenda

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



BGP

Border Gateway Protocol



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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).

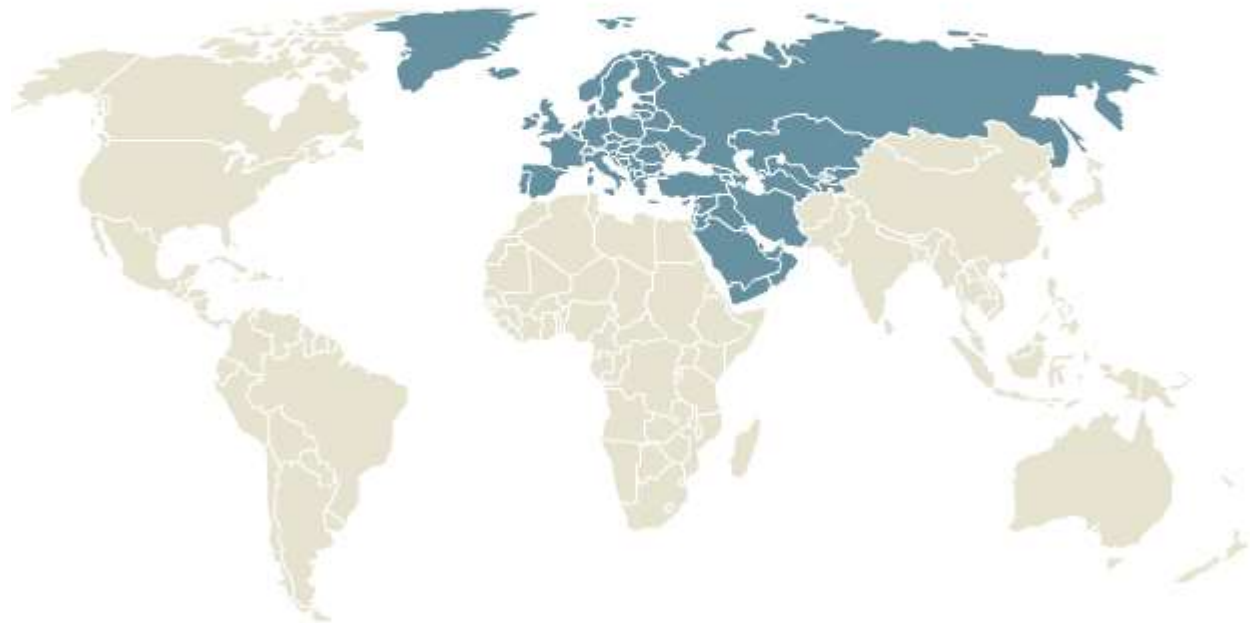
Public IP Address Assignment Regional Internet Registries (RIR)



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

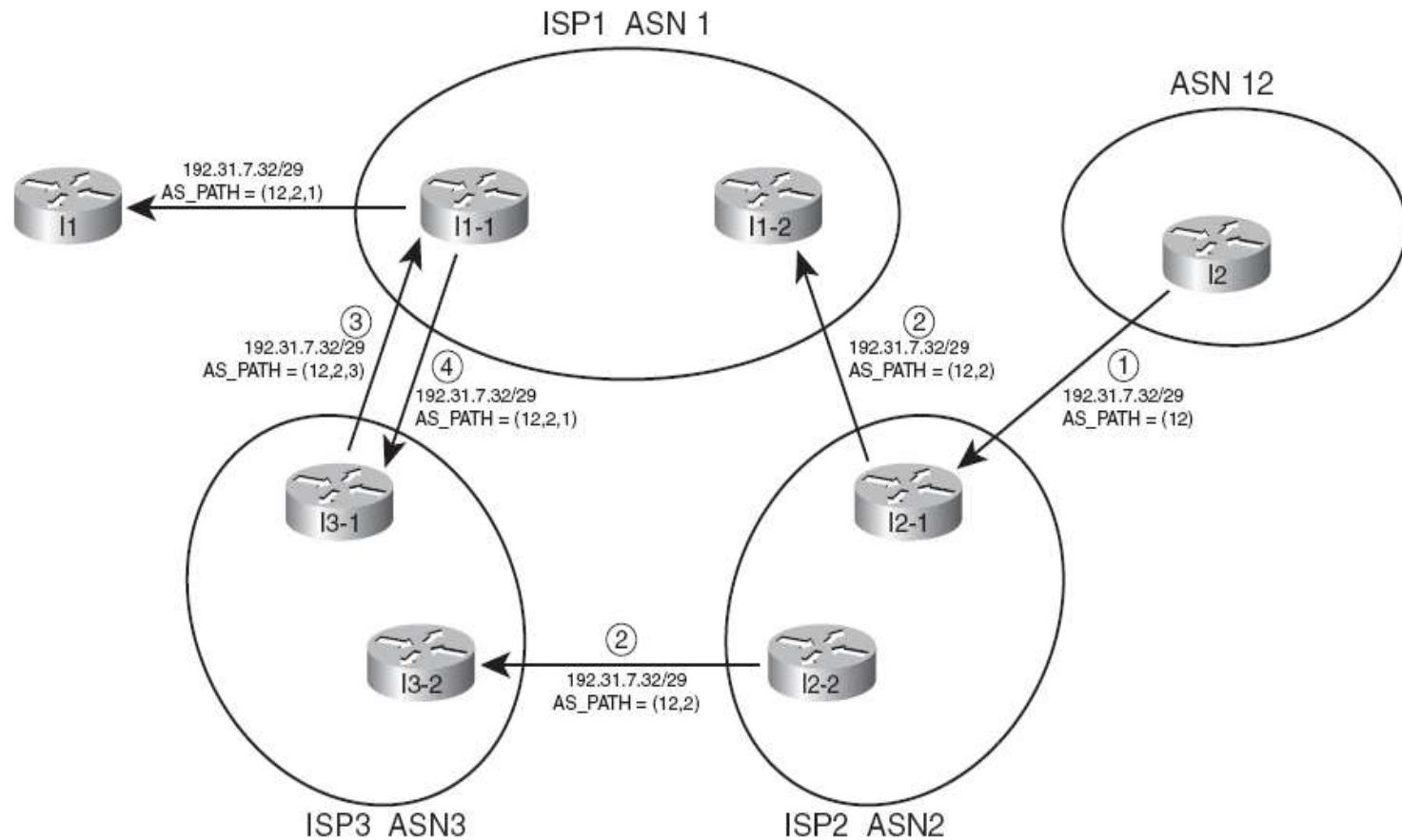
AS Path

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

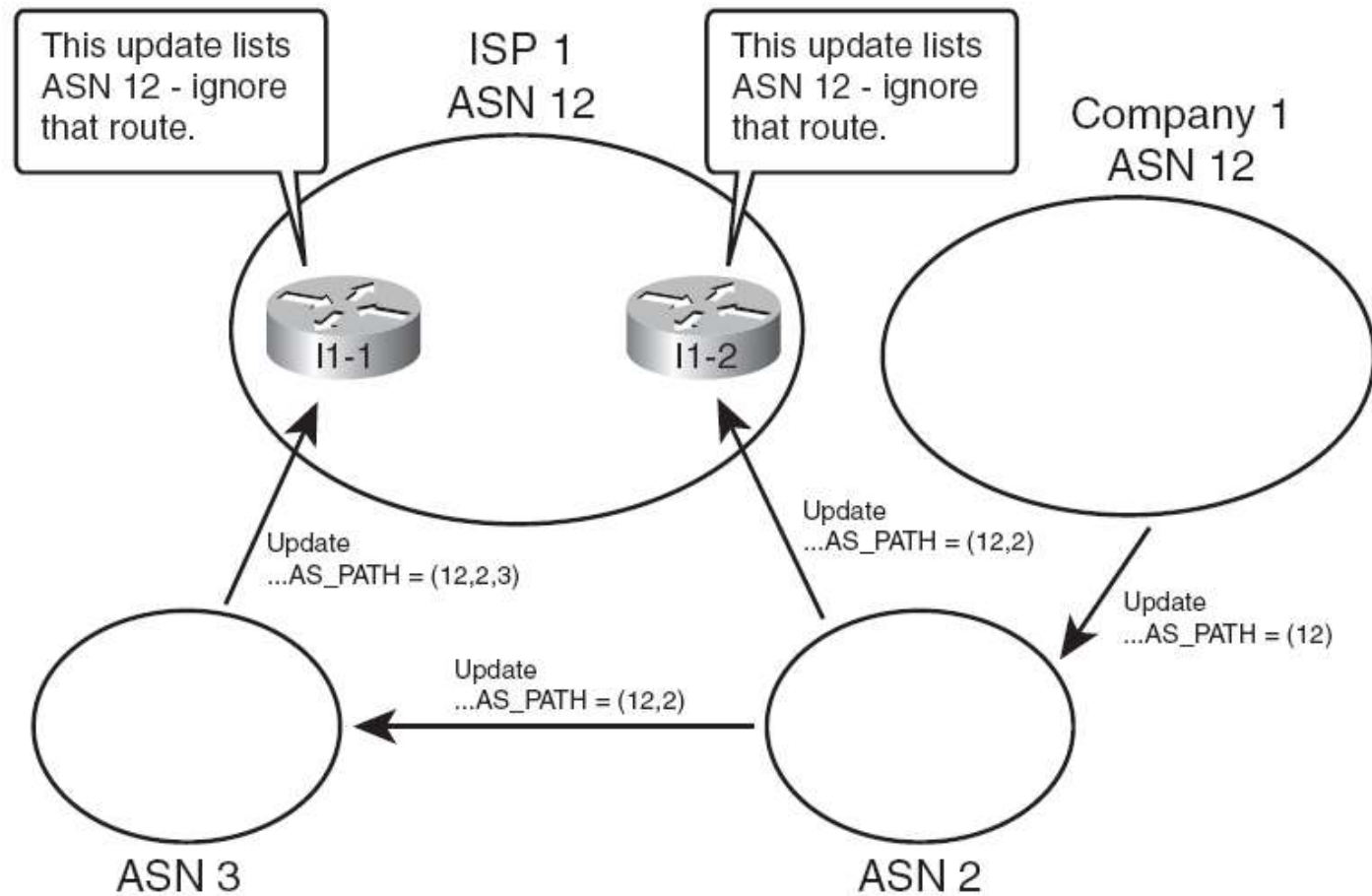
Preventing routing loops in BGP

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)

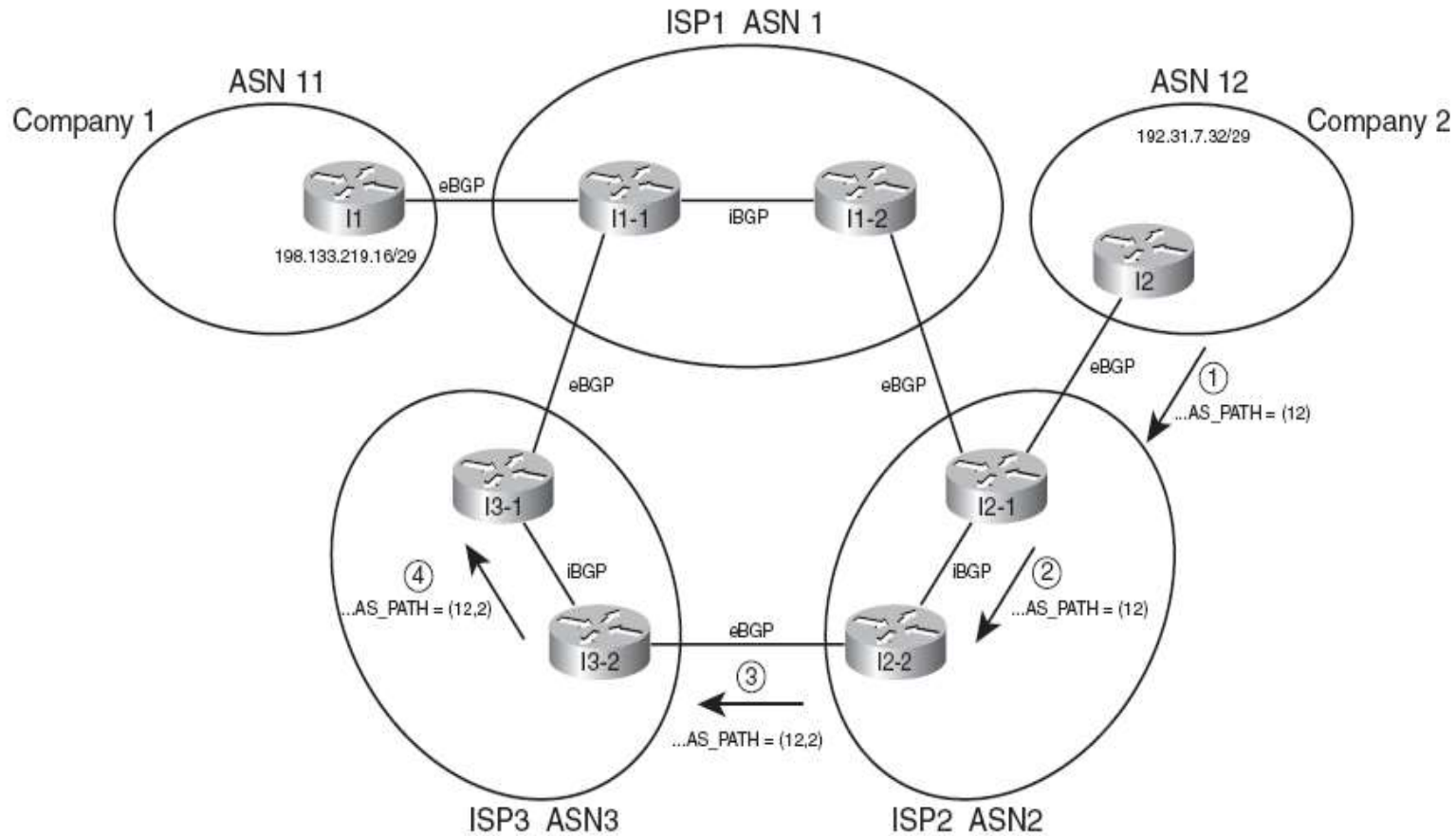
BGP neighbor is in the different ASN.

When advertising , a BGP router updates the AS_Path PA.



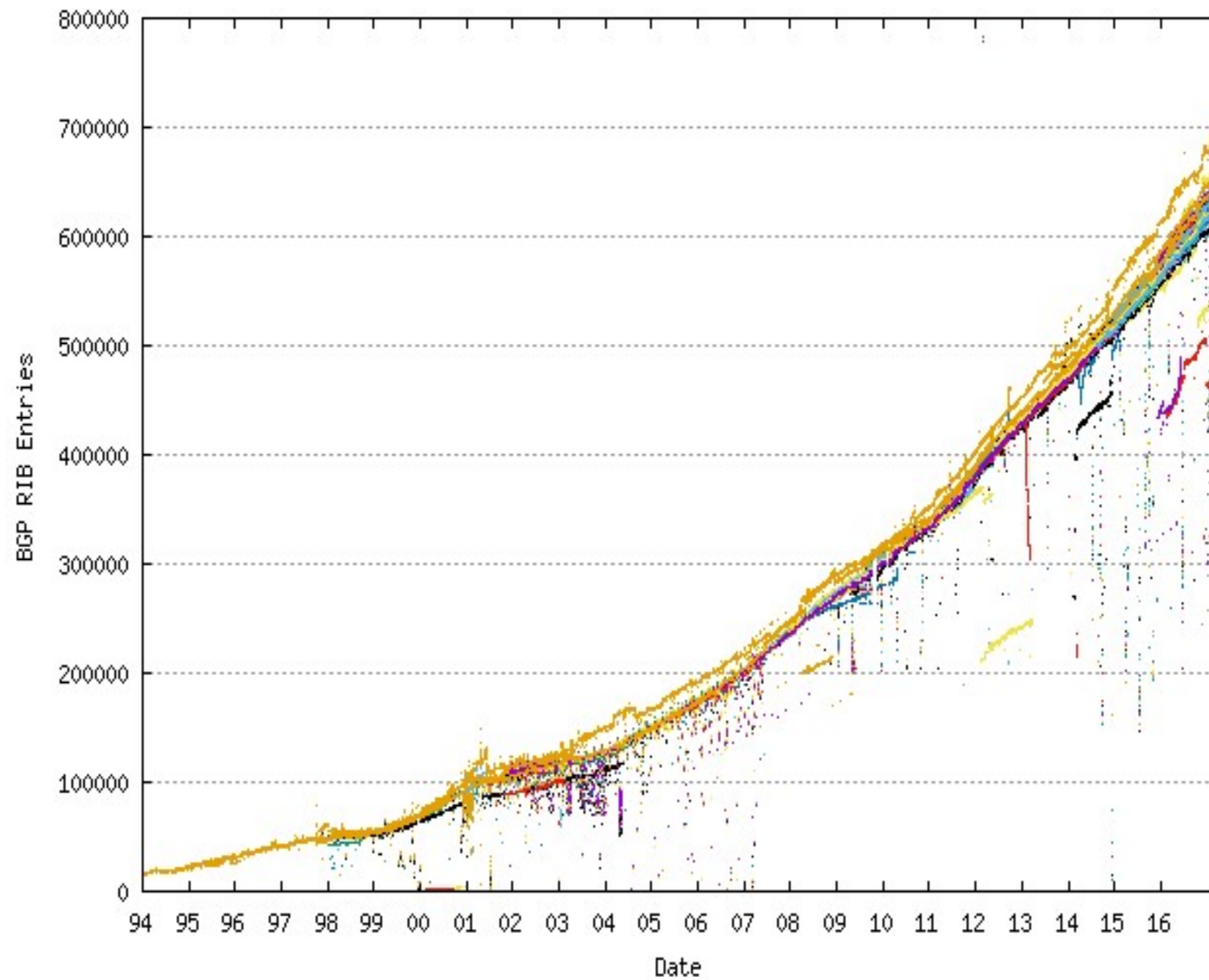
Introduction to BGP

Internal and External BGP





BGP table growth on the Internet.



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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.

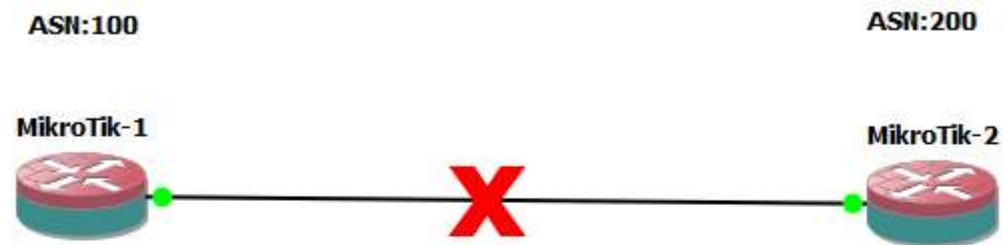
Requirements for Forming eBGP Neighborships

- 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



MikroTik

Redundancy Between BGP



MikroTik

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

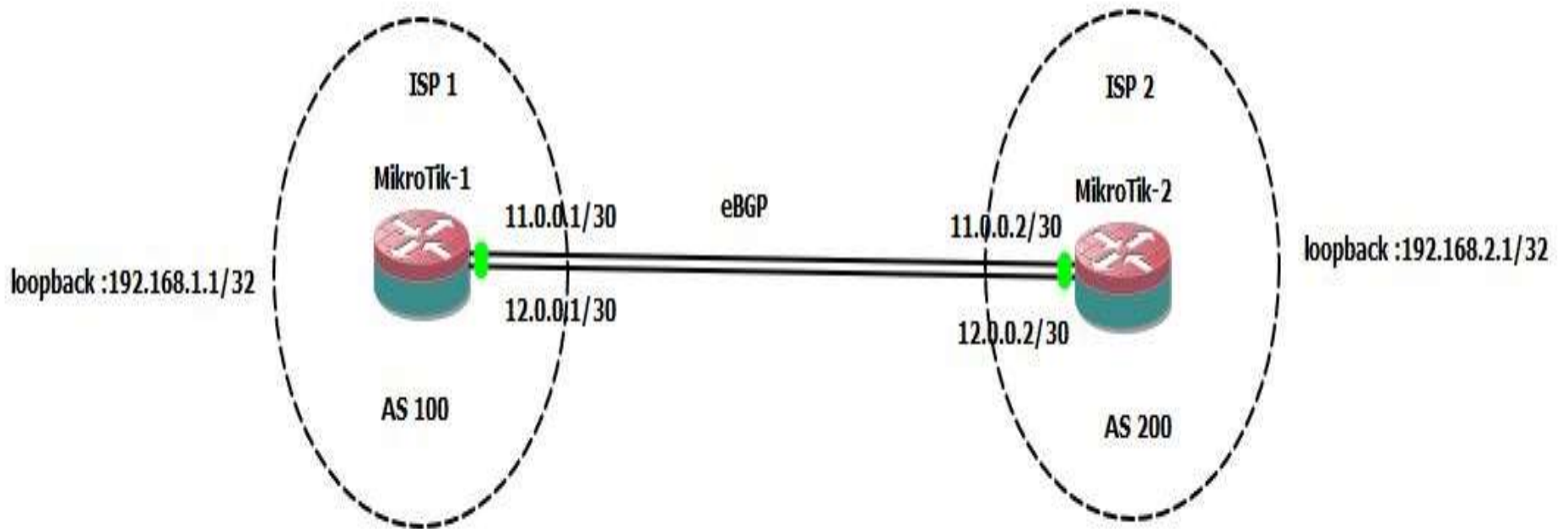
2. use bridge interfaces(loopback) as the TCP connection endpoints

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.

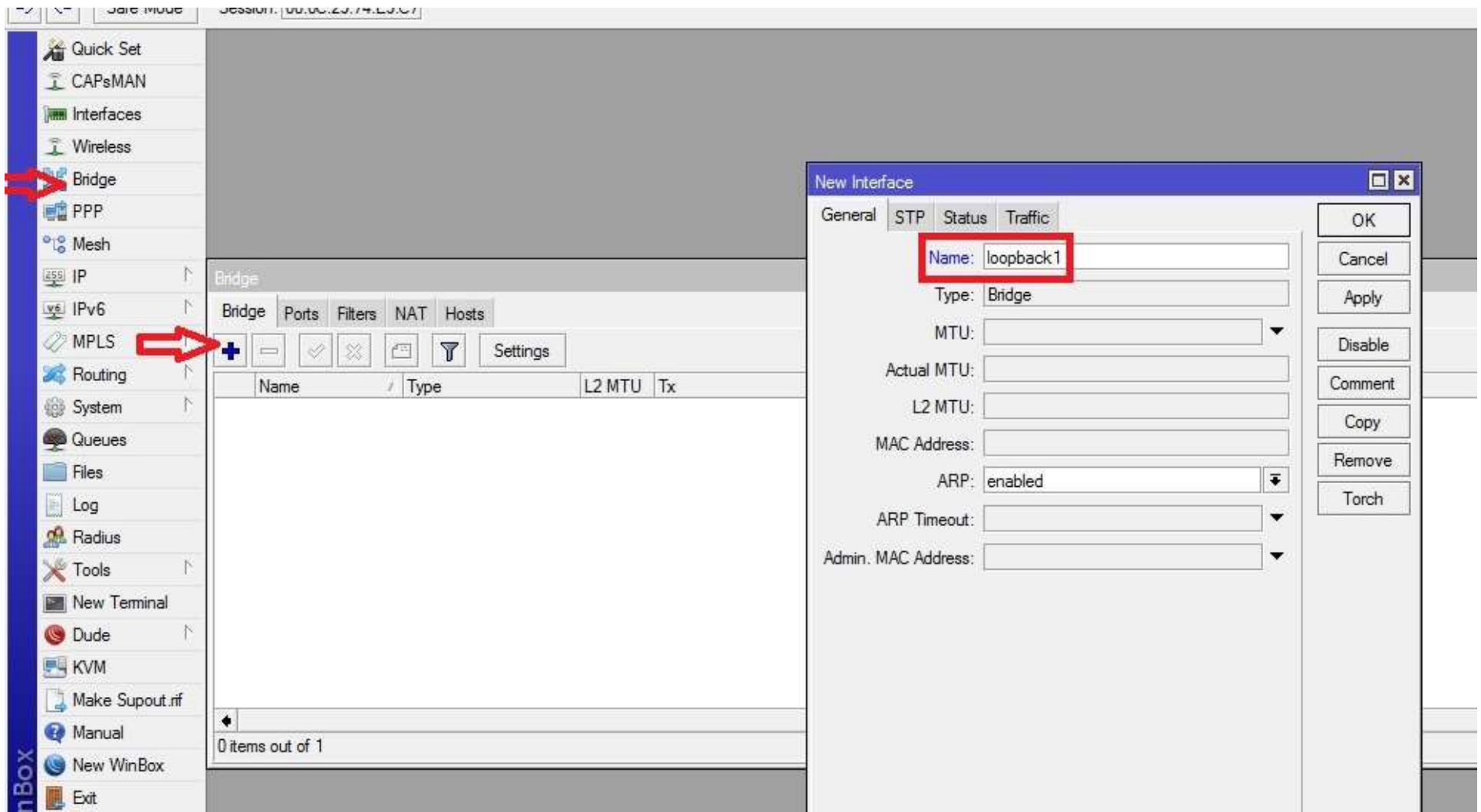


eBGP Neighbor Configuration with loopback



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. In the main workspace, the 'Address List' window is open, showing a table with one entry: Address 11.0.0.1/8, Network 11.0.0.0, and Interface ether1. A red arrow points to the '+' icon in the Address List toolbar. To the right, the 'New Address' dialog box is open, with the 'Address' field set to '192.168.1.1/32' and the 'Interface' dropdown set to 'loopback1', both fields highlighted with red boxes. The 'Network' field is empty. The status at the bottom of the dialog is 'enabled'.

Address	Network	Interface
11.0.0.1/8	11.0.0.0	ether1

New Address dialog fields:

- Address: 192.168.1.1/32
- Network: (empty)
- Interface: loopback1

Status: enabled

Step3

Configure the BGP on router 1

The screenshot shows the Mikrotik WinBox interface. On the left sidebar, the 'Routing' menu is highlighted with a red arrow. In the main window, the 'BGP' configuration page is open, with the 'Instances' tab selected. A table lists the BGP instances:

Name	AS	Router ID
default	65530	

Below the table, the text '1 item (1 selected)' is visible. A red arrow points to the 'Instances' tab. To the right, the 'BGP Instance <default>' dialog box is open, showing the following configuration:

- Name: default
- AS: 100
- Router ID: 1.1.1.1
- Redistribute Connected:
- Redistribute Static:
- Redistribute RIP:
- Redistribute OSPF:
- Redistribute Other BGP:
- Out Filter: [dropdown]
- Confederation: [dropdown]
- Confederation Peers: [dropdown]
- Cluster ID: [dropdown]
- Routing Table: [dropdown]
- Client To Client Reflection:
- Ignore AS Path Length:

Buttons for 'OK', 'Cancel', 'Apply', 'Disable', 'Comment', 'Copy', and 'Remove' are visible on the right side of the dialog.

Step3

Configure the BGP on router 2

The screenshot shows a network configuration interface. On the left, a sidebar menu has 'Routing' selected. The main window displays the 'BGP' configuration for a router. A red arrow points to the 'Instances' tab, which contains a table with the following data:

Name	AS	Router ID
default	200	2.2.2.2

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

- Name: default
- AS: 200
- Router ID: 2.2.2.2

There are several checkboxes for redistribution:

- Redistribute Connected
- Redistribute Static
- Redistribute RIP
- Redistribute OSPF
- Redistribute Other BGP

Other fields include:

- Out Filter: (empty)
- Confederation: (empty)
- Confederation Peers: (empty)
- Cluster ID: (empty)
- Routing Table: (empty)
- Client To Client Reflection
- Ignore AS Path Length

The status at the bottom of the dialog is 'enabled'. Buttons for 'OK', 'Cancel', 'Apply', 'Disable', 'Comment', 'Copy', and 'Remove' are visible on the right side of the dialog.

Step 4

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

The screenshot displays the Mikrotik WinBox interface. On the left is a navigation tree with categories like Quick Set, CAPsMAN, Interfaces, Wireless, Bridge, PPP, Mesh, IP, IPv6, MPLS, Routing, System, Queues, Files, Log, Radius, Tools, New Terminal, Dude, and KVM. The 'Routing' category is expanded, and the 'Peers' tab under 'BGP' is selected, indicated by a red arrow. Below the navigation tree is a table with columns for Name, Instance, and Remote Address. The main window shows the 'New BGP Peer' configuration dialog. The 'General' tab is active, and the following fields are visible: Name: peer1, Instance: default, Remote Address: 192.168.2.1 (highlighted with a red box), Remote Port: (empty), Remote AS: 200 (highlighted with a red box), TCP MD5 Key: (empty), Nexthop Choice: default, Multihop (unchecked), Route Reflect (unchecked), Hold Time: 180 s, Keepalive Time: (empty), TTL: default, Max Prefix Limit: (empty), Max Prefix Restart Time: (empty), In Filter: (empty), and Out Filter: (empty). On the right side of the dialog are buttons for OK, Cancel, Apply, Disable, Comment, Copy, Remove, Refresh, Refresh All, Resend, and Resend All.

Step 4

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

The screenshot displays the Mikrotik WinBox interface. On the left is a sidebar menu with various configuration categories. The main window is divided into two panes. The left pane shows the 'BGP' configuration area with tabs for 'Instances', 'Peers', 'Networks', and 'Aggregates'. The 'Peers' tab is selected, and a red arrow points to it. Below the tabs is a table with columns for 'Name', 'Instance', and 'Remote Address', which is currently empty. The right pane is the 'New BGP Peer' dialog box, which is open to the 'General' tab. The dialog contains several fields: 'Name' (peer1), 'Instance' (default), 'Remote Address' (192.168.1.1), 'Remote Port' (dropdown), 'Remote AS' (100), 'TCP MD5 Key' (dropdown), 'Nexthop Choice' (default), 'Hold Time' (180 s), 'Keepalive Time' (dropdown), 'TTL' (default), 'Max Prefix Limit' (dropdown), 'Max Prefix Restart Time' (dropdown), 'In Filter' (dropdown), 'Out Filter' (dropdown), and 'AllowAS In' (dropdown). There are also checkboxes for 'Multihop', 'Route Reflect', and 'Remove Private AS'. On the right side of the dialog are buttons for 'OK', 'Cancel', 'Apply', 'Disable', 'Comment', 'Copy', 'Remove', 'Refresh', 'Refresh All', 'Resend', and 'Resend All'. Red boxes highlight the 'Remote Address' and 'Remote AS' fields in the dialog.

Quick Set
CAPsMAN
Interfaces
Wireless
Bridge
PPP
Mesh
IP
IPv6
MPLS
Routing
System
Queues
Files
Log
Radius
Tools
New Terminal
Dude
KVM
Make Supout.rf
Manual
New WinBox

BGP

Instances Peers Networks Aggregates

Name	Instance	Remote Address
0 items		

New BGP Peer

General Advanced Status

Name: peer1

Instance: default

Remote Address: 192.168.1.1

Remote Port: [dropdown]

Remote AS: 100

TCP MD5 Key: [dropdown]

Nexthop Choice: default

Multihop

Route Reflect

Hold Time: 180 s

Keepalive Time: [dropdown]

TTL: default

Max Prefix Limit: [dropdown]

Max Prefix Restart Time: [dropdown]

In Filter: [dropdown]

Out Filter: [dropdown]

AllowAS In: [dropdown]

Remove Private AS

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

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. The main window shows a table of BGP peers, and a detailed configuration window for a specific peer is open on the right.

BGP Peer Configuration Window:

- Tab: **General** (highlighted with a red arrow)
- Address Families: ip ipv6 I2vpn vpn4 I2vpn-cisco
- Update Source: **Loopback1** (highlighted with a red box)
- Cisco VPLS NLRI Length Format: auto bits

Main BGP Configuration Window:

- Tab: **Peers** (highlighted with a red arrow)
- Table:

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.

The screenshot shows a network simulator interface with a sidebar menu on the left. The 'Tools' menu is open, and the 'Ping' option is selected. The 'Ping' dialog box is open, showing the 'General' tab with 'Ping To: 192.168.2.1' and the 'Advanced' tab with 'Src. Address: 192.168.1.1'. Red arrows point to the 'Tools' menu, the 'Ping' option, and the 'Advanced' tab.

Seq # /	Host	Time	Reply Size	TTL	Status
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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.

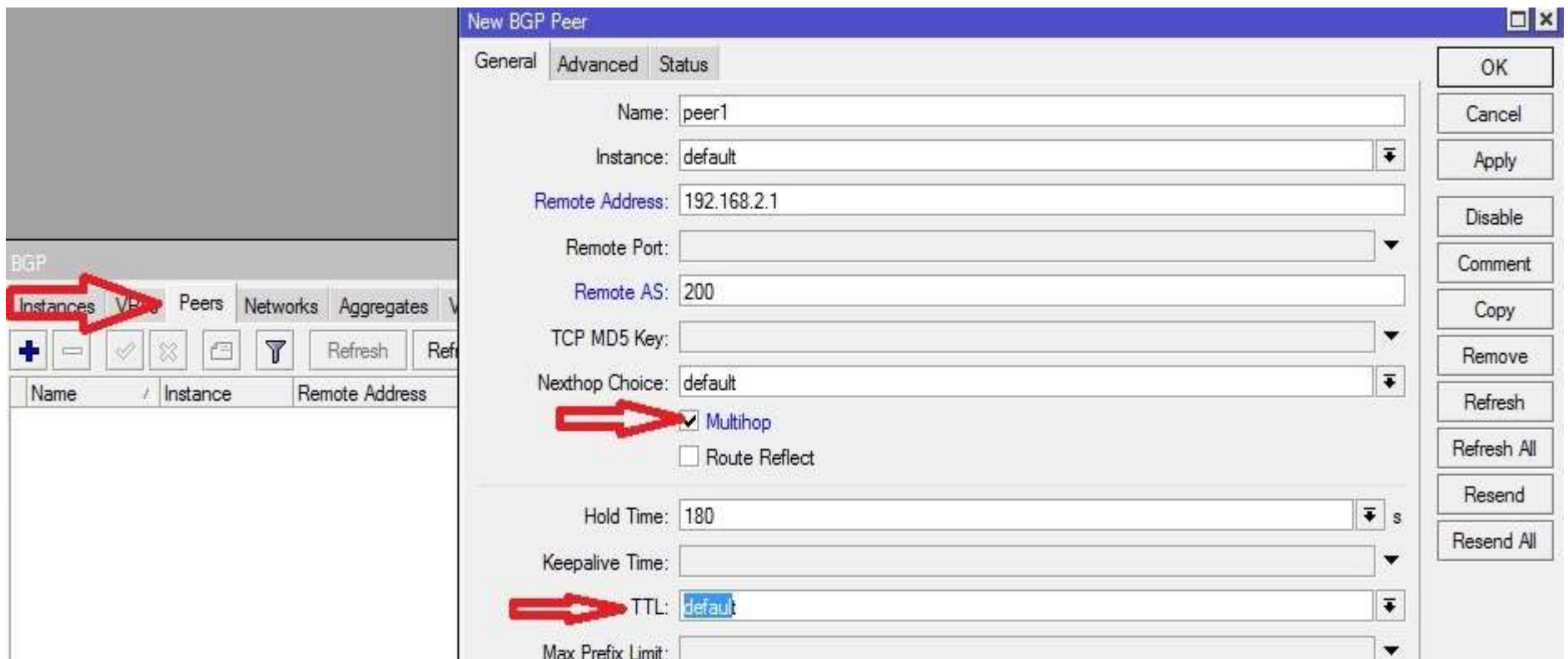


Step 7

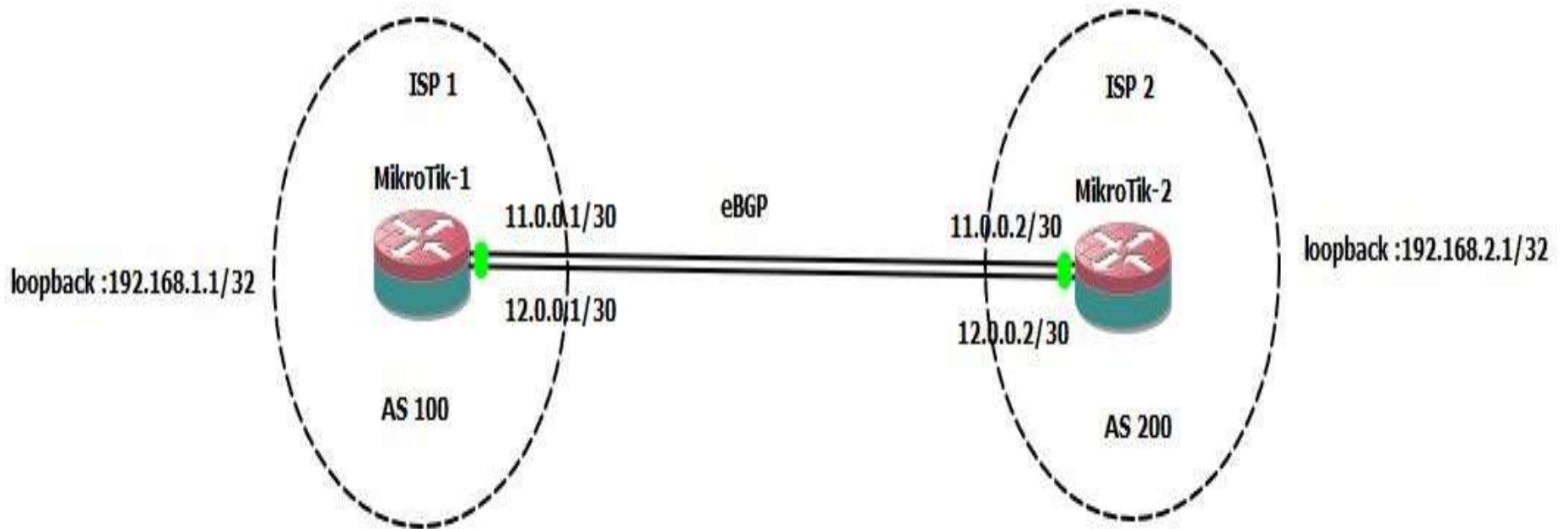
Configure eBGP multihop.

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.

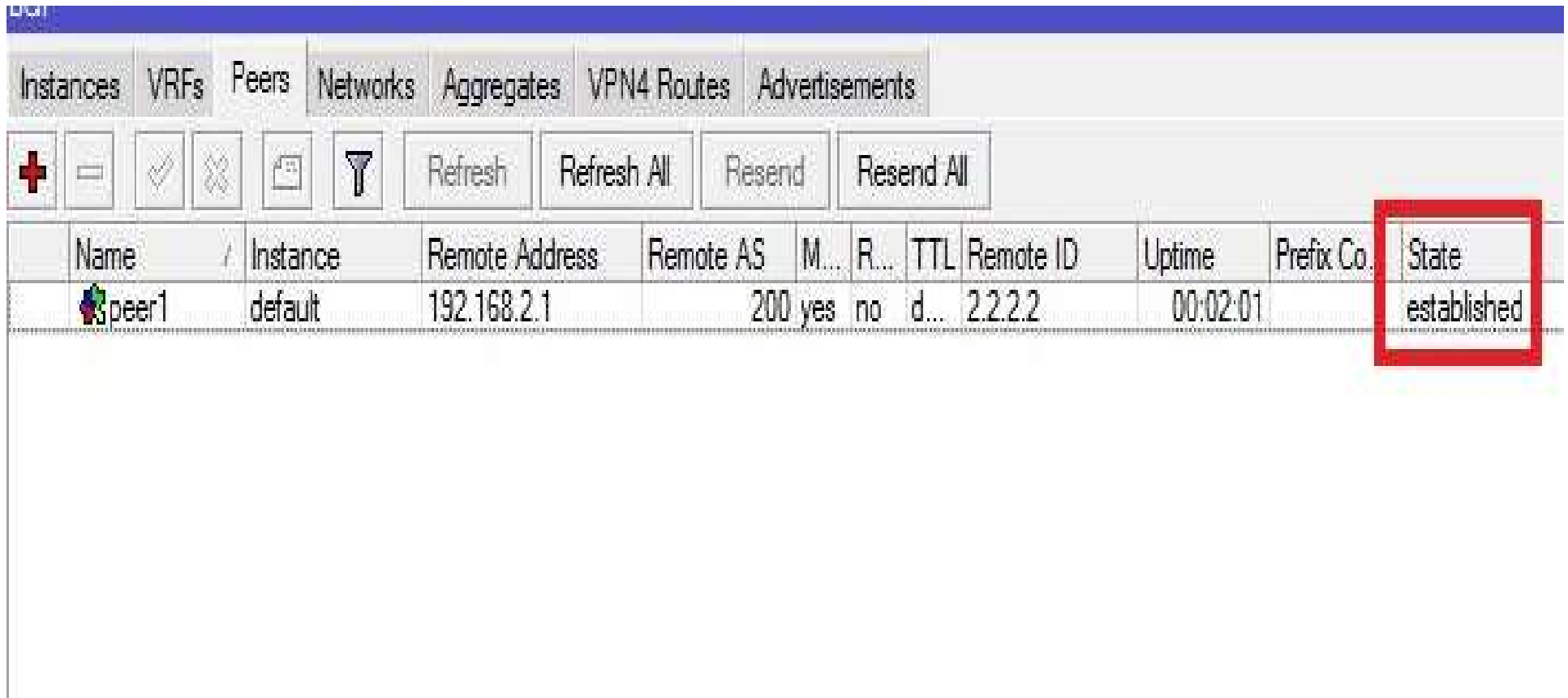
With this default action, the eBGP neighborhood fails to complete when using loopback interface IP addresses.



eBGP Neighbor Configuration with loopback



Verifying eBGP Neighbor Status



The screenshot shows the Mikrotik WinBox interface with the 'Peers' tab selected. The table below displays the status of an eBGP neighbor named 'peer1'. The 'State' column for this neighbor is highlighted with a red box, showing 'established'.

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

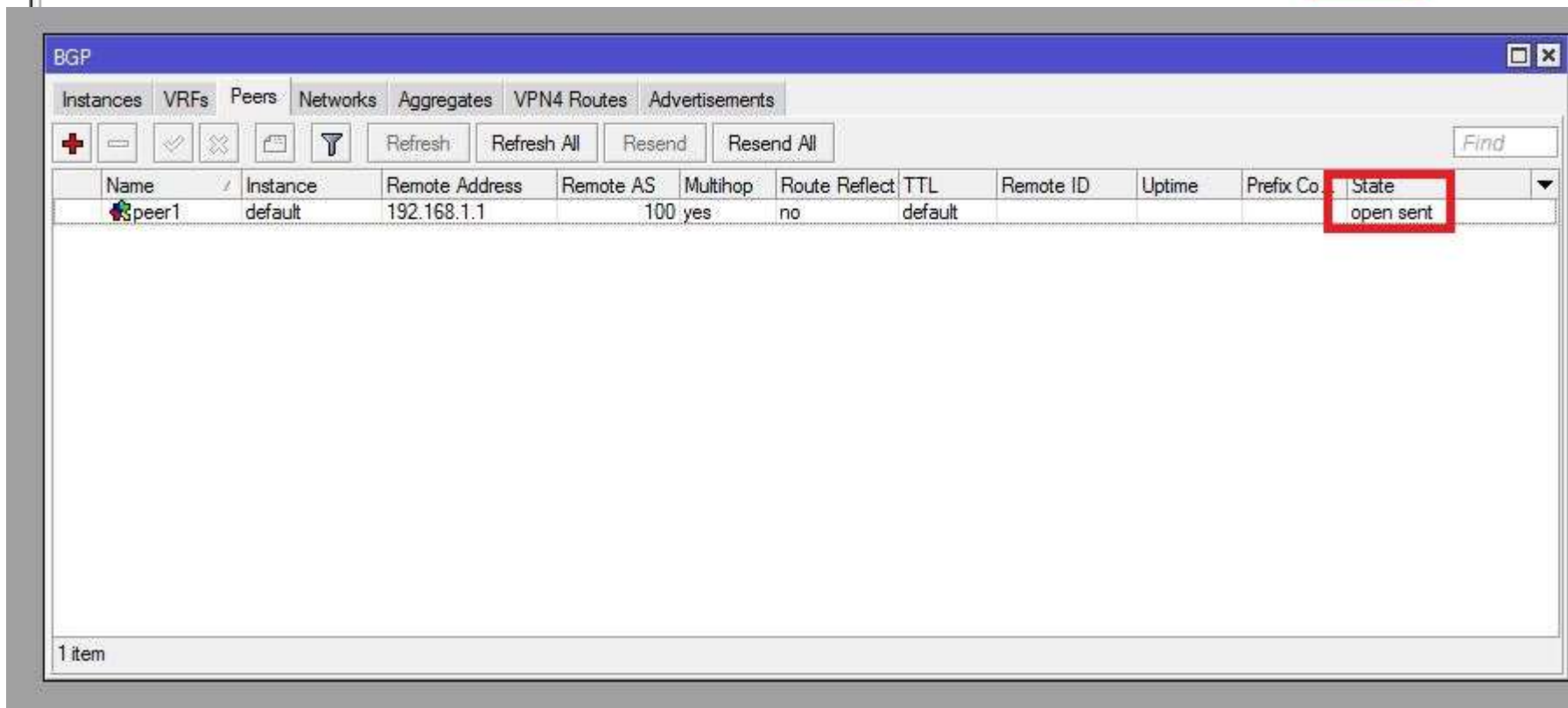
State

either lists the BGP peer state



The screenshot shows the BGP configuration interface with the 'Peers' tab selected. A table lists the BGP peers. The 'peer1' entry is highlighted, and its 'State' is 'idle', which is circled in red.

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 configuration interface with the 'Peers' tab selected. A table lists the BGP peers. The 'peer1' entry is highlighted, and its 'State' is 'open sent', which is circled in red. Below the table, it 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
?



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