Load Sharing Internet with MikroTik

MikroTik User Meeting
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i-BEAM
steering ahead

About Me

- My name is **Lay Minh**
- You can call me **Makito**
- CCIE # 47682
- Chief Technology Officer (CTO) at i-BEAM
- MikroTik Certified Trainer & Consultant
- Experiences:
  - 10 years in ISP industry since 2005
  - Billing solutions for service providers
  - ISP core network design and operations
- MikroTik Certifications:

- Areas of interest:

  BGP, MPLS, IPv6

As you might know…

- There are many accidents on internet infrastructure, such as:

Someone cuts your cable quietly with unknown reason

Unexpected electricity explosion, which kills everything on the pole

Or…perhaps, your ISP is in trouble now…

So…

- **Some people did these:**

1. Simply connect to two ISPs, plug some users to ISP1's router, and some other users to ISP2's router, the key concept will be how fast they can switch the cable when one link has failed;

2. Or pay more to their existing ISP for secondary cable from different path, however this secondary link is gonna stay idle as long as primary link is up;

3. Or some rich people might request their own IP block, and buy IP transit from two ISPs, do load sharing and failover by BGP.

What can we do?

IF…

- We want a redundant link
- We want automated failover
- We want the redundant link can be used simultaneously with the primary link for better ROI (Return On Investment) ☺

BUT…

- We have limited budget ☹
- Or the boss is stingy…

THEN…

- We can try to set it up with MikroTik router
- We will do Load Sharing instead of Load Balancing

What will you need?

- **2 x Internet connection**
  - Connect to different ISPs for better redundancy
    Such as: MPT + YTP, or MPT + Ooredoo…etc.
  - Not required to have the same speed on both links, but it is good to have

- **1 x MikroTik router**
  - Recommended series:
    - **RB750GL** (5 x GE, no Wi-Fi)
    - **RB951Ui-2HnD**
      (5 x FE, Wi-Fi 802.11a/b/g/n, dual-chain antenna)
    - **RB1100AHx2**
      (If you require up to 300Mbps routing throughput)
    - **hAP** (Gift from MikroTik today! ☺)

Load Sharing vs. Load Balancing

	Load Sharing	Load Balancing
Definition	Share traffic loads to multiple links	Balance traffic loads on multiple links
Mechanism	Policy Based Routing (PBR), IGP Route Leaking, BGP Routing Policy	Equal Cost Multi Path (ECMP), Link Aggregation
Administration	Required explicit policy	Operate automatically according to the technology specs
Application	Utilize multiple WAN links simultaneously	LAN environment, Service provider backbone
Limitation	Hard to balance traffic between multiple links, required more administration involvement on defining policy	Not working well when apply on WAN links of a NATTed network

Why NOT ECMP+NAT?

- ECMP behavior is vendor specific:
  - **Per flow** or **per packet** load balancing
  - **MikroTik does per flow load balancing, refresh every 10 minutes**

- ISPs usually apply security filters on their Provider Edge (PE)
  - Firewall rules that permit only their customer's IP
  - RPF (Reverse Path Forwarding) Check

- If the path changed according to ECMP behavior, but NAT table is not updated, router will send packet with wrong source IP to ISP, then it's gonna be dropped by the ISP
  - MikroTik router makes NAT decision on first packet only
  - Once the decision is made, it caches the result for other packets
  - **When ECMP path changed, the result is not flushed and recalculated**

Why NOT Link Aggregation?

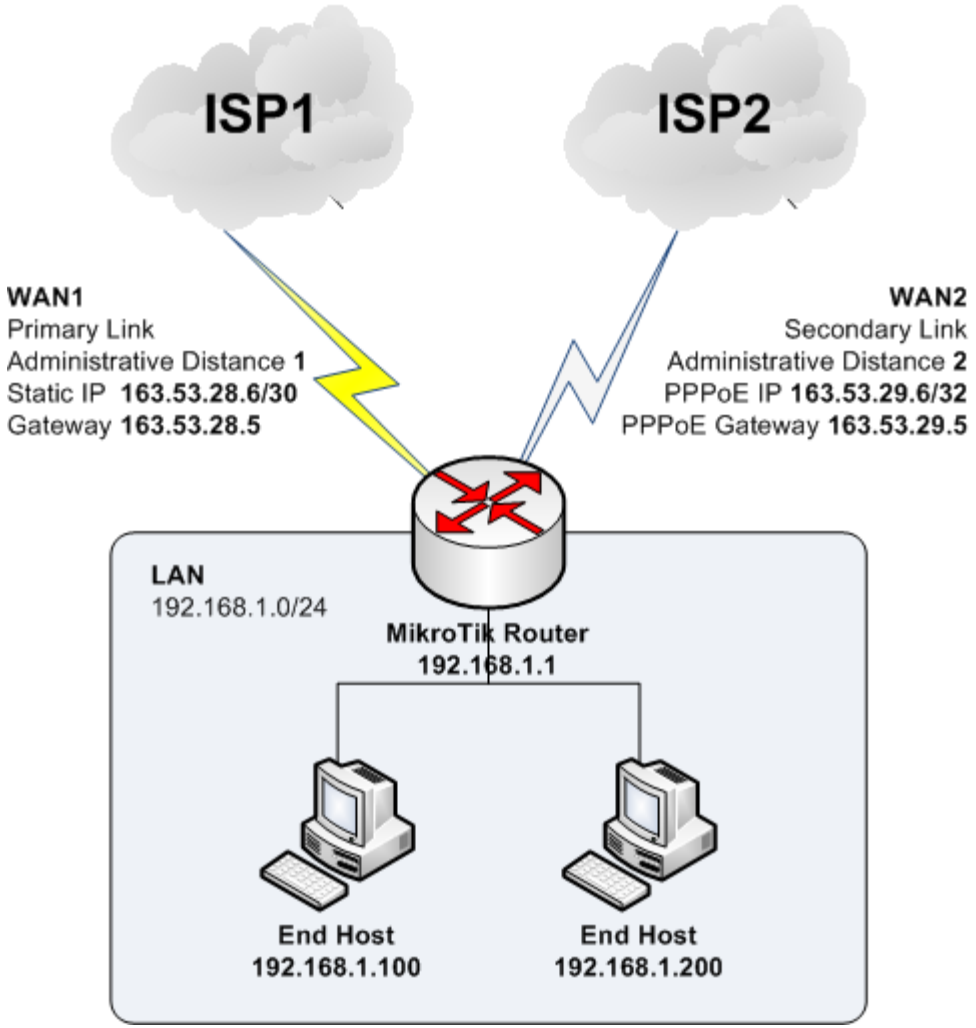
- Most ISPs don't support link aggregation to customer, **some might do it if they can charge you an enterprise tariff.** ☺

- Link aggregation **does not work** when you are connecting to two different ISPs.

- If bandwidth of both links is natively unequal (i.e: 4Mbps for Link 1, and 2Mbps for Link 2), according to default behavior of the technology, it will cause packet loss when one of the links is full.

Network Topology

- Let's go ahead to configure this:



Router Initialization

Note: Configuration example in this presentation is based on **MikroTik RB951Ui-2HnD**

- Download Winbox
  - Winbox is a GUI software for managing MikroTik routers
  - Download from MikroTik website: http://download2.mikrotik.com/routeros/winbox/3.0rc5/winbox.exe

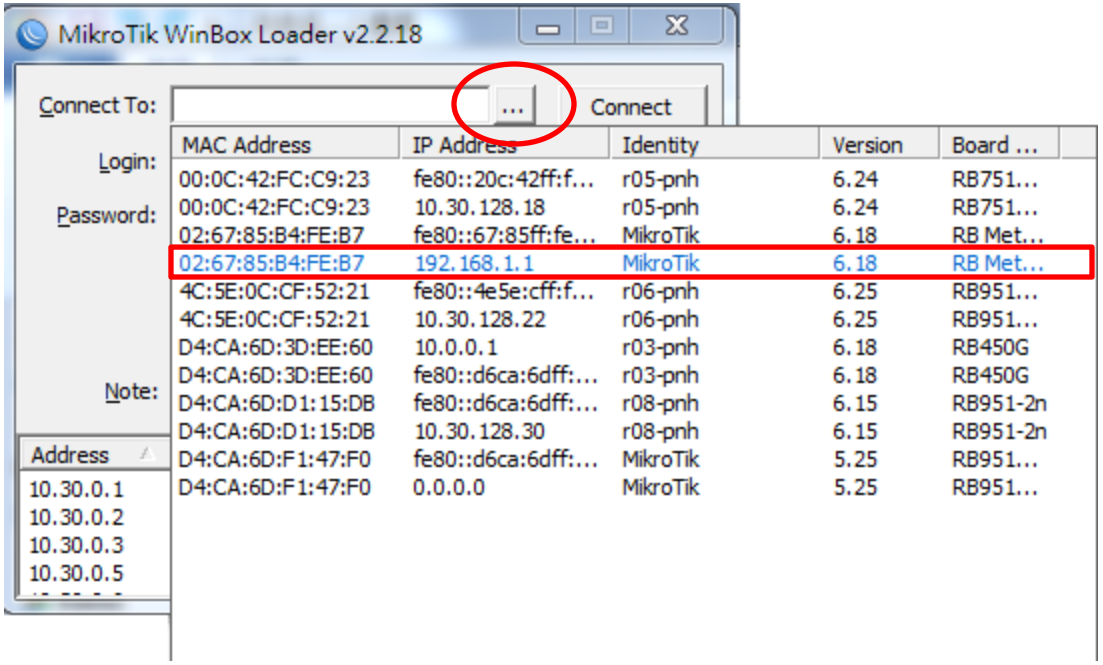
- Connect both of your internet links to your MikroTik Router
  - WAN1 to ether1 (Primary Link, Static IP)
  - WAN2 to ether2 (Secondary Link, PPPoE)

- Connect your PC to one of the LAN ports (ether3-ether5)

Router Initialization (Cont.)

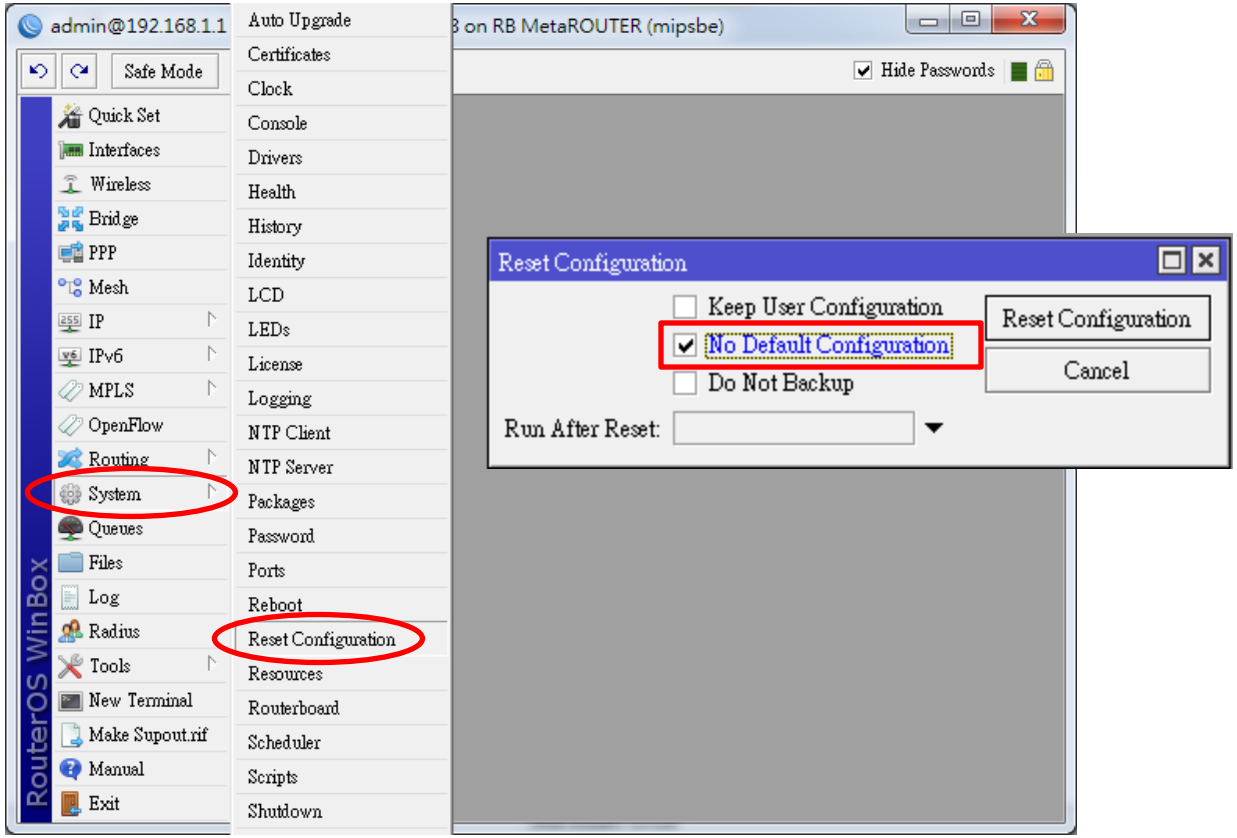
- Login to the router with MAC Address:
  - Press on **[…]**
  - Wait a few seconds, if you cannot see the list, turn off your PC firewall
  - Select your router's MAC address
  - Key-in router's **Login** and **Password** and press **[Connect]**

    (Default Login: admin, no password)



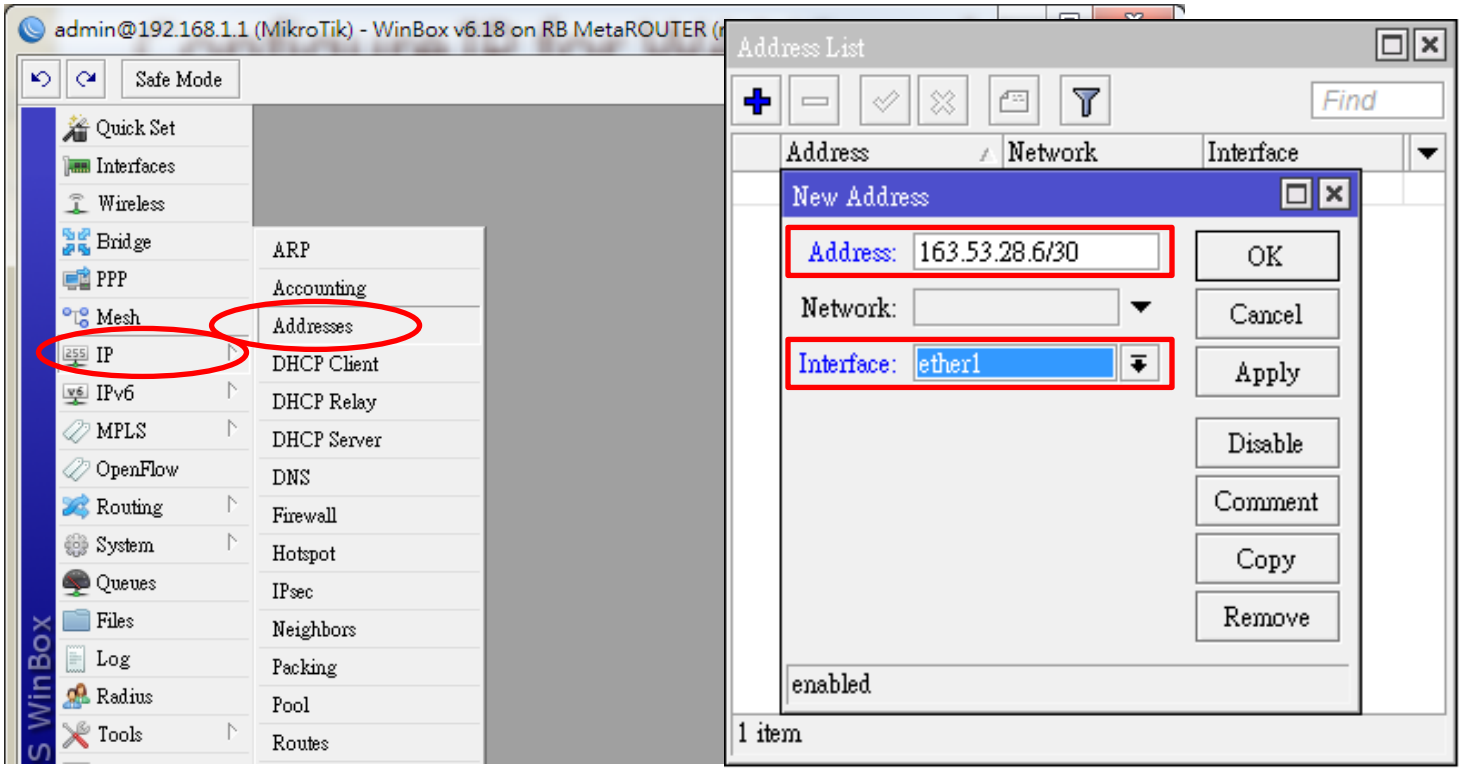
Router Initialization (Cont.)

- Reset the router to factory default with no default configuration:
  - This step can be skipped if you wanna keep your configuration
  - Select Menu **[System]** -> **[Reset Configuration]**
  - Tick **[No Default Configuration]**, then press **[Reset Configuration]**



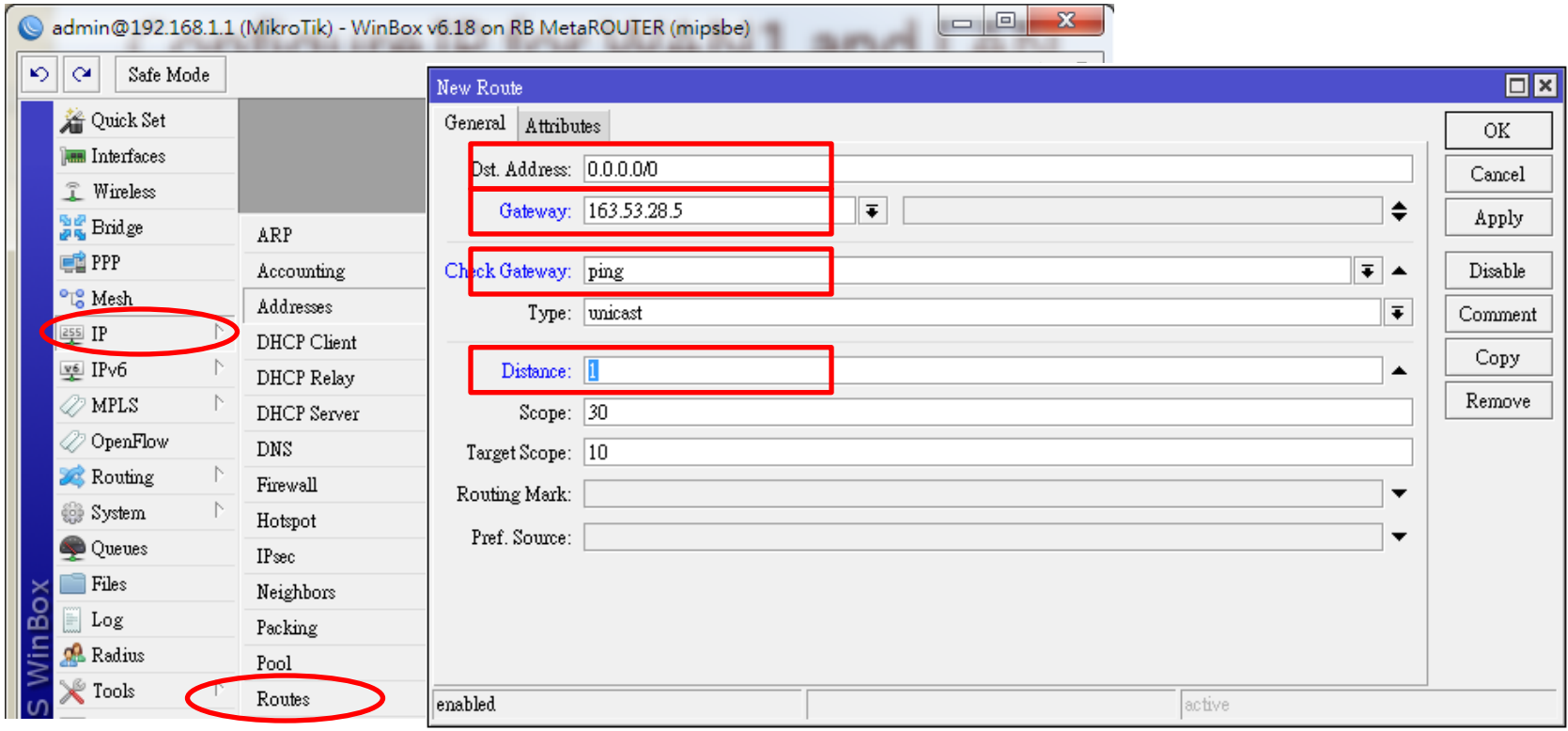
Configure WAN1 and LAN

- In our example, WAN1 uses Static IP:
  - Go to menu **[IP]** -> **[Address]**, press **[+]**
  - Key-in your IP address in CIDR notation (i.e.: **163.53.28.6/30**)
  - Select appropriate interface which this IP belongs to, then press **[OK]**
- Configure your LAN IP (192.168.1.1/24) with the same way.



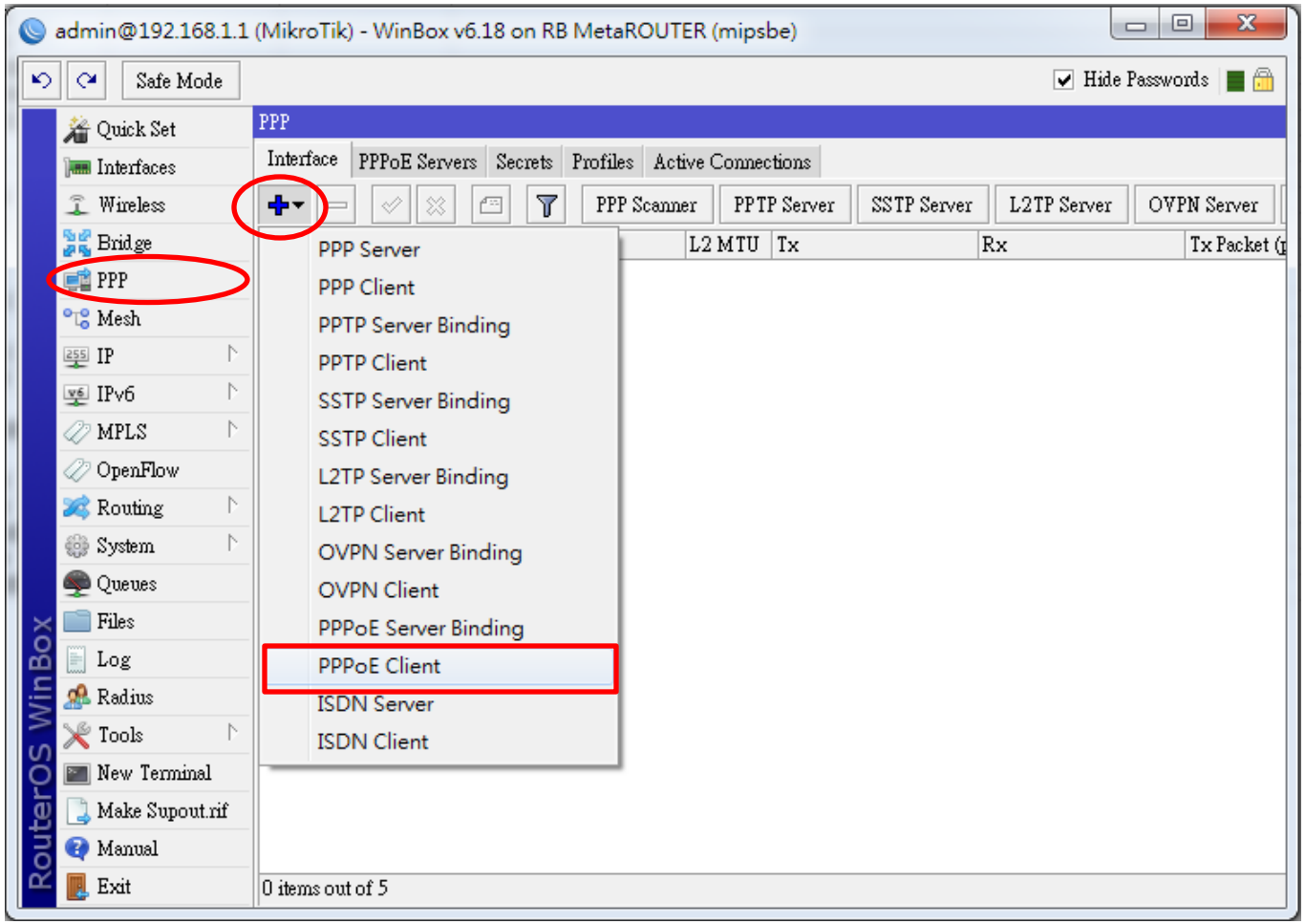
Add Default Gateway for WAN1

- Since WAN1 was statically configured, we need to manually configure default route for it:
  - Go to menu **[IP]** -> **[Route]**, press **[+]**
  - Key-in **0.0.0.0/0** in **[Dst. Address]**, and **163.53.28.5** in **[Gateway]**
  - **[Check Gateway**] by **ping**, [**Distance]** is **1**, then press **[OK]**



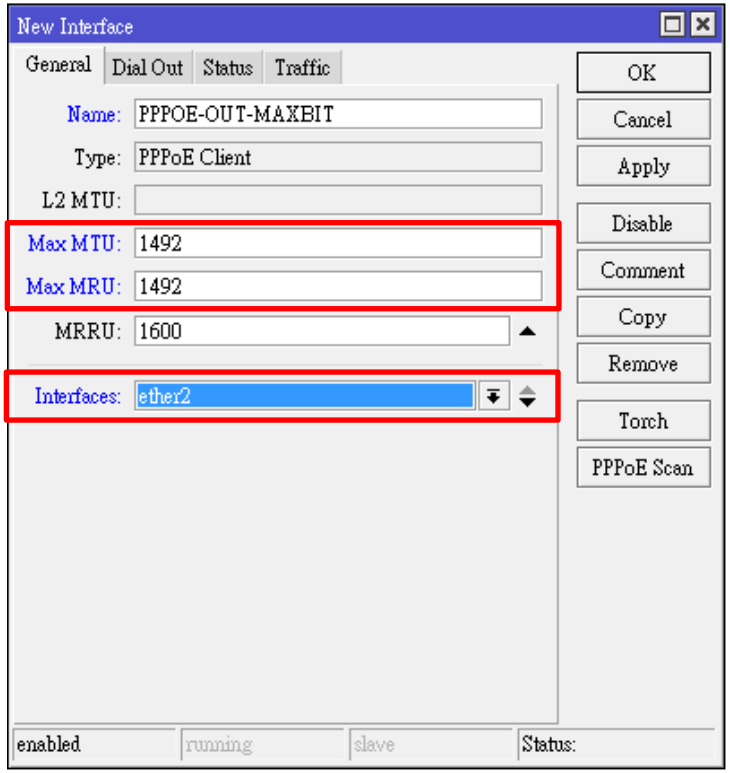
Configure WAN2 PPPoE

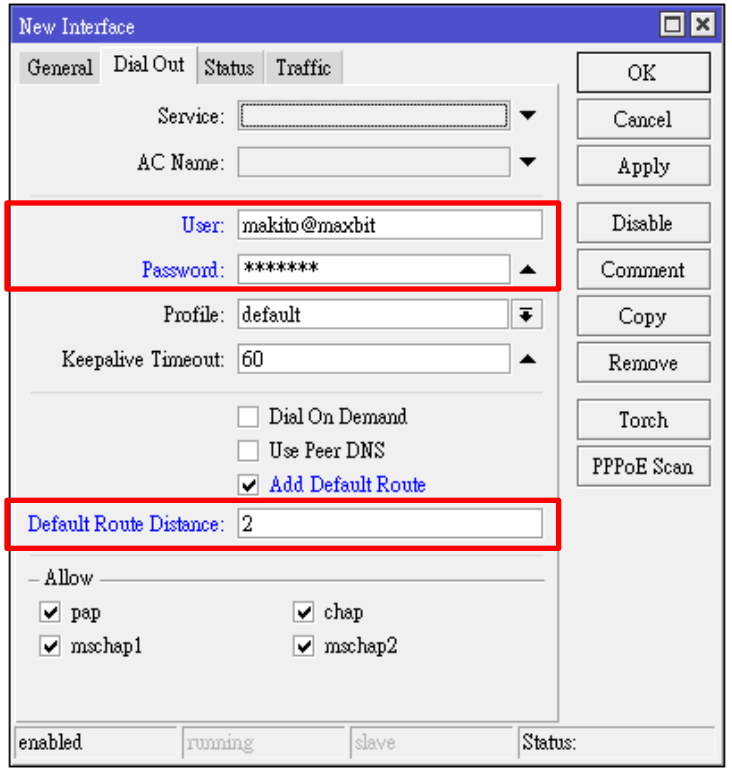
- WAN2 uses PPPoE:
  - Go to menu **[PPP]**, press **[+]**, select **[PPPoE Client]**



Configure WAN2 PPPoE (Cont.)

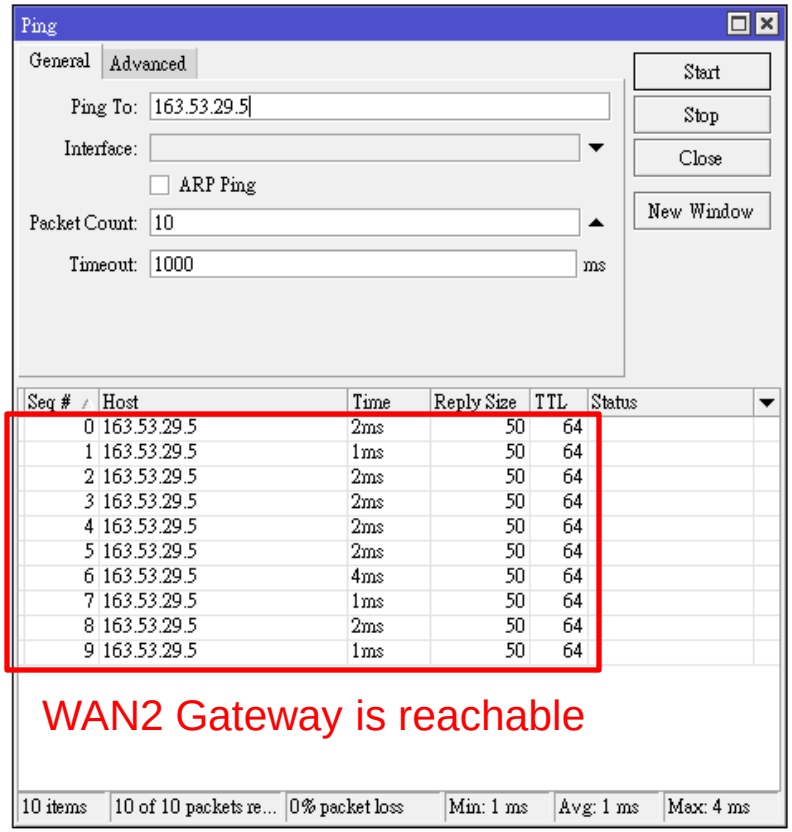
- Configure PPPoE according to information provided by your ISP
  - Max PPPoE MTU is **1492** for most ISPs
  - Select WAN **[Interface]** that used for dialing PPPoE
  - Fill in your PPPoE **[User]** and **[Password]**
  - Set **[Default Route Distance]** to **2**, then press **[OK]**

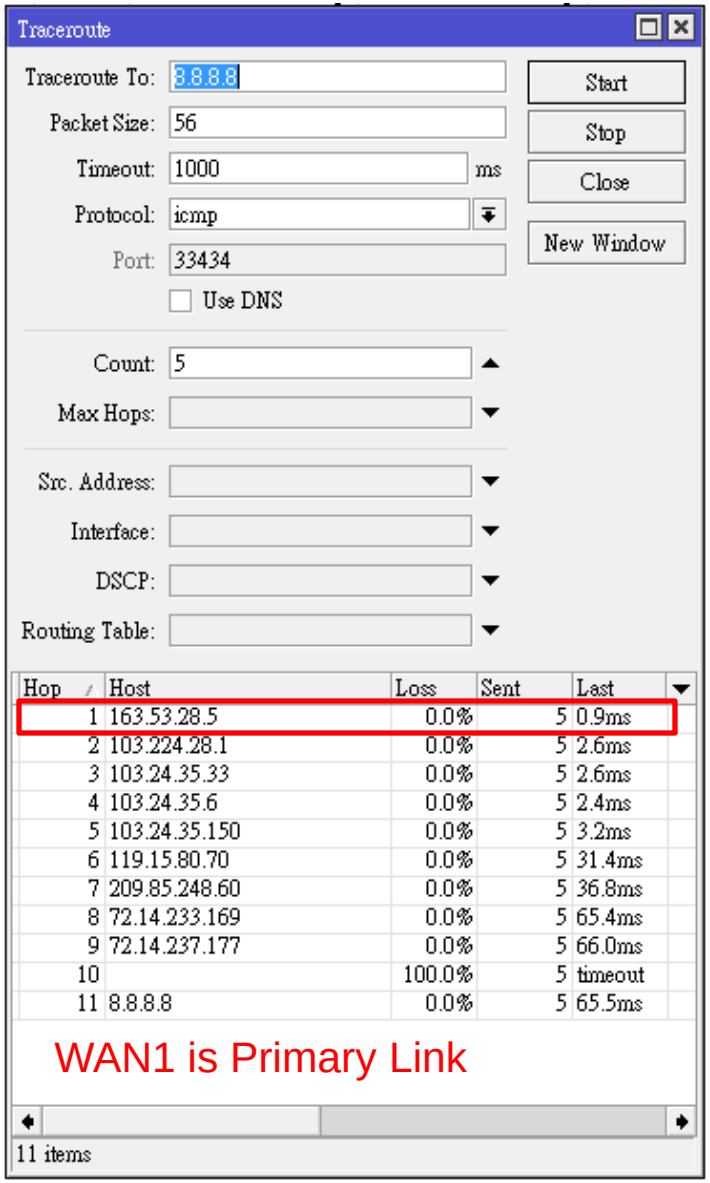




Test Connectivity

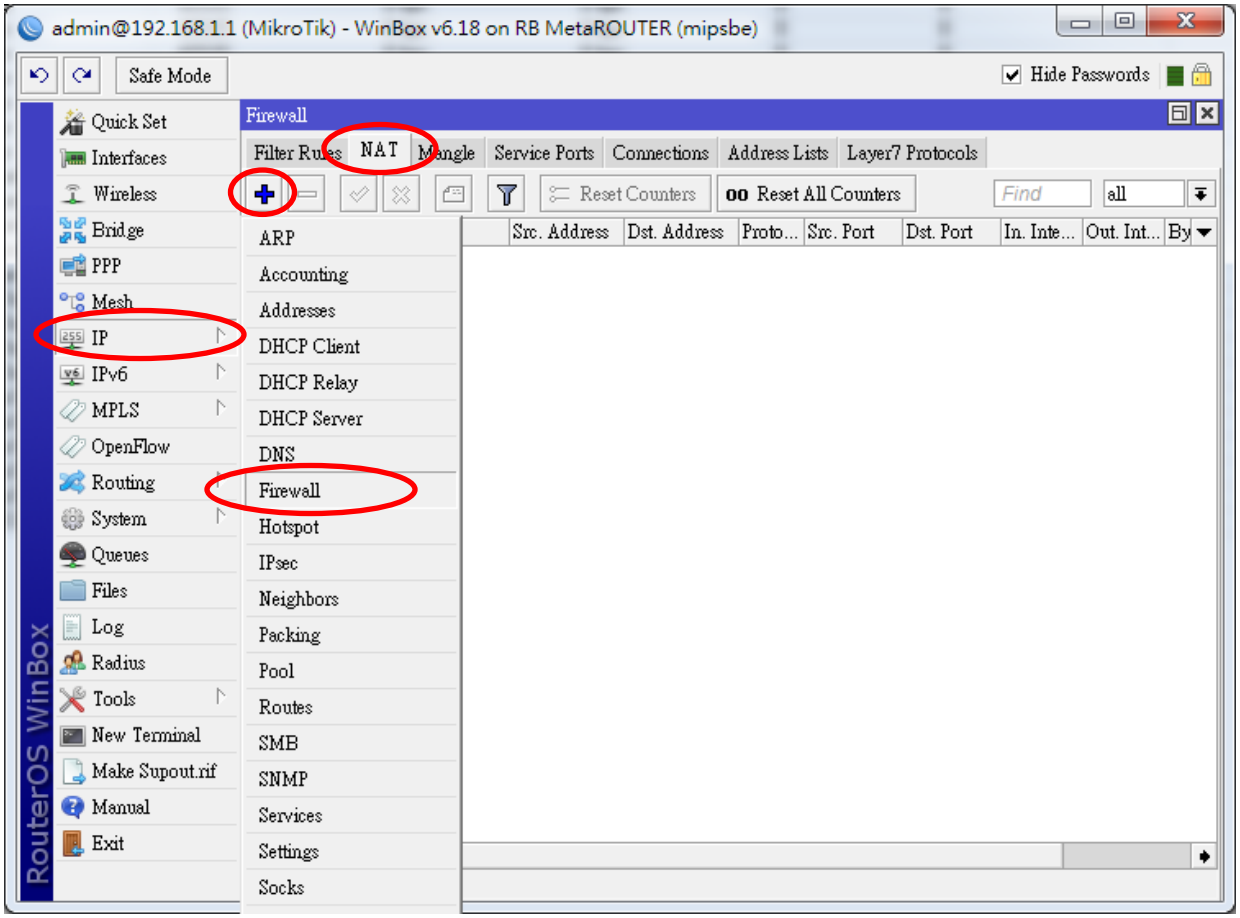
- Ping to your WAN Gateways
  - WAN1: **163.53.28.5**
  - WAN2: **163.53.29.5**
- Traceroute to Google DNS (**8.8.8.8**)





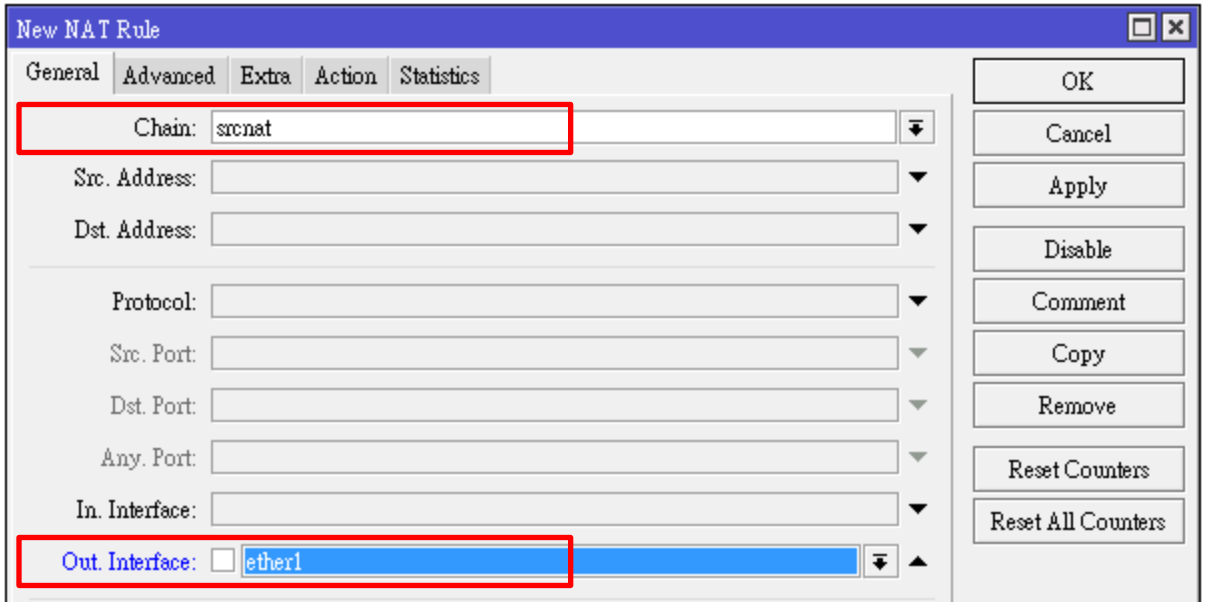
Configure NAT

- In order to allow clients in LAN to access internet, we need to configure NAT:
  - Go to menu **[IP]** -> **[Firewall]**, select tab **[NAT]**, press **[+]**



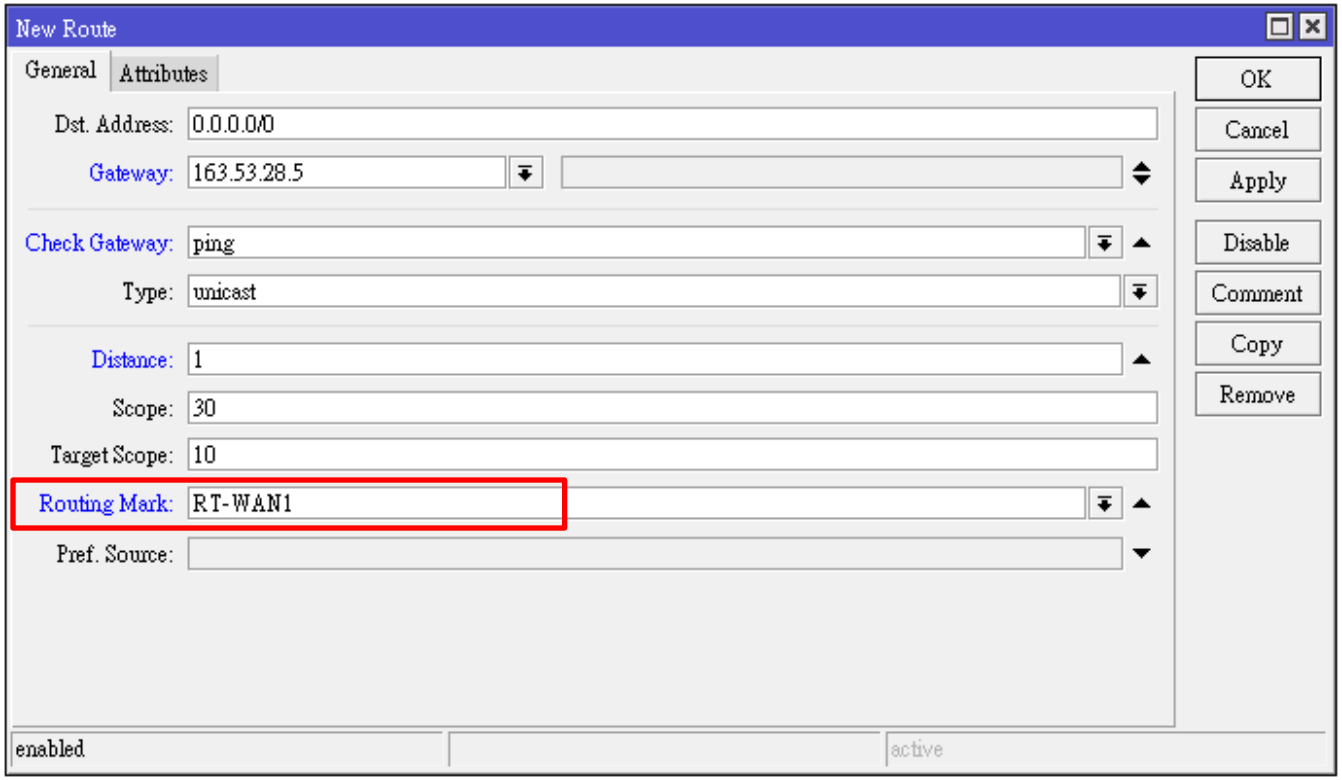
Configure NAT (Cont.)

- Select **srcnat** in **[Chain]**, **[Out Interface]** is WAN1 interface (**ether1**)
- Go to tab **[Action],** select **masquerade** in **[Action]**, press **[OK]**
- Repeat above steps again to create another NAT rule for WAN2, select **PPPOE-OUT-MAXBIT** as **[Out Interface]**



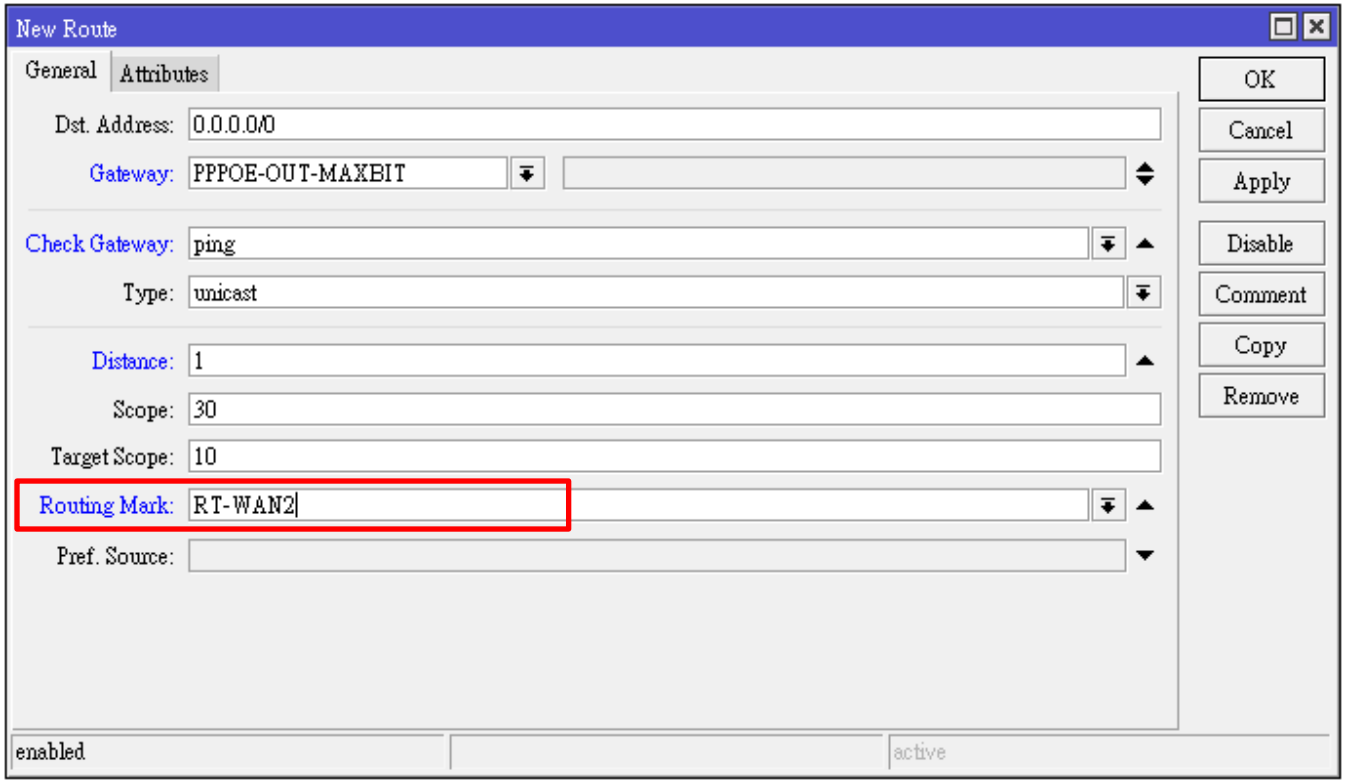
Create Routing Table for WAN1

- To configure PBR in MikroTik, we need additional routing table (called VRF in Cisco) for each WAN:
  - Go to menu **[IP]** -> **[Route]**, press **[+]**
  - Parameters are the same, except we need to specify the routing table name in **[Routing Mark]**, we use **RT-WAN1** for WAN1's routing table



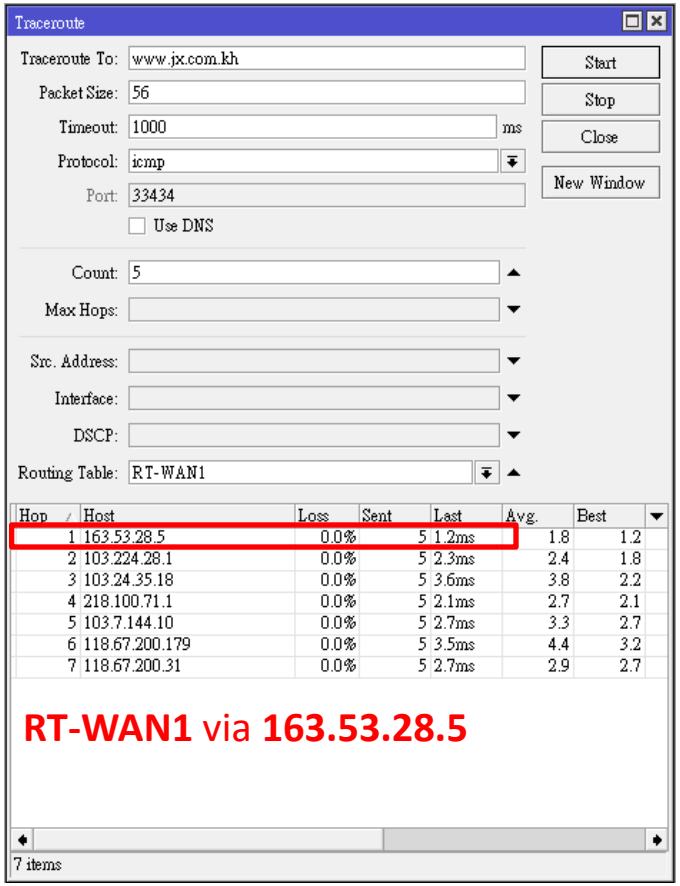
Create Routing Table for WAN2

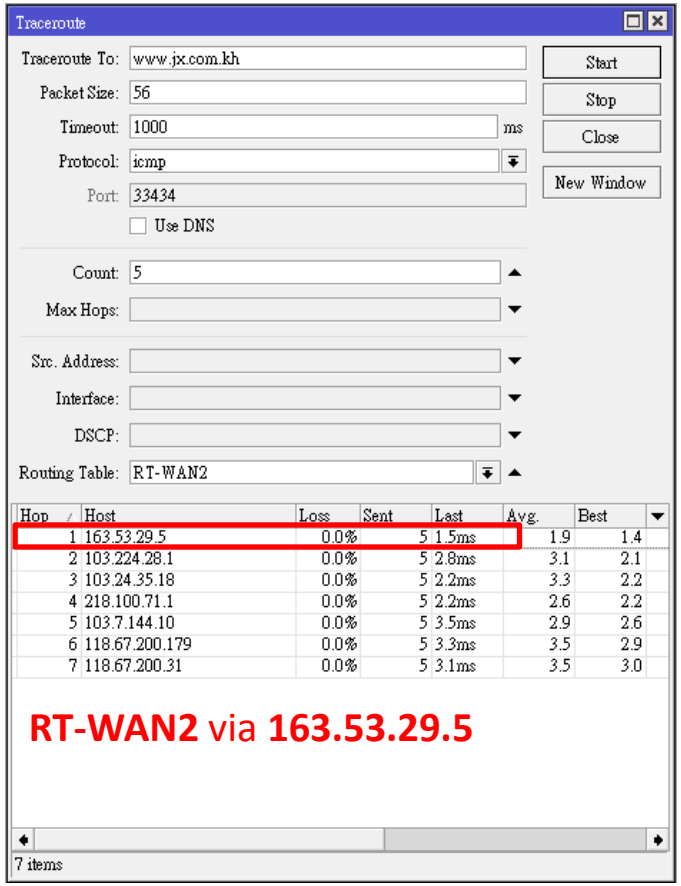
- WAN2 Routing Table creation
  - Go to menu **[IP]** -> **[Route]**, press **[+]**
  - Parameters are identical to WAN1's, but **[Gateway]** is your PPPoE Client interface **PPPOE-OUT-MAXBIT**
  - We use **RT-WAN2** as WAN2's routing table name



Test Routing Table Connectivity

- Do a traceroute to any website (i.e.: www.jx.com.kh)
- Select **[Routing Table]** to test (**RT-WAN1**, or **RT-WAN2**)
- Check whether traffic are going through the correct gateway as expected





Check Point

- **Let's summarize what we have done so far:**
  - Configured WAN1, which uses Static IP
  - Configured LAN (No DHCP)
  - Pointed default route to WAN1, set WAN1 as primary link, check gateway reachability by PING, if WAN1 fails, fallback to WAN2
  - Configured WAN2, which uses PPPoE
  - Configured default route of WAN2 as secondary link
  - Configured NAT rules for both WANs
  - Created routing table for each WAN:
    1. RT-WAN1, default to WAN1, if fails then fallback to main routing table
    2. RT-WAN2, default to WAN2, if fails then fallback to main routing table

- **Next, we have to decide…**
  - **Which users we wanna put them into which link?**
  - **Which services we wanna put into which link?**

Define Policy

- **Let's say we wanna apply following policy to the network**
  - Users with IP from 192.168.1.2 to 192.168.1.127, use WAN1
  - Users with IP from 192.168.1.128 to 192.168.1.254 use WAN2

  - Destinations to Google use WAN1
  - Destinations to Facebook use WAN2
  - Destinations in DIX use WAN1

  - The router itself (192.168.1.1) will not be affected by any policy

Note:

DIX = Domestic Internet eXchange, usually includes all IP prefixes belong to local ISPs.

Policy Configuration Logic

- **Our policy can be translated to following configuration:**

  Packets with…

1. Destination IP **192.168.1.0/24**, look up **main** routing table

2. Destination IP in **GOOGLE** address list, look up **RT-WAN1**
3. Destination IP in **FACEBOOK** address list, look up **RT-WAN2**
4. Destination IP in **DIX** address list, look up **RT-WAN1**

5. Source IP **192.168.1.1**, look up **main** routing table
6. Source IP **192.168.1.0/25**, look up **RT-WAN1**
7. Source IP **192.168.1.128/25**, look up **RT-WAN2**

Note:

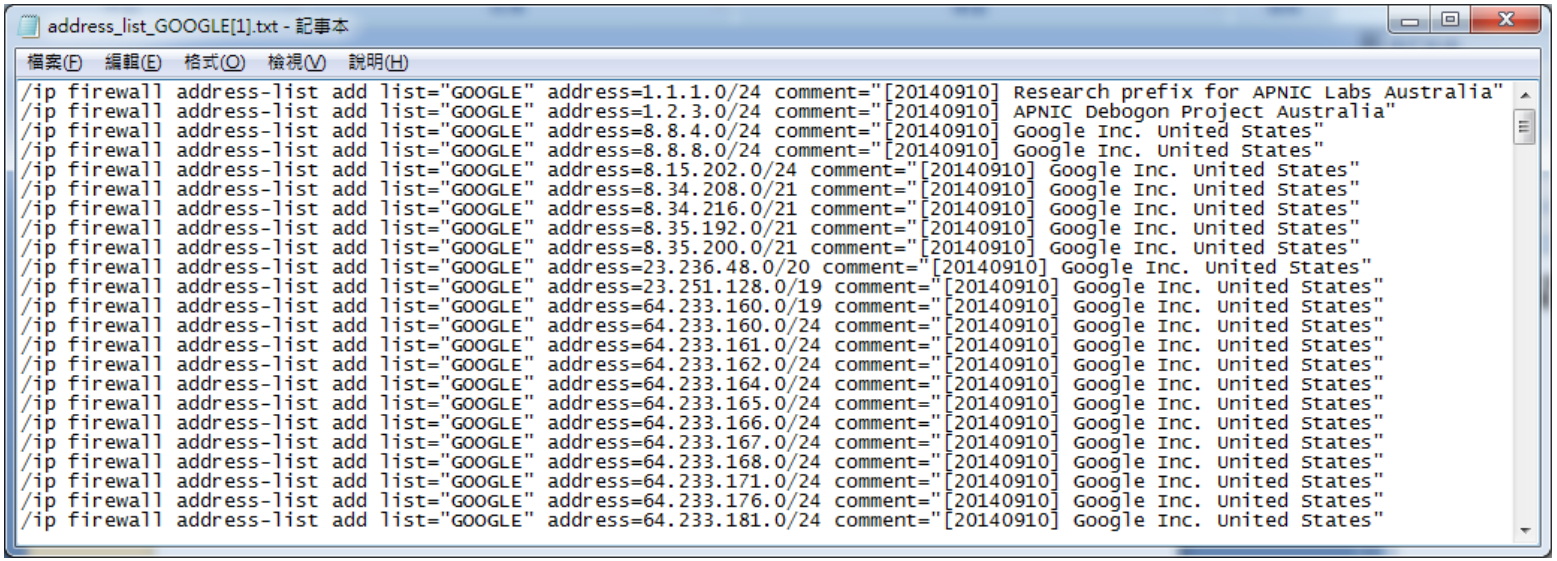
(1) Order of the rules is important, the router will process from top to bottom

(2) Address list in MikroTik is similar to access list in Cisco

(3) Address list scripts can be downloaded in **i-BEAM** Facebook Group: https://www.facebook.com/groups/1481854632142914/

Create Address Lists

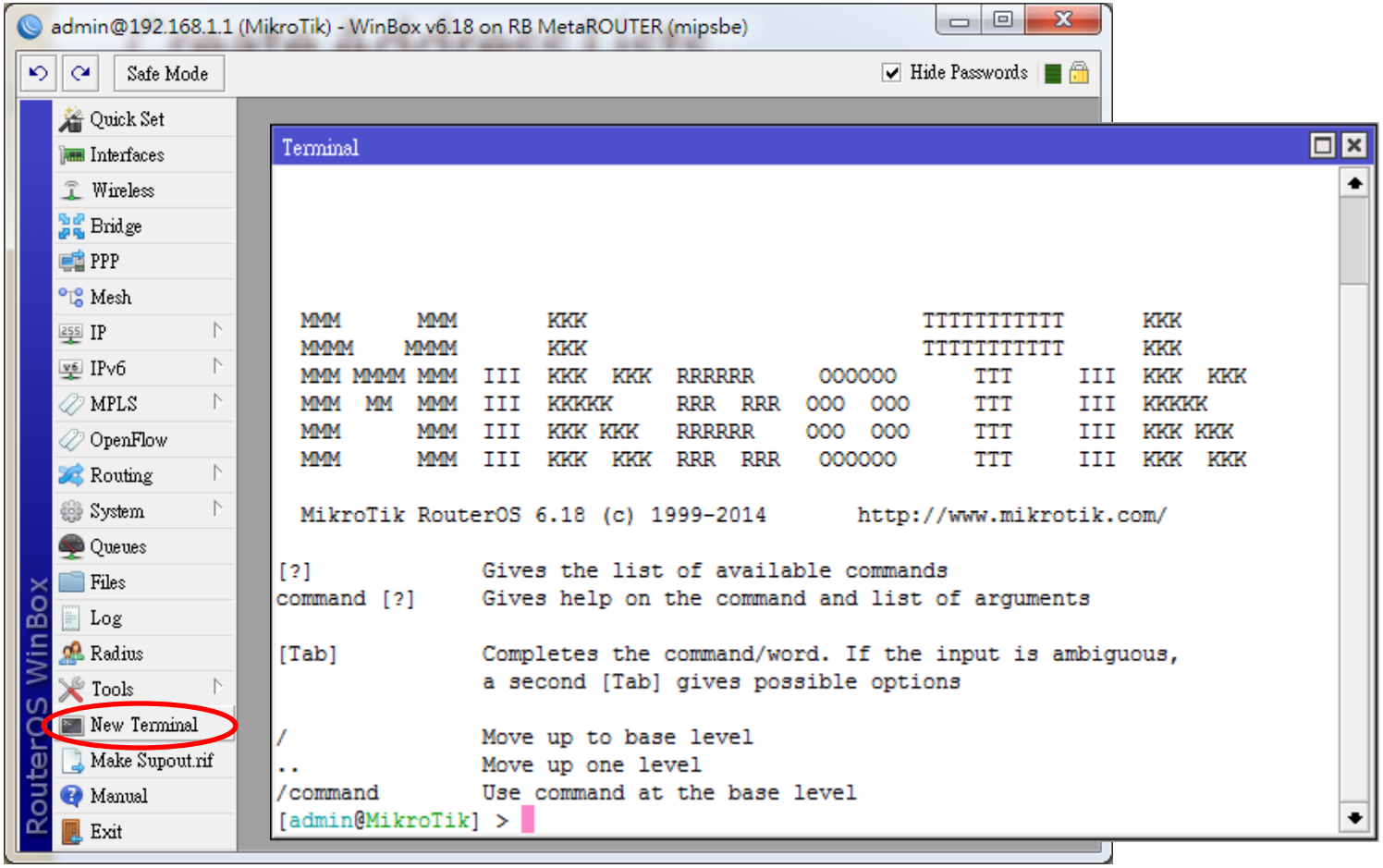
- Download address lists from **i-BEAM** Facebook Group
- Open the address list text file



- The file includes all commands to create GOOGLE address list in your MikroTik router
- Just simply select all and copy

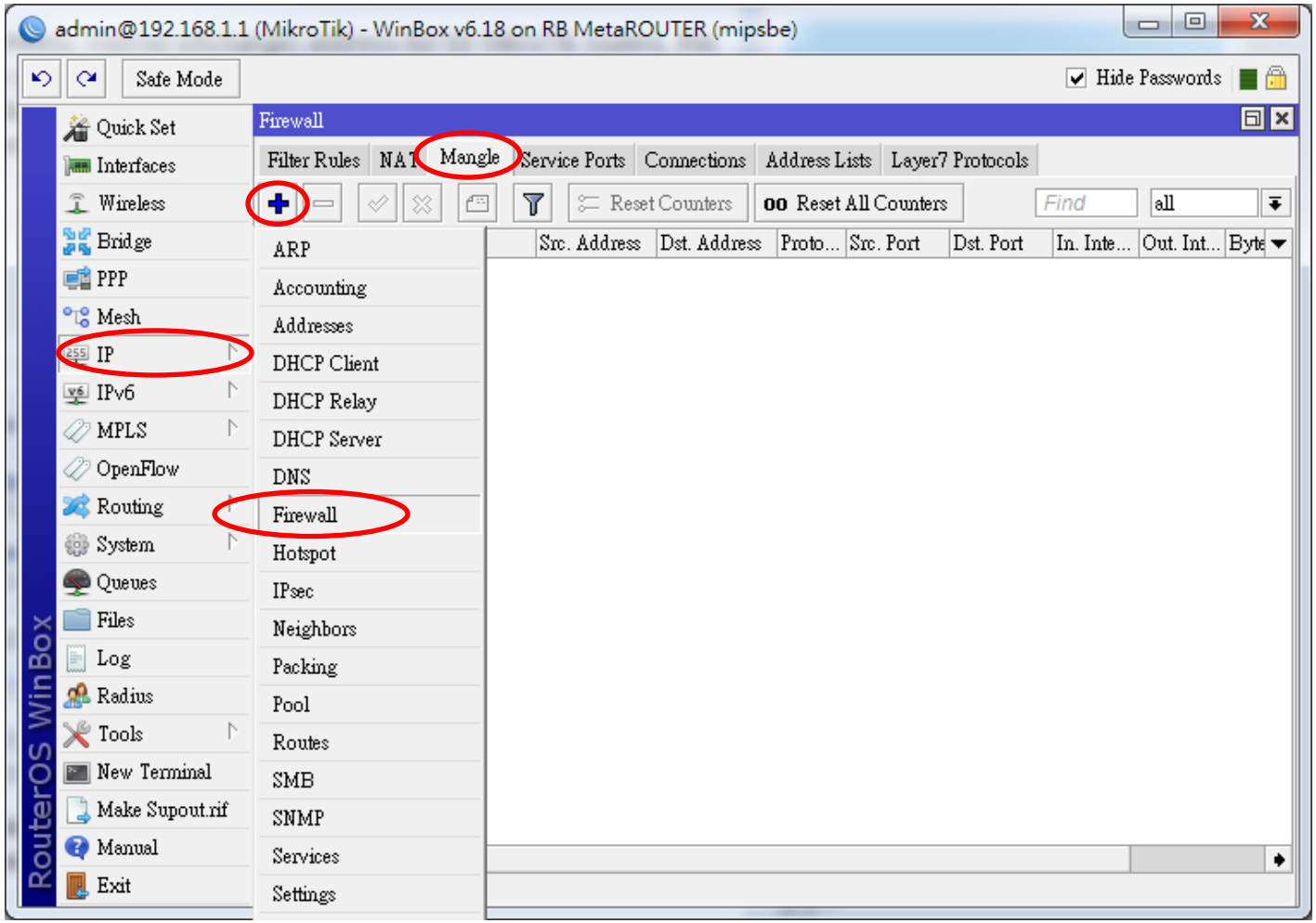
Create Address Lists (Cont.)

- Then go to Winbox menu **[New Terminal]**
- Right click on the new **[Terminal]** window, select **[Paste]**
- Repeat these steps for each address list



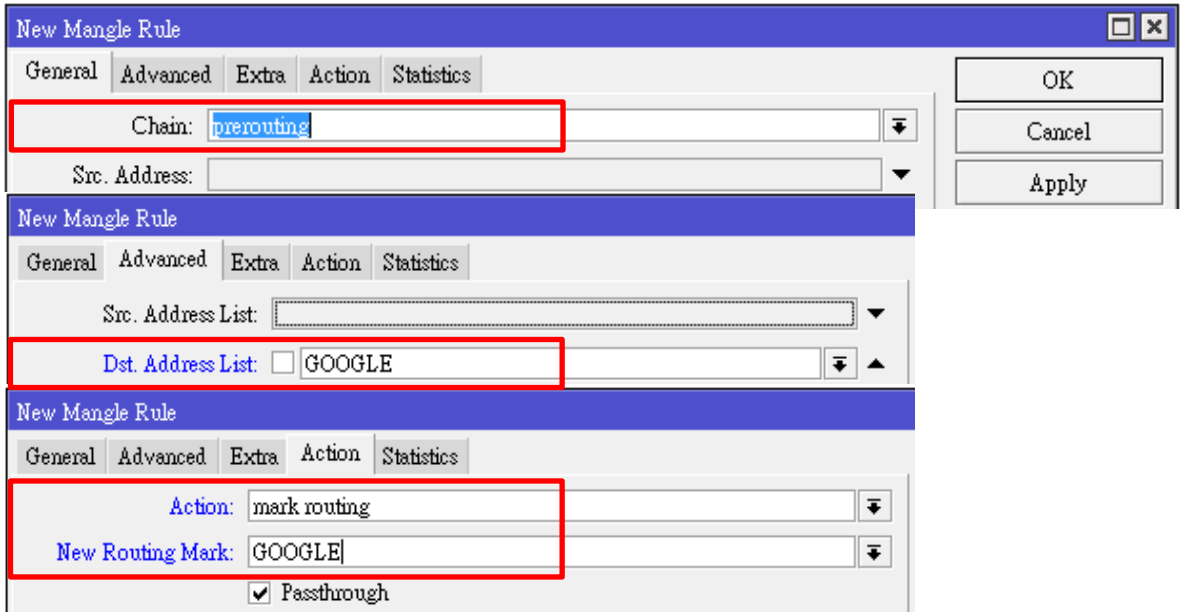
Mark Traffic

- Now we have address lists, we can start to mark traffic:
  - Go to menu **[IP]** -> **[Firewall]**, select tab **[Mangle]**, press **[+]**



Mark Traffic (Cont.)

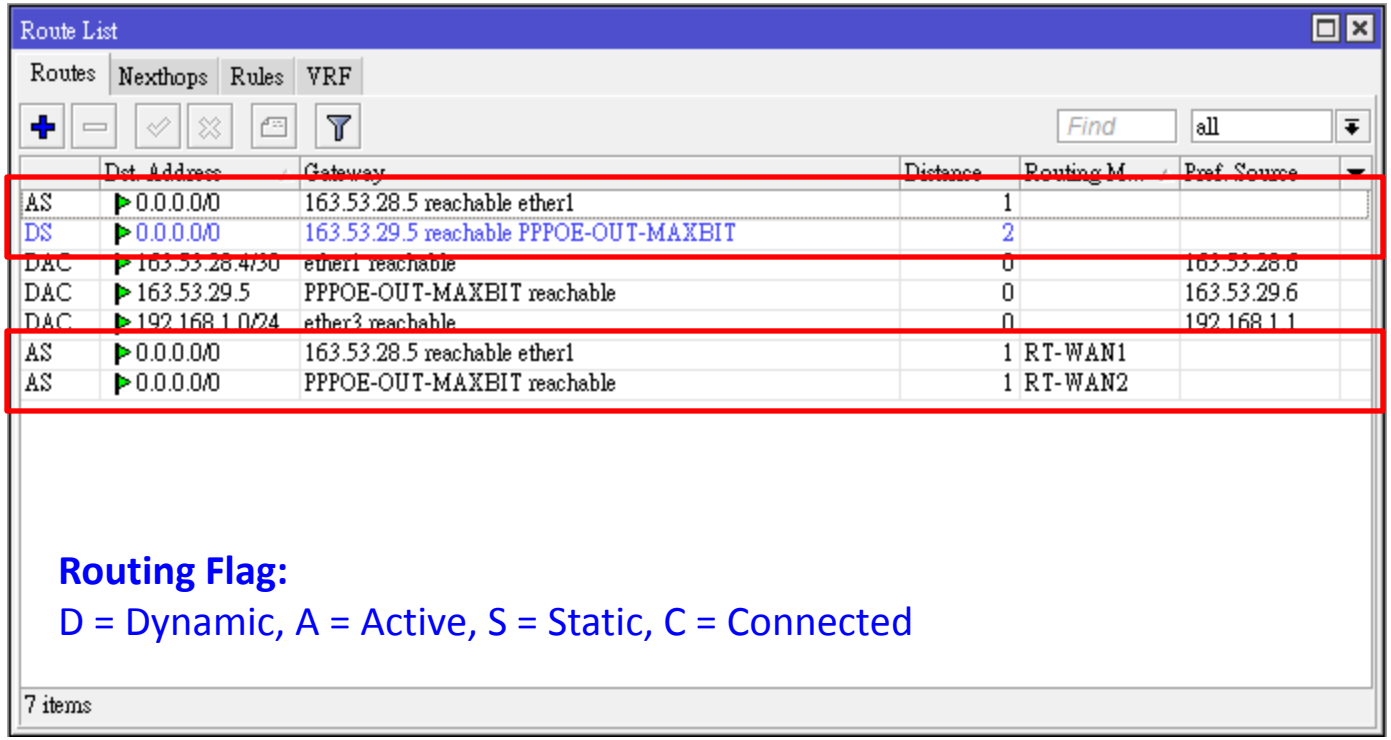
- Select **prerouting** in **[Chain]**
- Go to tab **[Advanced]**, select **GOOGLE** in **[Dst. Address List]**
- Go to tab **[Action]**, select mart routing in **[Action]**, fill in a name in field **[New Routing Mark]**, in this example, we will use routing mark exact same as address list name, which is **GOOGLE**, then press **[OK]**
- Repeat these steps for each address list



Note: All variable names in MikroTik are case-sensitive!

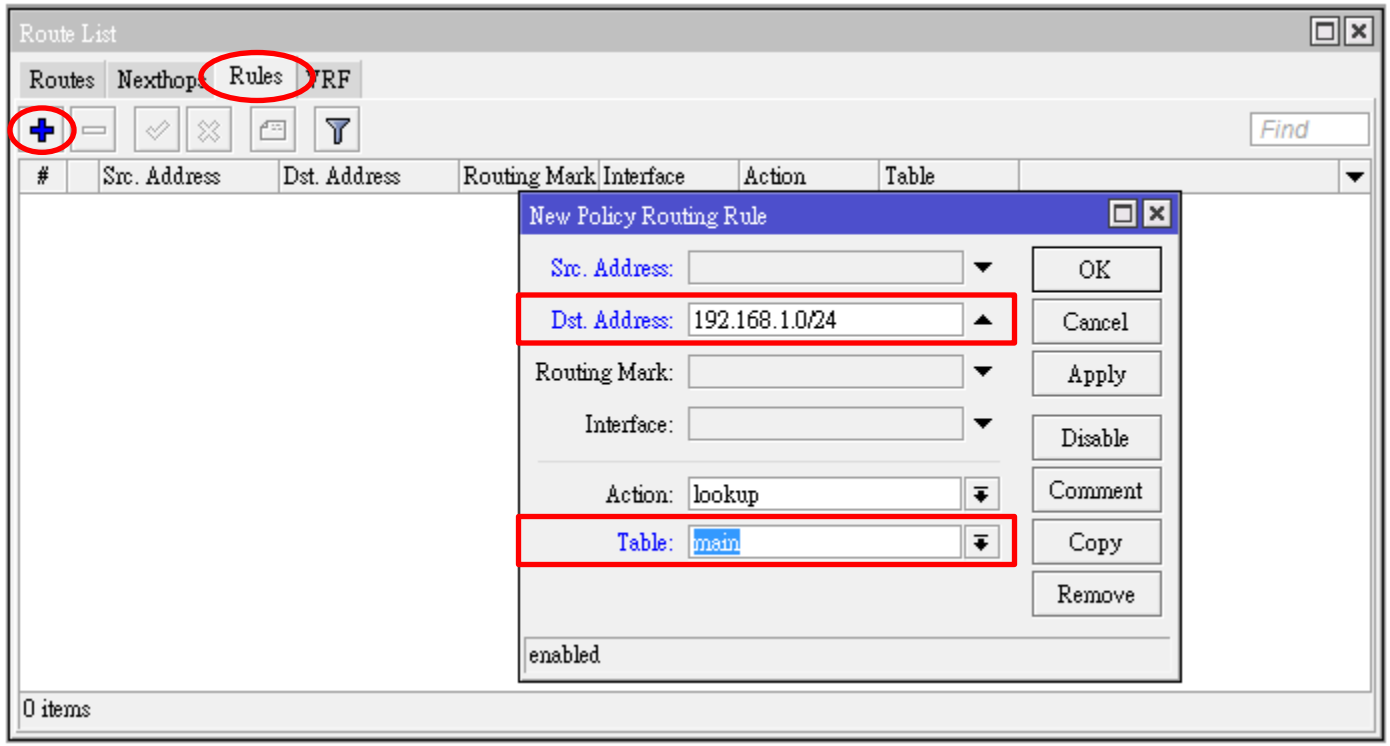
Create Route Rules

- Before you start, make sure you routing table has routes as below:
  - Default route via **168.53.28.5** in **main** routing table, state **Active**
  - Default route via **168.53.29.5** in **main** routing table, state **Inactive**
  - Default route via **163.53.28.5** in **RT-WAN1** routing table, state **Active**
  - Default route via **168.53.29.5** in **RT-WAN2** routing table, state **Active**



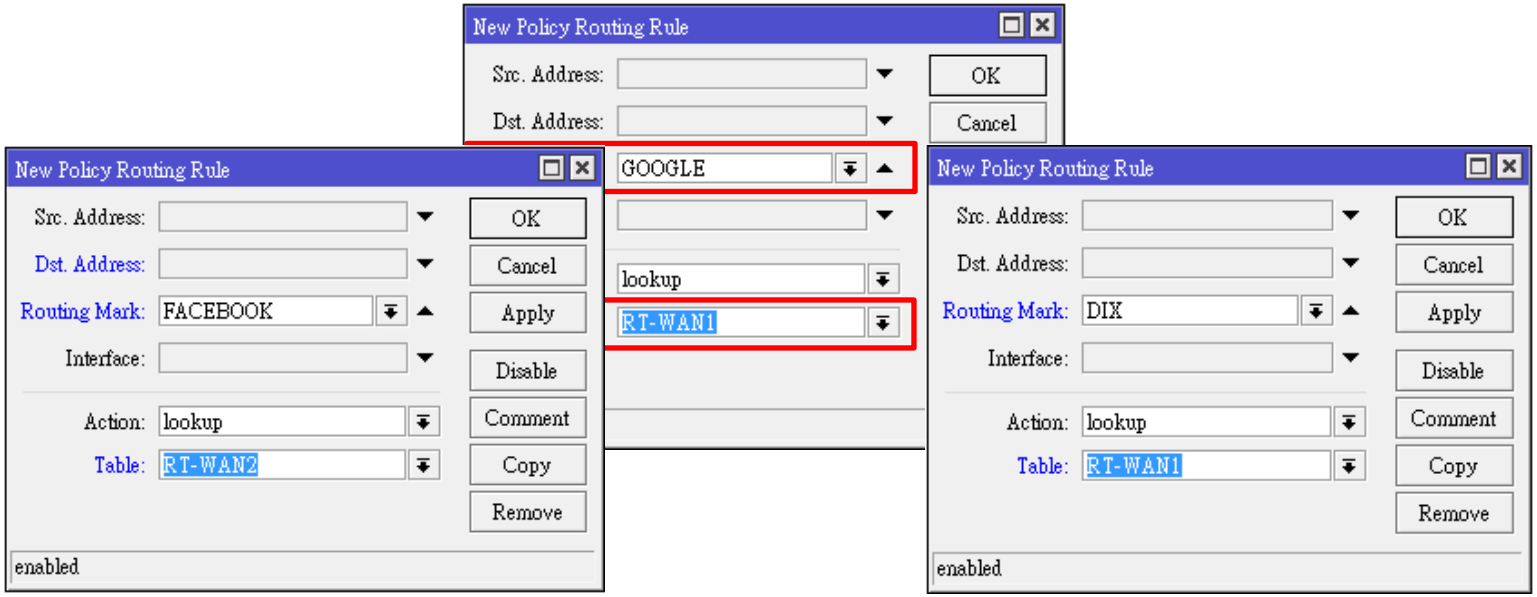
Create Route Rules (Cont.)

- Configure rules according to configuration logic in previous slides
  - **Rule 1:** Destination IP **192.168.1.0/24**, look up **main** routing table
  - Go to tab **[Rules]**, press **[+]**
  - Fill in **192.168.1.0/24** in **[Dst. Address]**
  - Select **main** in **[Table]**, then press **[OK]**



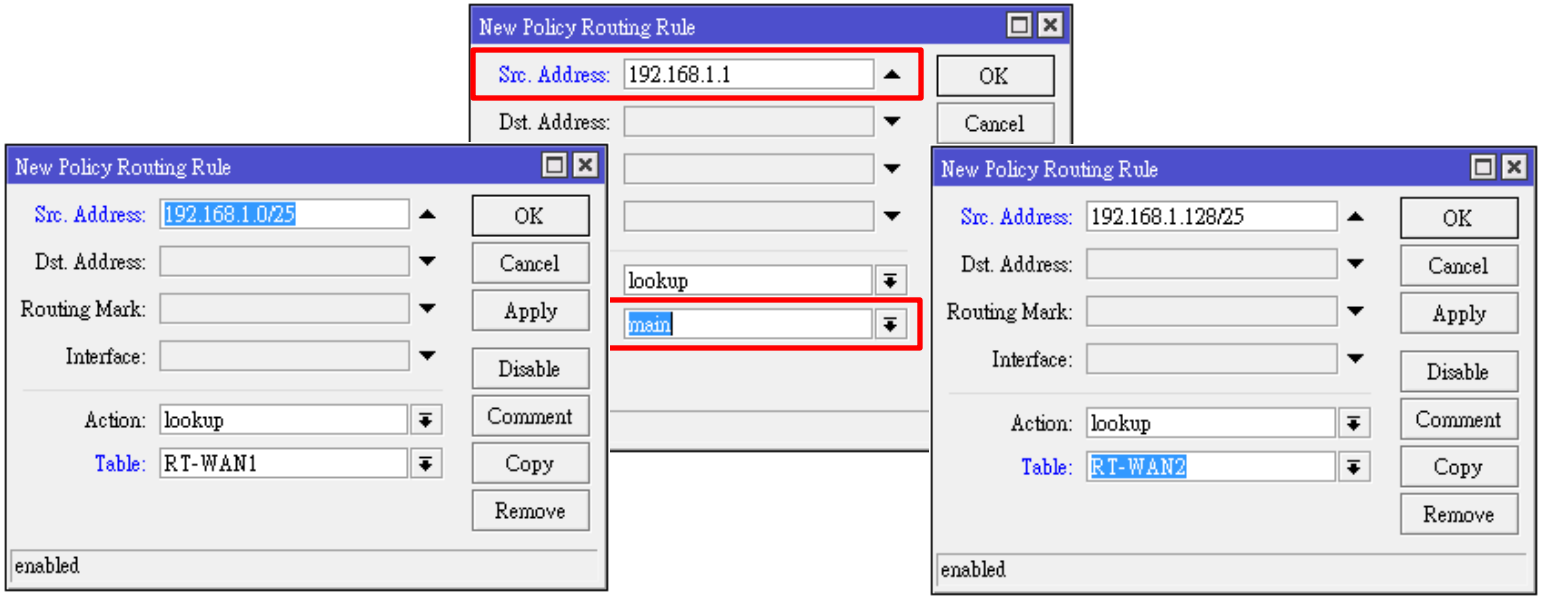
Create Route Rules (Cont.)

- Configure rules according to configuration logic in previous slides
  - **Rule 2:** Destination IP in **GOOGLE** address list, look up **RT-WAN1**
  - press **[+]** to add new rule
  - Select **GOOGLE** in **[Routing Mark]**
  - Select **RT-WAN1** in **[Table]**, then press **[OK]**
  - Configure **Rule 3** and **Rule 4** with the same way, just select the appropriate **[Routing Mark]** and **[Table]** according to our policy



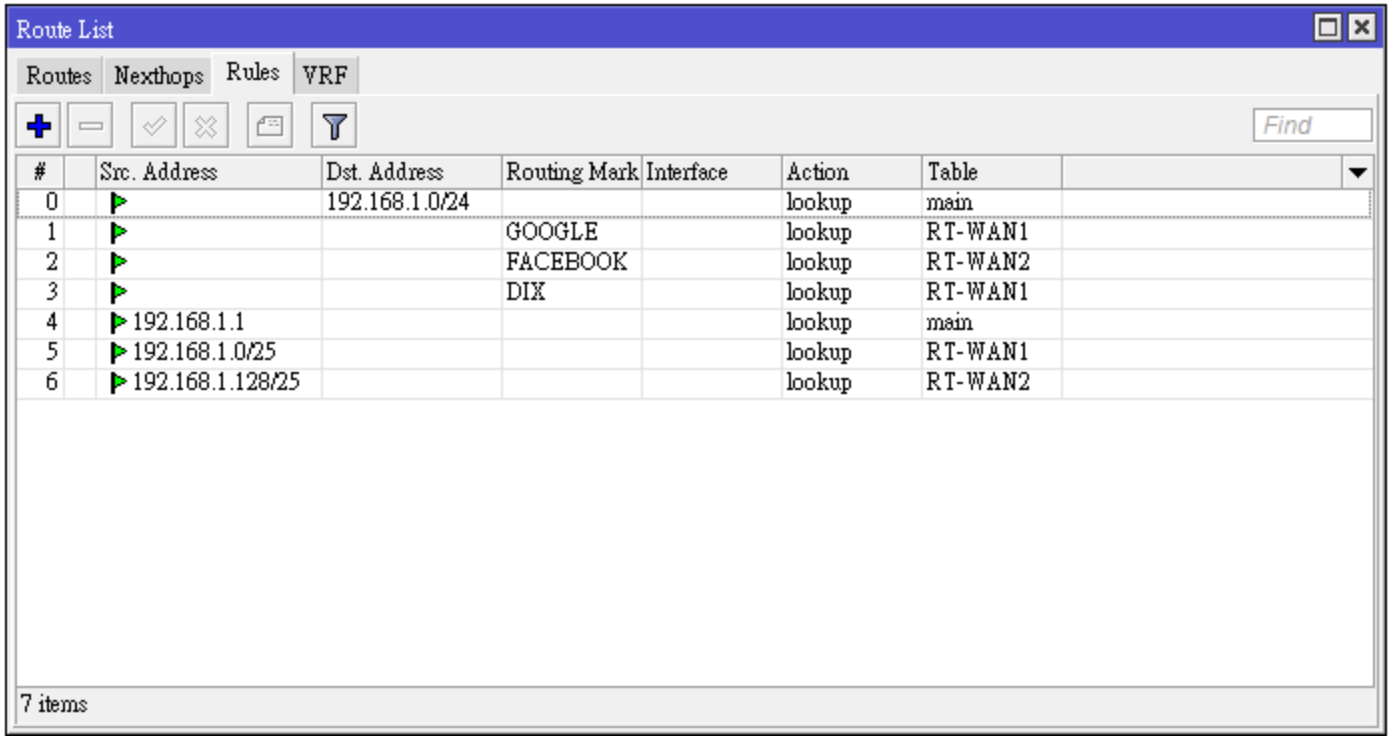
Create Route Rules (Cont.)

- Configure rules according to configuration logic in previous slides
  - **Rule 5:** Source IP **192.168.1.1**, look up **main** routing table
  - press **[+]** to add new rule
  - Fill in **192.168.1.1** in **[Src. Address]**
  - Select **main** in **[Table]**, then press **[OK]**
  - Configure **Rule 6** and **Rule 7** with the same way, just fill in the appropriate **[Src. Address]** and select **[Table]** according to our policy



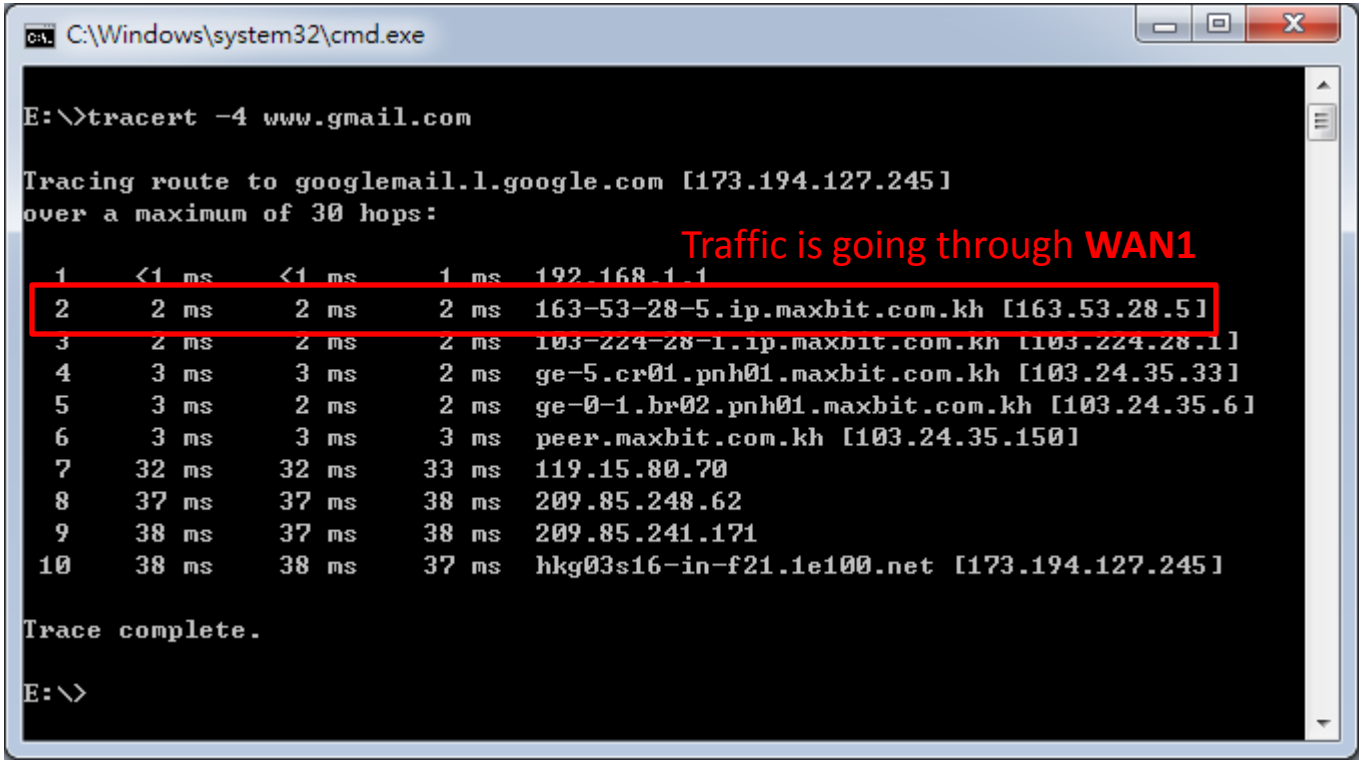
Create Route Rules (Cont.)

- Let's verify all rules that we have created, make sure you see 7 routing rules totally the same as output below:



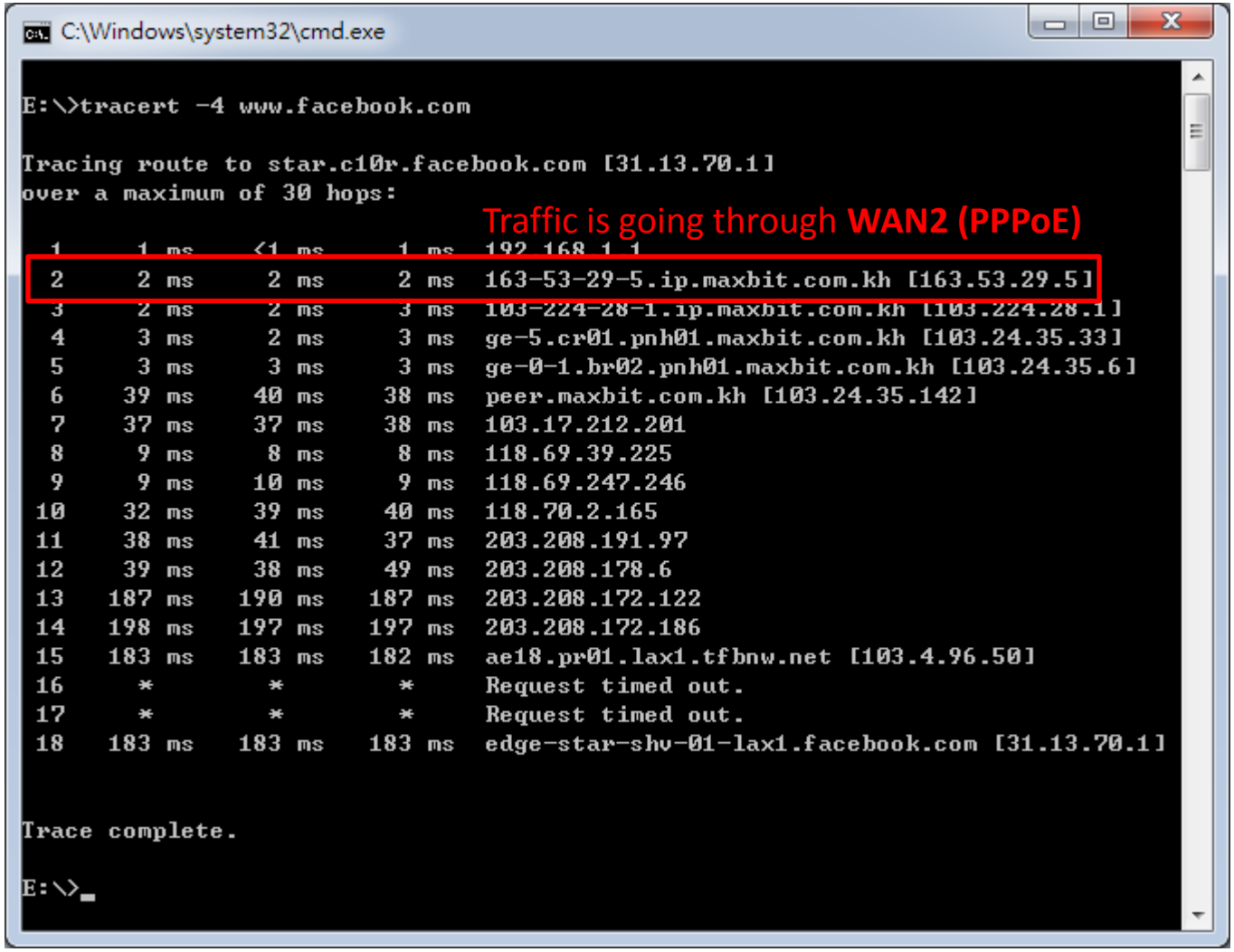
End Host Connectivity Test

- Traceroute from user **192.168.1.100** to **GMail**



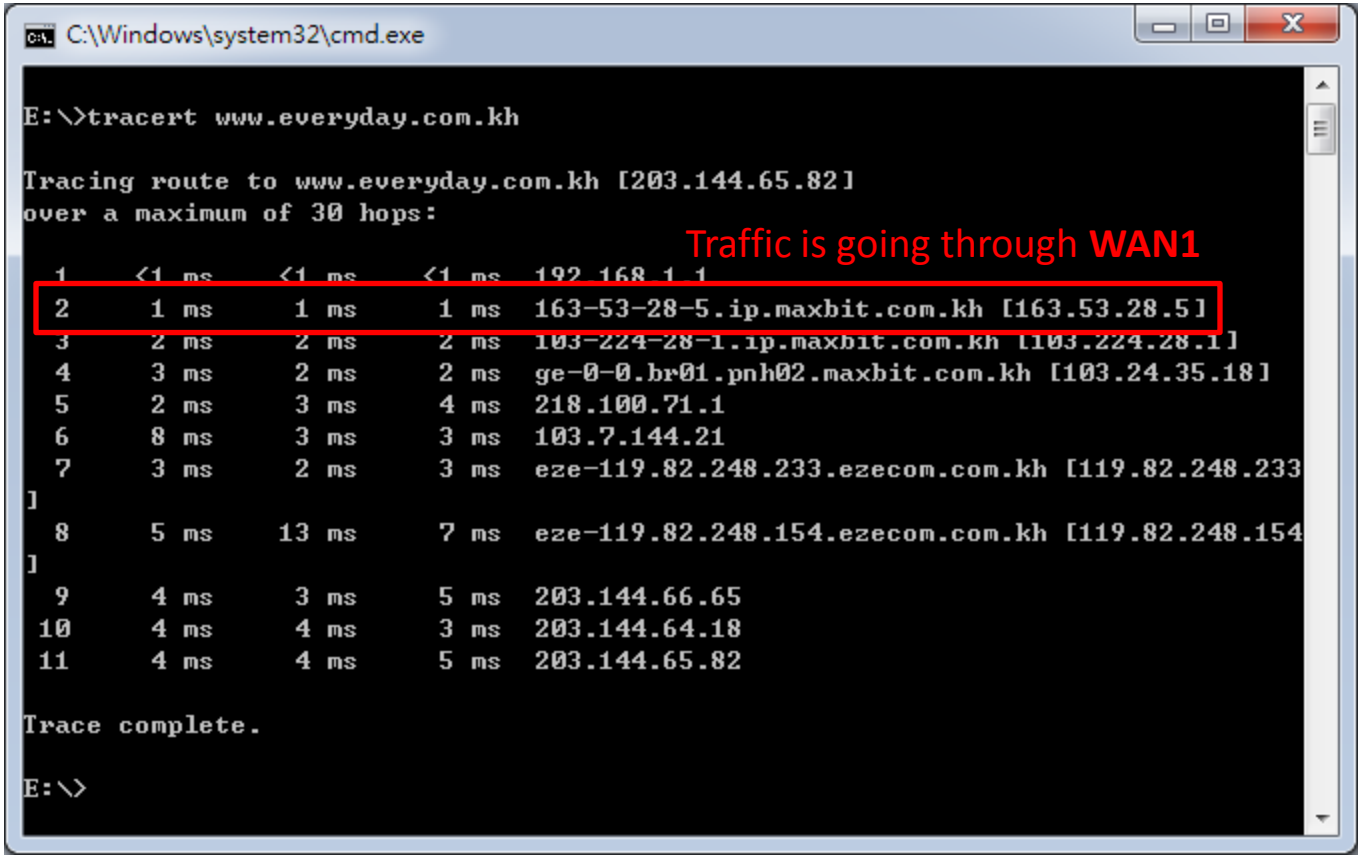
End Host Connectivity Test (Cont.)

- Traceroute from user **192.168.1.100** to **Facebook**



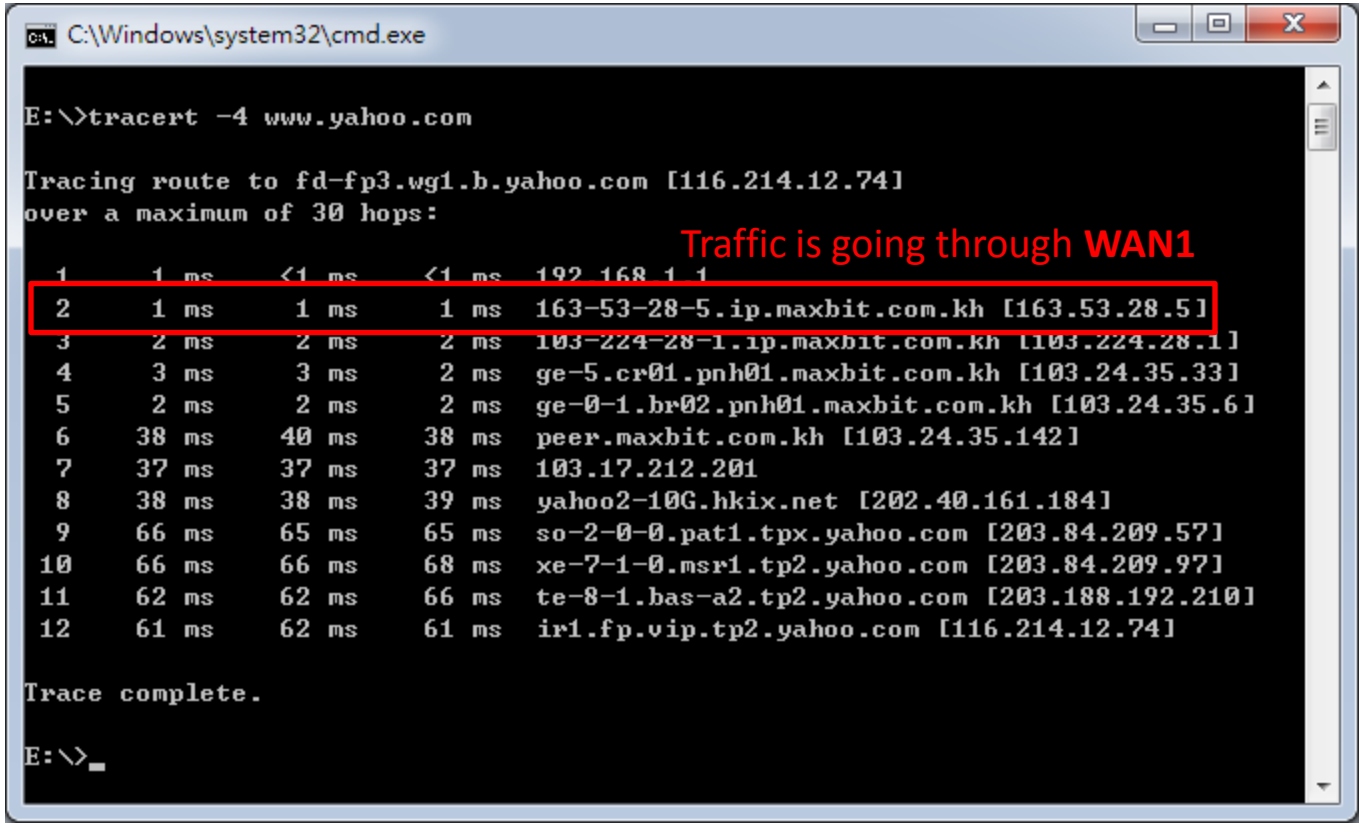
End Host Connectivity Test (Cont.)

- Traceroute from user **192.168.1.100** to www.everyday.com.kh



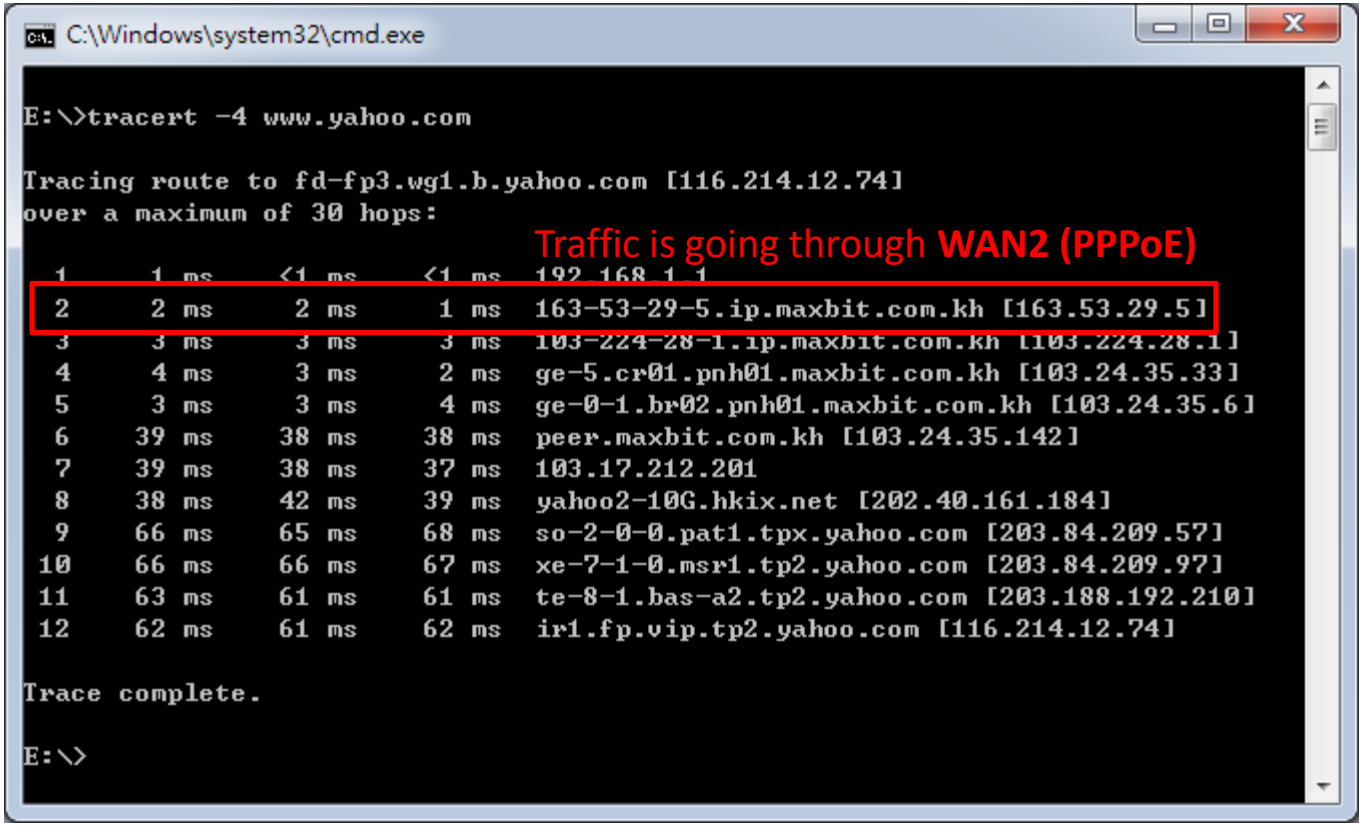
End Host Connectivity Test (Cont.)

- Traceroute from user **192.168.1.100** to **Yahoo**



End Host Connectivity Test (Cont.)

- Traceroute from user **192.168.1.200** to **Yahoo**



Questions and Answers

Thank you for your attention!

i-BEAM
steering ahead