bdNOG11 IPv6 Routing Workshop on MikroTik RouterOS – LAB Topology
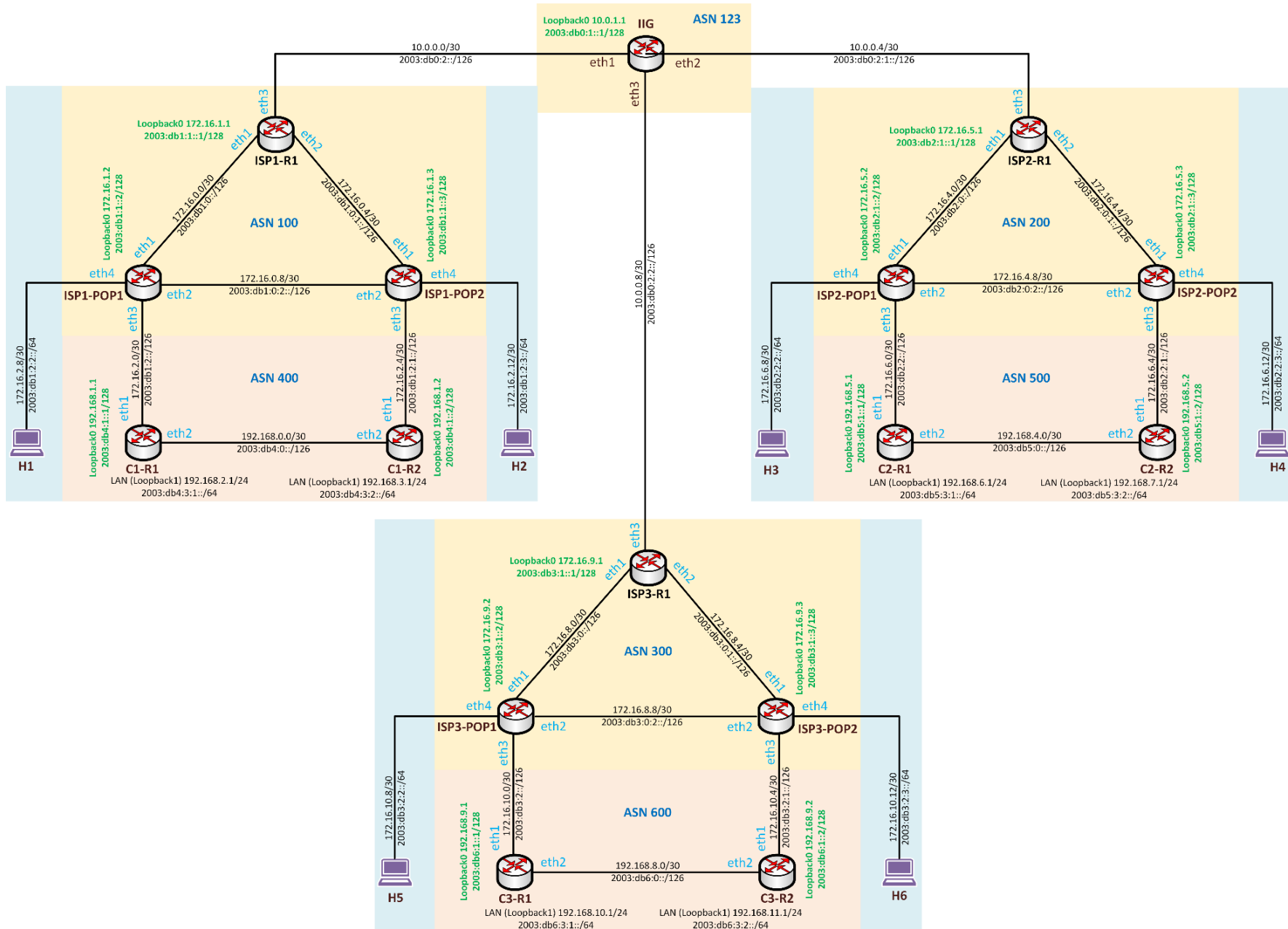
IP Address Allocation

	ASN	IPv4	IPv6
Organizations hold below number resources from RIR			
IIG	123	10.0.0.0/22	2003:db0::/32
ISP1	100	172.16.0.0/22	2003:db1::/32
ISP2	200	172.16.4.0/22	2003:db2::/32
ISP3	300	172.16.8.0/22	2003:db3::/32
C1	400	192.168.0.0/22	2003:db4::/32
C2	500	192.168.4.0/22	2003:db5::/32
C3	600	192.168.8.0/22	2003:db6::/32

IP Address Breakdown Plan

IIG	2003:db0::/32	10.0.0.0/22	
	Infra P2P	2003:db0:0::/48	10.0.0.0/24
	Infra Loopback	2003:db0:1::/48	10.0.1.0/24
	PE-CE	2003:db0:2::/48	10.0.2.0/24
	CE LAN	2003:db0:3::/48	10.0.3.0/24

ISP1	2003:db1::/32	172.16.0.0/22	
	Infra P2P	2003:db1:0::/48	172.16.0.0/24
	Infra Loopback	2003:db1:1::/48	172.16.1.0/24
	PE-CE	2003:db1:2::/48	172.16.2.0/24
	CE LAN	2003:db1:3::/48	172.16.3.0/24

C1	2003:db4::/32	192.168.0.0/22	
	Infra P2P	2003:db4:0::/48	192.168.0.0/24
	Infra Loopback	2003:db4:1::/48	192.168.1.0/24
	PE-CE	2003:db4:2::/48	192.168.2.0/24
	CE LAN	2003:db4:3::/48	192.168.3.0/24

ISP2	2003:db2::/32	172.16.4.0/22	
	Infra P2P	2003:db2:0::/48	172.16.4.0/24
	Infra Loopback	2003:db2:1::/48	172.16.5.0/24
	PE-CE	2003:db2:2::/48	172.16.6.0/24
	CE LAN	2003:db2:3::/48	172.16.4.0/24

C2	2003:db5::/32	192.168.4.0/22	
	Infra P2P	2003:db5:0::/48	192.168.4.0/24
	Infra Loopback	2003:db5:1::/48	192.168.5.0/24
	PE-CE	2003:db5:2::/48	192.168.6.0/24
	CE LAN	2003:db5:3::/48	192.168.7.0/24

ISP3	2003:db3::/32	172.16.8.0/22		C3	2003:db6::/32	192.168.8.0/22	
	Infra P2P	2003:db3:0::/48	172.16.8.0/24		Infra P2P	2003:db6:0::/48	192.168.8.0/24
	Infra Loopback	2003:db3:1::/48	172.16.9.0/24		Infra Loopback	2003:db6:1::/48	192.168.9.0/24
	PE-CE	2003:db3:2::/48	172.16.10.0/24		PE-CE	2003:db6:2::/48	192.168.10.0/24
	CE LAN	2003:db3:3::/48	172.16.11.0/24		CE LAN	2003:db6:3::/48	192.168.11.0/24

Final IP Plan

P2P IP				Loopback		LAN Block
Link Between		IPv4 Block	IPv6 Block	Router	IPv4 / IPv6	IPv4 / IPv6
IIG	ISP1-R1	10.0.0.0/30	2003:db0:2::/126	IIG	10.0.1.1	N/A
IIG	ISP2-R1	10.0.0.4/30	2003:db0:2:1::/126		2003:db0:1::1/128	N/A
IIG	ISP3-R1	10.0.0.8/30	2003:db0:2:2::/126			
ISP1-R1	ISP1-POP1	172.16.0.0/30	2003:db1:0::/126	ISP1-R1	172.16.1.1	N/A
ISP1-R1	ISP1-POP2	172.16.0.4/30	2003:db1:0:1::/126		2003:db1:1::1/128	N/A
ISP1-POP1	ISP1-POP2	172.16.0.8/30	2003:db1:0:2::/126	ISP1-POP1	172.16.1.2	N/A
ISP1-POP1	C1-R1	172.16.2.0/30	2003:db1:2::/126		2003:db1:1::2/128	N/A
ISP1-POP2	C1-R2	172.16.2.4/30	2003:db1:2:1::/126	ISP1-POP2	172.16.1.3	N/A
ISP1-POP1	H1	172.16.2.8/30	2003:db1:2:2::/64		2003:db1:1::3/128	N/A
ISP1-POP2	H2	172.16.2.12/30	2003:db1:2:3::/64			
ISP2-R1	ISP2-POP1	172.16.4.0/30	2003:db2:0::/126	ISP2-R1	172.16.5.1	N/A
ISP2-R1	ISP2-POP2	172.16.4.4/30	2003:db2:0:1::/126		2003:db2:1::1/128	N/A
ISP2-POP1	ISP2-POP2	172.16.4.8/30	2003:db2:0:2::/126	ISP2-POP1	172.16.5.2	N/A
ISP2-POP1	C2-R1	172.16.6.0/30	2003:db2:2::/126		2003:db2:1::2/128	N/A
ISP2-POP2	C2-R2	172.16.6.4/30	2003:db2:2:1::/126	ISP2-POP2	172.16.5.3	N/A
ISP2-POP1	H3	172.16.6.8/30	2003:db2:2:2::/64		2003:db2:1::3/128	N/A
ISP2-POP2	H4	172.16.6.12/30	2003:db2:2:3::/64			

P2P IP				Loopback		LAN Block
Link Between		IPv4 Block	IPv6 Block	Router	IPv4 / IPv6	IPv4 / IPv6
ISP3-R1	ISP3-POP1	172.16.8.0/30	2003:db3:0::/126	ISP3-R1	172.16.9.1	N/A
ISP3-R1	ISP3-POP2	172.16.8.4/30	2003:db3:0:1::/126		2003:db3:1::1/128	N/A
ISP3-POP1	ISP3-POP2	172.16.8.8/30	2003:db3:0:2::/126	ISP3-POP1	172.16.9.2	N/A
ISP3-POP1	C3-R1	172.16.10.0/30	2003:db3:2::/126		2003:db3:1::2/128	N/A
ISP3-POP2	C3-R2	172.16.10.4/30	2003:db3:2:1::/126	ISP3-POP2	172.16.9.3	N/A
ISP3-POP1	H5	172.16.10.8/30	2003:db3:2:2::/64		2003:db3:1::3/128	N/A
ISP3-POP2	H6	172.16.10.12/30	2003:db3:2:3::/64			
C1-R1	C1-R2	192.168.0.0/30	2003:db4:0::/126	C1-R1	192.168.1.1	192.168.2.1/24
					2003:db4:1::1/128	2003:db4:3:1::/64
				C1-R2	192.168.1.2	192.168.3.1/24
					2003:db4:1::2/128	2003:db4:3:2::/64
C2-R1	C2-R2	192.168.4.0/30	2003:db5:0::/126	C2-R1	192.168.5.1	192.168.6.1/24
					2003:db5:1::1/128	2003:db5:3:1::/64
				C2-R2	192.168.5.2	192.168.7.1/24
					2003:db5:1::2/128	2003:db5:3:2::/64
C3-R1	C3-R2	192.168.8.0/30	2003:db6:0::/126	C3-R1	192.168.9.1	192.168.10.1/24
					2003:db6:1::1/128	2003:db6:3:1::/64
				C3-R2	192.168.9.2	192.168.11.1/24
					2003:db6:1::2/128	2003:db6:3:2::/64

Task-11: Configure eBGP between IIG and ISPs for IPv4

IIG
```
/routing bgp instance set default as=123 router-id=10.0.1.1

/routing bgp peer add name=ISP1 remote-address=10.0.0.2 remote-as=100 default-originate=always
/routing bgp peer add name=ISP2 remote-address=10.0.0.6 remote-as=200 default-originate=always
/routing bgp peer add name=ISP3 remote-address=10.0.0.10 remote-as=300 default-originate=always

/routing bgp network add network=10.0.0.0/24 synchronize=yes
/routing bgp network add network=10.0.1.0/24 synchronize=yes
/routing bgp network add network=10.0.2.0/24 synchronize=yes
/routing bgp network add network=10.0.3.0/24 synchronize=yes

/ip route add dst-address=10.0.0.0/24 type=blackhole
/ip route add dst-address=10.0.1.0/24 type=blackhole
/ip route add dst-address=10.0.2.0/24 type=blackhole
/ip route add dst-address=10.0.3.0/24 type=blackhole
```

ISP1-R1
```
/routing bgp peer add name=IIG remote-address=10.0.0.1 remote-as=123

/routing bgp network add network=172.16.0.0/24 synchronize=yes
/routing bgp network add network=172.16.1.0/24 synchronize=yes
/routing bgp network add network=172.16.2.0/24 synchronize=yes
/routing bgp network add network=172.16.3.0/24 synchronize=yes
/routing bgp network add network=172.16.0.0/22 synchronize=yes

/ip route add dst-address=172.16.0.0/24 type=blackhole
/ip route add dst-address=172.16.1.0/24 type=blackhole
/ip route add dst-address=172.16.2.0/24 type=blackhole
/ip route add dst-address=172.16.3.0/24 type=blackhole
/ip route add dst-address=172.16.0.0/22 type=blackhole
```

ISP2-R1
```
/routing bgp peer add name=IIG remote-address=10.0.0.5 remote-as=123

/routing bgp network add network=172.16.4.0/24 synchronize=yes
/routing bgp network add network=172.16.5.0/24 synchronize=yes
/routing bgp network add network=172.16.6.0/24 synchronize=yes
/routing bgp network add network=172.16.7.0/24 synchronize=yes
/routing bgp network add network=172.16.4.0/22 synchronize=yes

/ip route add dst-address=172.16.4.0/24 type=blackhole
/ip route add dst-address=172.16.5.0/24 type=blackhole
/ip route add dst-address=172.16.6.0/24 type=blackhole
/ip route add dst-address=172.16.7.0/24 type=blackhole
/ip route add dst-address=172.16.4.0/22 type=blackhole
```

ISP3-R1
```
/routing bgp peer add name=IIG remote-address=10.0.0.9 remote-as=123

/routing bgp network add network=172.16.8.0/24 synchronize=yes
/routing bgp network add network=172.16.9.0/24 synchronize=yes
/routing bgp network add network=172.16.10.0/24 synchronize=yes
/routing bgp network add network=172.16.11.0/24 synchronize=yes
/routing bgp network add network=172.16.8.0/22 synchronize=yes

/ip route add dst-address=172.16.8.0/24 type=blackhole
/ip route add dst-address=172.16.9.0/24 type=blackhole
/ip route add dst-address=172.16.10.0/24 type=blackhole
/ip route add dst-address=172.16.11.0/24 type=blackhole
/ip route add dst-address=172.16.8.0/22 type=blackhole
```

/routing bgp peer print
/ip route print where bgp

Task-12: Configure eBGP between IIG and ISPs for IPv6

IIG
```
/routing bgp peer add name=ISP1-v6 address-families=ipv6 remote-address=2003:db0:2::2 \
    remote-as=100 default-originate=always
/routing bgp peer add name=ISP2-v6 address-families=ipv6 remote-address=2003:db0:2:1::2 \
    remote-as=200 default-originate=always
/routing bgp peer add name=ISP3-v6 address-families=ipv6 remote-address=2003:db0:2:2::2 \
    remote-as=300 default-originate=always

/routing bgp network add network=2003:db0:3::/48 synchronize=yes

/ipv6 route add dst-address=2003:db0:3::/48 type=unreachable
```

ISP1-R1
```
/routing bgp peer add name=IIG-v6 address-families=ipv6 remote-address=2003:db0:2::1 remote-as=123

/routing bgp network add network=2003:db1::/32 synchronize=yes

/ipv6 route add dst-address=2003:db1::/32 type=unreachable
```

ISP2-R1
```
/routing bgp peer add name=IIG-v6 address-families=ipv6 remote-address=2003:db0:2:1::1 remote-as=123

/routing bgp network add network=2003:db2::/32 synchronize=yes

/ipv6 route add dst-address=2003:db2::/32 type=unreachable
```

ISP3-R1
```
/routing bgp peer add name=IIG-v6 address-families=ipv6 remote-address=2003:db0:2:2::1 remote-as=123

/routing bgp network add network=2003:db3::/32 synchronize=yes

/ipv6 route add dst-address=2003:db3::/32 type=unreachable
```

/routing bgp peer print
/ip route print where bgp

Task-13: PE-CE Peering and Originating Customer Prefixes for IPv4

ISP1-POP1
```
/routing bgp peer add name=C1-R1 remote-address=172.16.2.2 remote-as=400 \
    default-originate=if-installed
```

ISP1-POP2
```
/routing bgp peer add name=C1-R2 remote-address=172.16.2.6 remote-as=400 \
    default-originate=if-installed
```

C1-R1
```
/routing bgp peer add name=ISP1-POP1 remote-address=172.16.2.1 remote-as=100

/routing bgp network add network=192.168.0.0/22 synchronize=yes

/ip route add dst-address=192.168.0.0/22 type=blackhole
```

C1-R2
```
/routing bgp peer add name=ISP1-POP2 remote-address=172.16.2.5 remote-as=100
```


/routing bgp peer print
/ip route print where bgp

ISP2-POP1
```
/routing bgp peer add name=C2-R1 remote-address=172.16.6.2 remote-as=500 \
    default-originate=if-installed
```

ISP2-POP2
```
/routing bgp peer add name=C2-R2 remote-address=172.16.6.6 remote-as=500 \
    default-originate=if-installed
```

C2-R1
```
/routing bgp peer add name=ISP2-POP1 remote-address=172.16.6.1 remote-as=200

/routing bgp network add network=192.168.4.0/22 synchronize=yes

/ip route add dst-address=192.168.4.0/22 type=blackhole
```

C2-R2
```
/routing bgp peer add name=ISP2-POP2 remote-address=172.16.6.5 remote-as=200
```


/routing bgp peer print
/ip route print where bgp

ISP3-POP1
```
/routing bgp peer add name=C3-R1 remote-address=172.16.10.2 remote-as=600 \
    default-originate=if-installed
```

ISP3-POP2
```
/routing bgp peer add name=C2-R2 remote-address=172.16.10.6 remote-as=600 \
    default-originate=if-installed
```

C3-R1
```
/routing bgp peer add name=ISP3-POP1 remote-address=172.16.10.1 remote-as=300

/routing bgp network add network=192.168.8.0/22 synchronize=yes

/ip route add dst-address=192.168.8.0/22 type=blackhole
```

C3-R2
```
/routing bgp peer add name=ISP3-POP2 remote-address=172.16.10.5 remote-as=300
```

```
/routing bgp peer print
/ip route print where bgp
```

Task-14: PE-CE Peering and Originating Customer Prefixes for IPv6

ISP1-POP1
```
/routing bgp peer add name=C1-R1-v6 address-families=ipv6 remote-address=2003:db1:2::2 \
    remote-as=400 default-originate=if-installed
```

ISP1-POP2
```
/routing bgp peer add name=C1-R2-v6 address-families=ipv6 remote-address=2003:db1:2:1::2 \
    remote-as=400 default-originate=if-installed
```

C1-R1
```
/routing bgp peer add name=ISP1-POP1-v6 address-families=ipv6 remote-address=2003:db1:2::1 remote-as=100

/routing bgp network add network=2003:db4:3::/48 synchronize=yes
/routing bgp network add network=2003:db4::/32 synchronize=yes

/ipv6 route add dst-address=2003:db4:3::/48 type=unreachable
/ipv6 route add dst-address=2003:db4::/32 type=unreachable
```

C1-R2
```
/routing bgp peer add name=ISP1-POP2-v6 address-families=ipv6 remote-address=2003:db1:2:1::1 remote-as=100
```

/routing bgp peer print
/ip route print where bgp

ISP2-POP1
```
/routing bgp peer add name=C2-R1-v6 address-families=ipv6 remote-address=2003:db2:2::2 \
    remote-as=500 default-originate=if-installed
```

ISP2-POP2
```
/routing bgp peer add name=C2-R2-v6 address-families=ipv6 remote-address=2003:db2:2:1::2 \
    remote-as=500 default-originate=if-installed
```

C2-R1
```
/routing bgp peer add name=ISP2-POP1-v6 address-families=ipv6 remote-address=2003:db2:2::1 remote-as=200

/routing bgp network add network=2003:db5:3::/48 synchronize=yes
/routing bgp network add network=2003:db5::/32 synchronize=yes

/ipv6 route add dst-address=2003:db5:3::/48 type=unreachable
/ipv6 route add dst-address=2003:db5::/32 type=unreachable
```

C2-R2
```
/routing bgp peer add name=ISP2-POP2-v6 address-families=ipv6 remote-address=2003:db2:2:1::1 remote-as=200
```

/routing bgp peer print
/ip route print where bgp

ISP3-POP1

```
/routing bgp peer add name=C3-R1-v6 address-families=ipv6 remote-address=2003:db3:2::2 \
    remote-as=600 default-originate=if-installed
```

ISP3-POP2

```
/routing bgp peer add name=C3-R2-v6 address-families=ipv6 remote-address=2003:db3:2:1::2 \
    remote-as=600 default-originate=if-installed
```

C3-R1

```
/routing bgp peer add name=ISP3-POP1-v6 address-families=ipv6 remote-address=2003:db3:2::1 remote-as=300

/routing bgp network add network=2003:db6:3::/48 synchronize=yes
/routing bgp network add network=2003:db6::/32 synchronize=yes

/ipv6 route add dst-address=2003:db6:3::/48 type=unreachable
/ipv6 route add dst-address=2003:db6::/32 type=unreachable
```

C3-R2

```
/routing bgp peer add name=ISP3-POP2-v6 address-families=ipv6 remote-address=2003:db3:2:1::1 remote-as=300
```

/routing bgp peer print
/ip route print where bgp