Overview of BGP v7

MIKroTIK

About me

- **Guilherme Ramires**

- MikroTik Official Trainer Partner - Riga, Latvia (2010)

- MikroTik Official Consultant (2009)

- MikroTik Academy Coordinator (2013)

- MikroTik Certifications:
  - MTCNA, MTCWE, MTCRE, MTCTCE, MTCSE, MTCINE, MTCUME, MTCEWE and MTCIPv6E

Agenda

- What has changed from v6 to v7?

- How to upgrade from v6

- New v7 resources

- Setup from scratch

- Trobleshooting

- Overview about new filters

What has changed from v6 to v7?

What has changed from v6 to v7?

- A complete redesigned routing engine;
- This includes a new BGP setup compared to ROSv6;
  - For example: There is no more **instance** or **peer** configuration menus;
- Instead, we have **connection**, **template** and **session** menus;
- New routing filter rules syntax;
- So, the most important thing to remember is:

"The whole winbox and CLI scripts/backups will be COMPLETLY different"

Performance diferences beteween v6 and v7

- On version 6 we have a multi task/core routing process which is able to manage different routing protocol tasks like:
  - OSPF instances
  - BGP peer feed
  - RIP neighbor sync
  - Etc..
- But the real problem is about "routing update messages";
- Routing update messages are managed by one task/core only. That's why we sometimes face problems to manage filters rules or simply get a routing table print;

Performance diferences beteween v6 and v7

- On version 7 there is one "main" task, which can start/stop sub-tasks and process data between those sub-tasks;

- Each sub-task can allocate "private" (only accessible by this particular task) and "shared" memory (accessible by all route tasks);

- Each sub-task can be managed by a different thread;

- This way BGP can have up to 100 unique processes;

Real case running BGP on ROSv7

Real case running BGP on ROSv7

- Here we can see a real scenario running 23 active bgp sessions and around 4Gbps of aggregate traffic in a CCR2116:

```
[guilherme_ramires@BGP_LINKUP] > interface/monitor-traffic aggregate
            rx-packets-per-second:  578 225
               rx-bits-per-second:  4.3Gbps
         fp-rx-packets-per-second:  578 067
            fp-rx-bits-per-second:  4.3Gbps
              rx-drops-per-second:        0
             rx-errors-per-second:        0
            tx-packets-per-second:  574 953
               tx-bits-per-second:  4.3Gbps
         fp-tx-packets-per-second:  578 067
            fp-tx-bits-per-second:  4.3Gbps
              tx-drops-per-second:        0
        tx-queue-drops-per-second:        0
             tx-errors-per-second:        0
```

```
[guilherme_ramires@BGP_LINKUP] > system/resource/print
                      uptime: 2w2d8h51m40s
                     version: 7.12.1 (stable)
                  build-time: Nov/17/2023 11:38:45
            factory-software: 7.2
                 free-memory: 15.0GiB
                total-memory: 15.9GiB
                         cpu: ARM64
                   cpu-count: 16
                    cpu-load: 23%
              free-hdd-space: 103.7MiB
             total-hdd-space: 128.0MiB
      write-sect-since-reboot: 25964
             write-sect-total: 630943
                  bad-blocks: 0%
           architecture-name: arm64
                  board-name: CCR2116-12G-4S+
                    platform: MikroTik
```

```
[guilherme_ramires@BGP_LINKUP] > tool/profile duration=5
Columns: NAME, USAGE
NAME            USAGE
ethernet        2.9%
firewall        3%
networking      7.8%
e-mail          0%
winbox          0%
management      0%
routing         2.4%
internet-detect 0%
unclassified    3.2%
total           19.3%
```

```
[guilherme_ramires@BGP_LINKUP] > routing/bgp/session/print count-only
23
[guilherme_ramires@BGP_LINKUP] >
```

Real case running BGP on ROSv7

- And here we can see how the processes are managed:

Real case running BGP on ROSv7

- And here we can see how the processes are managed:

18 BGP Input 172.1	4608.0KiB	8.0MiB	0	0	0	703	bgp-remote-7	30335	5	49s710ms	35s600ms	6s370ms	550ms
BGP Output 172.												
19 BGP Input 172.1	4608.0KiB	8.0MiB	0	0	0	245	bgp-remote-8	451	1	31m270ms	28m11s890ms	470ms	480ms
BGP Output 172.												
20 BGP Input 2804:	2048.0KiB	3584.0KiB	0	0	0	853	bgp-remote-9	452	1	27m18s500ms	27m12s30ms	230ms	230ms
BGP Output 2804												
21 BGP Input 187.1	512.0KiB	512.0KiB	0	0	0	1	bgp-remote-10	7458	10	3m22s210ms	3m8s800ms	16h51m28s650ms	240ms
BGP Output 187.												
22 BGP Input 2001:	768.0KiB	768.0KiB	0	0	0	36	30	26190	10	22m9s650ms	23m3s60ms	16h54m27s760ms	230ms
BGP Output 2001												
23 BGP Input 187.1	512.0KiB	768.0KiB	0	0	0	30	bgp-remote-11	7463	12	3m24s220ms	3m6s30ms	16h38m59s950ms	230ms
BGP Output 187.												
24 BGP Input 2001:	768.0KiB	768.0KiB	0	0	0	35	bgp-remote-12	26193	3	21m57s770ms	22m50s510ms	16h56m23s800ms	240ms
BGP Output 2001												
25 BGP Input 187.1	512.0KiB	768.0KiB	0	0	0	31	bgp-remote-13	7441	9	3m21s710ms	3m5s30ms	16h57m17s590ms	230ms
BGP Output 187.												
26 BGP Input 187.1	512.0KiB	768.0KiB	0	0	0	30	bgp-remote-14	7444	16	3m22s220ms	3m5s50ms	16h59m11s140ms	230ms
BGP Output 187.												
27 BGP Input 187.1	512.0KiB	768.0KiB	0	0	0	28	bgp-remote-15	7445	4	3m25s420ms	3m560ms	17h1m10s30ms	240ms
BGP Output 187.												
28 BGP Input 2001:	512.0KiB	768.0KiB	0	0	0	6	bgp-remote-16	7446	3	3m21s510ms	3m1s900ms	17h2m24s320ms	230ms
BGP Output 2001												
29 BGP Input 2001:	1280.0KiB	4096.0KiB	0	0	0	750	bgp-remote-17	7473	8	3m39s640ms	3m6s120ms	17h2m54s980ms	230ms
BGP Output 2001												
30 BGP Input 2001:	1280.0KiB	4096.0KiB	0	0	0	505	bgp-remote-18	7474	4	3m37s580ms	3m7s430ms	17h4m2s990ms	240ms
BGP Output 2001												
31 BGP Input 2804:	2304.0KiB	3328.0KiB	0	0	0	1057	bgp-remote-19	30333	5	37s180ms	31s890ms	7s40ms	230ms
BGP Output 2804												
32 BGP Input 2001:	512.0KiB	768.0KiB	0	0	0	33	bgp-remote-20	26200	2	22m24s110ms	22m28s570ms	17h4m3s150ms	230ms
BGP Output 2001												
33 BGP Input 187.1	2048.0KiB	5.0MiB	0	0	0	1052	bgp-remote-21	7478	5	3m58s30ms	3m16s80ms	17h1m43s510ms	280ms
BGP Output 187.												
34 BGP Input 187.1	2048.0KiB	5.0MiB	0	0	0	150	bgp-remote-22	7484	5	4m4s700ms	3m18s920ms	17h4m1s80ms	230ms
BGP Output 187.												

Sensitive information

Performance diferences beteween v6 and v7

- By default, we have AFFINITY setting to manage all the input multi-core processes automatically;
- You can also make some changes on demand per connection peer:

  - **alone** - input and output of each session are processed in its own process, most likely the <u>best option</u> when there are a <u>lot of cores</u> and a <u>lot of peers</u>

  - **main** - run input or output in the main process (could potentially <u>increase performance</u> on <u>single-core</u> even possibly on multi-core devices with a small amount of cores)
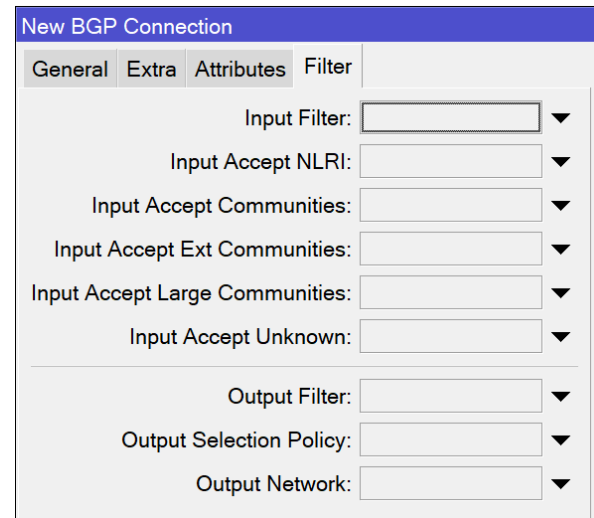
Performance diferences beteween v6 and v7

- By default, on ROSv6 we have all routing updates processes/messages activated by default;

- This may cost some performance from routers CPU;

- Since ROSv7 we can enable these options at filters tab on demand;

How to upgrade from v6 to v7?

How to upgrade from v6 to v7?

- You have basicly 2 ways to do it:
  - 1st: Directly from any **ROS v6.48.6+**
  - 2nd: Moving it manually according to the previous bgp data

- If you decide to make it directly from a ROSv6 then you gonna get all BGP and filters configuration migrated automatcly;
  - Always double check if all peers and filters are there and working fine

- If you decide to make it manually, make sure you have the propely skills to complete the task;

How to downgrade back to v6

- If you decide/need to downgrade back to ROSv6, make sure you are at least on ROSv7.3+. Otherwise you may face some problems;

- And of course, always make sure you have a v6 backup before upgrade;

- **Have in mind that not all RouterBoards support ROSv6, so pay close attetion on its documentation before buy it;**

Specifications

Details

Product code	CRS354-48G-4S+2Q+RM
Architecture	MIPSBE
CPU	QCA9531
CPU core count	1
CPU nominal frequency	650 MHz
Switch chip model	98DX3257
Dimensions	297 x 443 x 44 mm
RouterOS license	5
Operating System	RouterOS v7 / SwitchOS

New ROSv7 resources
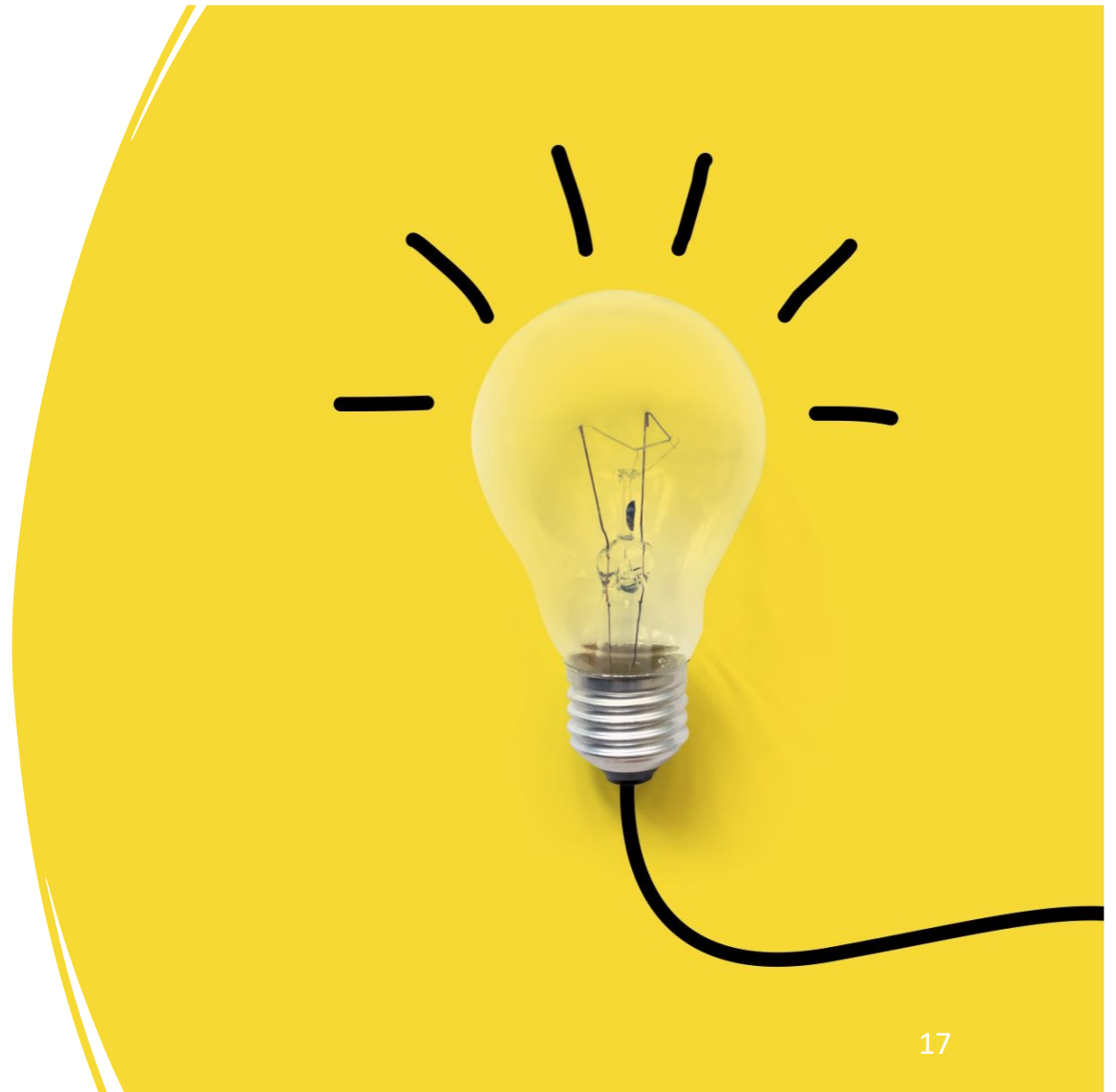
New v7 resources - **Templates**

- Allows you to create diferent base profiles. You can have for example:
  - Multi ASNs profiles;
  - eBGP default profile;
  - eBGP multihop profile;
  - eBGP/iBGP VPN profile;
  - eBGP IX profile;
  - IPv4/IPv6 profiles;
  - etc..

BGP Template <ebgp-multihop>

General | Extra | Attributes | Filter

Name: ebgp-multihop

AS: 100

AFI: ☑ ip ☐ ipv6 ☐ l2vpn ☐ vpnv4 ☐ l2vpn cisco

Router ID: 10.10.10.10

Multihop: ☑

Templates:

New v7 resources - **Dynamic Peers:**

- Allows you to establish peer connections just based on remote address/network;

- Allows you to recover disaster scenarios quickly;

- Allows you to establish a fast connection on demand;

- Allows you to create a huge study scenario easily;

Not mandatory

New v7 resources – **FlowSpec**

(partially working till 7.12)

- FlowSpec is a feature that provides a way to perform traffic filtering and rate-limiting based on specific flow characteristics, such as source and destination IPv4 and IPv6 addresses, IP protocol, source and destination ports, and more;

- Flowspec allows network operators to distribute traffic filtering and rate-limiting rules across their network using BGP, which can help mitigate the impact of DDoS attacks and other unwanted traffic patterns.

- Currently ROSv7 only supports flowspec forward function

New v7 resources - **Performance**
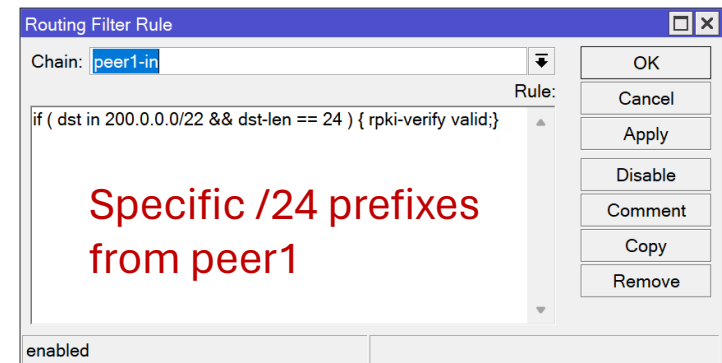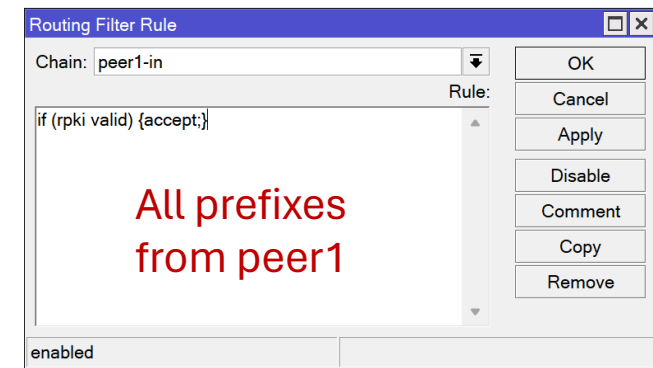
- Lot of perfomance improvements has been done to V7;

- Faster feed and way less memory usage. Around 100MB each 560k routes

- Few examples of CCR2004 performance:

1 peer and 560k routes		
Router	V6	V7
CCR2004	00:32	00:18

2 peers and 560k routes each feed		
Router	V6	V7
CCR2004	00:51	00:29

New v7 resources - **RPKI support**

- Since version V7.1 RPKI(Resource Public Key Infrastructure) is available;

- RTR is a very lightweight low memory footprint protocol which is able to get **PREFIX** and **ASN** validation data from RPKI validators;

- RPKI allows you to be sure you are getting correct data from correct ASN

Routing Filter Rule

Chain: peer1-in

Rule:

if (rpki valid) {accept;}

OK
Cancel
Apply
Disable
Comment
Copy
Remove

enabled

All prefixes from peer1

Routing Filter Rule

Chain: peer1-in

Rule:

if (dst in 200.0.0.0/22 && dst-len == 24) { rpki-verify valid;}

OK
Cancel
Apply
Disable
Comment
Copy
Remove

enabled

Specific /24 prefixes from peer1

Setup from scratch

Setup from scratch

- First, setup your **template** parameters. Then add all peer **connections** needed. They will get default values filled automatically:

Setup from scratch

- A setup from scratch on ROSv7 is still quite simple to deploy;

- Since we've learned that it's possible to create different templates, I recommend you focus on this idea to get a better management;

- But it's still possible to setup a BGP peer connection with just one command line:

```
/routing bgp connection
add address-families=ip as=100 disabled=no local.address=172.16.0.1 .role=ebgp name=peer1 \
    remote.address=172.16.0.2/32 .as=200 router-id=10.10.10.10
```

Setup from scratch

- The main reason of this presentation is to provide an overview BGP on ROSv7 so, **<u>DO NOT</u>** take any previous example as default settings for your ISP;

- Always remember that you must make adjustments according to your own scenario and demands;

Troubleshooting

Trobleshooting

- A common error troubleshooting BGP is "to try" figure out by yourself what's the problem:
  - Did I typo remote ASN? My ASN? Any address?

- Maybe you did it or just misplaced instance/peer info;

- So... ALWAYS take a look at the LOG session;

- It will be the fastest way to get the correct feedback;

Trobleshooting

- You also need to remember that BGP peering is a 2 sides configuration setup which must match;

- This means that sometimes the error will be not on your log side;
  - For example, if you just typo your own ASN;

- If you get no error, ask someone on the other side to report the error;

Trobleshooting – log session

- We got nice improvements on ROSv7 BGP log session;
  - Here we can see what exactly was made by the "admin"user:

Log Entry <Feb/13/2024 15:57:08>	
Time:	Feb/13/2024 15:57:08
Buffer:	memory
Topics:	system
	info
Message:	peer-R1 added by winbox-3.40/mac-msg(winbox):admin@00:1C:42:83:01:C0 (*1 = /routing bgp connection add disabled=no local.role=ebgp name=peer-R1 remote.address=192.168.10.1/32 templates=default)

- Here we can see an invalid remote ASN error. All log "errors" are in red;

23	Feb/13/2024 16:17:52	memory	route, bgp, error	Invalid remote AS (100), expected 300
24	Feb/13/2024 16:17:56	memory	route, bgp, error	Invalid remote AS (100), expected 300
25	Feb/13/2024 16:18:02	memory	route, bgp, error	Invalid remote AS (100), expected 300
26	Feb/13/2024 16:18:06	memory	route, bgp, error	Invalid remote AS (100), expected 300
27	Feb/13/2024 16:18:12	memory	route, bgp, error	Invalid remote AS (100), expected 300

Trobleshooting – implicit log

- If you add a peer which does not belong to a DAC route, you must specify a local-address;

- This is an implicit error and will not show up on log session;

- In this case you must specify **local-address** and **multihop** option;
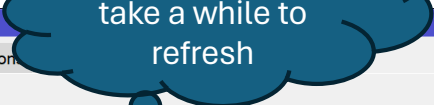
Trobleshooting – implicit log

- Another important implicit log its: routes limit exceeded;

- This error also will NOT show up on default log session;

- You must find it on peer's session stats:

BGP Peer <192.168.10.2>

Remote | Local | Attributes | Filter | Stats

Name: peer-R2-1
Prefix Count: 0
Uptime:
Tx/Rx Messages: 21 / 21
Tx/Rx Bytes: 399 B / 399 B

☐ IBGP
☑ EBGP
☑ Limit Exceeded
☐ Stopped

Sometimes this take a while to refresh
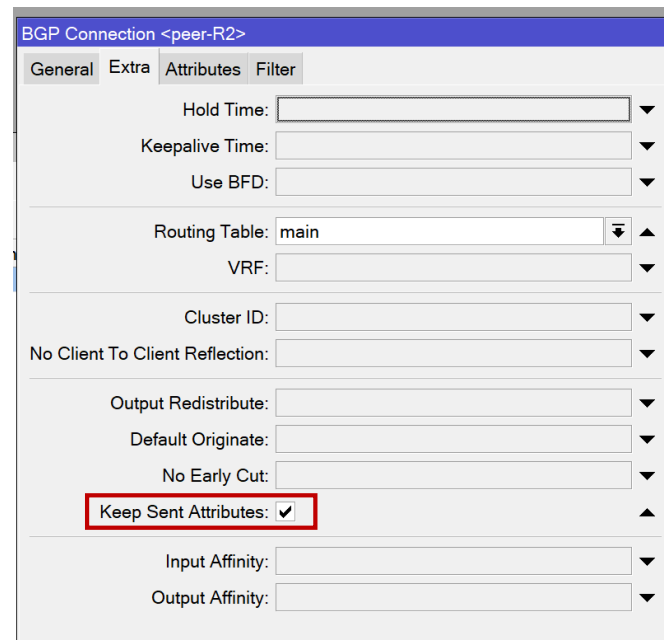
BGP

Connection | Templates | Session

Name	Template	AFI	Router ID	Remote Address	Remote...	Remote AS	Local Role	
--- session down because prefix limit was exceeded								
peer-R2	default	ip	192.168.10.1	192.168.10.2/32		200	ebgp	

Trobleshooting – advertisements

- We've got few improvements since ROSv7.2 about BGP advertisements but…

- By default, sent-out prefixes are not stored to preserve the router's memory.

- An option called **keep-sent-attributes** should be enabled only for debugging purposes when necessary to see currently advertised prefixes.

BGP Connection <peer-R2>

General Extra Attributes Filter

Hold Time:
Keepalive Time:
Use BFD:

Routing Table: main
VRF:

Cluster ID:
No Client To Client Reflection:

Output Redistribute:
Default Originate:
No Early Cut:
Keep Sent Attributes: ✔

Input Affinity:
Output Affinity:

Trobleshooting – advertisements

- BGP advertisements are fully supported since version 7.7+

Print based on out-peer

```
[admin@R2] /routing/bgp/advertisements> print where peer=peer-R1-1
 0 peer=peer-R1-1 dst=200.0.0.0/22 afi=ip nexthop=192.168.10.2 origin=0 as-path=sequence 200

 0 peer=peer-R1-1 dst=200.0.0.0/23 afi=ip nexthop=192.168.10.2 origin=0 as-path=sequence 200

 0 peer=peer-R1-1 dst=200.0.2.0/23 afi=ip nexthop=192.168.10.2 origin=0 as-path=sequence 200
```

Print based on out-prefixes

```
[admin@R2] /routing/bgp/advertisements> print where dst in 200.0.0.0/22
 0 peer=peer-R1-1 dst=200.0.0.0/22 afi=ip nexthop=192.168.10.2 origin=0 as-path=sequence 200

 0 peer=peer-R1-1 dst=200.0.0.0/23 afi=ip nexthop=192.168.10.2 origin=0 as-path=sequence 200

 0 peer=peer-R1-1 dst=200.0.2.0/23 afi=ip nexthop=192.168.10.2 origin=0 as-path=sequence 200
```

Overview about new filters

Overview about new filters

- Routing filters got a completely new interface which is not compatible with previous ROSv6;

- First IMPORTANT thing to take note is: since you set an input or output filter to a peer or instance the DEFAULT action is REJECT;

- So far in version 7.13 we still don't have DISCARD option. Don't worry about "blue" routes in winbox routing table;

- In fact, you SHOULD NOT use it to manage BGP. Use the terminal;

- And don't confuse "discard" with "delete" action. "Delete" action is to remove communities;

Overview about new filters

- Based on the filters you have, routes with "inactive" state/flag may also show up on routing table. Pay VERY close attention to those;

This is ok. You have backup routes

```
[admin@R1] > ip route/print detail where bgp
Flags: D - dynamic; X - disabled, I - inactive, A - active;
c - connect, s - static, r - rip, b - bgp, o - ospf, i - is-is, d - dhcp, v - vpn, m - modem, y - bgp-mpls-vpn; H - hw-offloaded; + - ecmp
   D b    dst-address=200.0.0.0/22 routing-table=main gateway=192.168.88.252 immediate-gw=192.168.88.252%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DAb    dst-address=200.0.0.0/22 routing-table=main gateway=192.168.10.2 immediate-gw=192.168.10.2%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   D b    dst-address=200.0.0.0/23 routing-table=main gateway=192.168.88.252 immediate-gw=192.168.88.252%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DAb    dst-address=200.0.0.0/23 routing-table=main gateway=192.168.10.2 immediate-gw=192.168.10.2%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   D b    dst-address=200.0.2.0/23 routing-table=main gateway=192.168.88.252 immediate-gw=192.168.88.252%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DAb    dst-address=200.0.2.0/23 routing-table=main gateway=192.168.10.2 immediate-gw=192.168.10.2%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no
```

This is bad. You do not have backup routes

```
[admin@R1] > ip route/print detail where bgp
Flags: D - dynamic; X - disabled, I - inactive, A - active;
c - connect, s - static, r - rip, b - bgp, o - ospf, i - is-is, d - dhcp, v - vpn, m - modem, y - bgp-mpls-vpn; H - hw-offloaded; + - ecmp
   DIb    dst-address=200.0.0.0/22 routing-table=main gateway=192.168.88.252 immediate-gw=192.168.88.252%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DAb    dst-address=200.0.0.0/22 routing-table=main gateway=192.168.10.2 immediate-gw=192.168.10.2%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DIb    dst-address=200.0.0.0/23 routing-table=main gateway=192.168.88.252 immediate-gw=192.168.88.252%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DAb    dst-address=200.0.0.0/23 routing-table=main gateway=192.168.10.2 immediate-gw=192.168.10.2%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DIb    dst-address=200.0.2.0/23 routing-table=main gateway=192.168.88.252 immediate-gw=192.168.88.252%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no

   DAb    dst-address=200.0.2.0/23 routing-table=main gateway=192.168.10.2 immediate-gw=192.168.10.2%bridge distance=20 scope=40 target-scope=10 suppress-hw-offload=no
```

Overview about new filters

- Common mistakes can happen if you don't follow the new syntaxes. Like this one:

On ROSv6

```
/routing filter
add action=accept chain=peer-R1-out prefix=200.0.0.0/22 prefix-length=24
```

WRONG conversion to ROSv7

```
/routing filter rule
add chain=peer-R1-out rule="if (dst==200.0.0.0/22 && dst-len==24) {accept;}"
```

CORRECT conversion to ROSv7

```
/routing filter rule
add chain=peer-R1-out rule="if (dst in 200.0.0.0/22 && dst-len==24) {accept;}"
```

Overview about new filters

- So… To avoid all these kind of mistakes I recommend you to use CLI to deploy all filters you need;

- CLI helps you to verify if you got the correct syntaxes on the way;

```
  MMM      MMM      KKK                         TTTTTTTTTTT     KKK
  MMMM    MMMM      KKK                         TTTTTTTTTTT     KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR    OOOOOO     TTT    III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR RRR  OOO  OOO    TTT    III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR   OOO  OOO    TTT    III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR  OOOOOO     TTT    III  KKK  KKK

  MikroTik RouterOS 7.13.2 (c) 1999-2024      https://www.mikrotik.com/

Press F1 for help

[ramires@BGP] >
[ramires@BGP] >
```

Overview about new filters

- As ROSv7 comes with this new routing filter winbox and CLI management, I suggest you to always read the documentation:
  - https://help.mikrotik.com/docs/display/ROS/Moving+from+ROSv6+to+v7+with+examples#MovingfromROSv6tov7withexamples-RoutingFilters
- Read the documentation, acquire deep knowledge and then just upgrade your ROSv6 to ROSv7 to get all filters migrated;
- I was not able to find a tool to convert filters from v6 to v7.
- This presentation will be available on https://mtpc.world and if is there an online tool to convert those codes, please let me know ☺
- I would be glad to update my slides before upload it;

Final considerations

- Make sure the router you gonna buy, supports V7 only;

- Make sure you will be able to MANAGE the router. Remember that BGP is like a 3 years old child: "can provide happiness or darkness in a matter of minute.";

- If you gonna use V7, keep tracking of current updates;

Final considerations

- If you can manage your router smoothly on V6, stick with that if can't manage it the same way on V7;

- But if you decide to use V7 and can't manage it by your own, look for specialized support. Mikrotik has certified consulters and trainers all around the world:
https://mikrotik.com/training/centers

Questions?

Thanks!!

- Contacts
  - ramires@alivesolutions.com.br
  - +5583991237626 (WhatsApp)