Access Control Lists (ACLs) User Guide

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1. Introduction

1.1. ACL Use Cases

In RBFS, Access Control Lists (ACL) serve multiple purposes:

- Provide security by traffic filtering. This applies to both host and transit traffic. ACLs for traffic filtering are user-defined by configuration.
- Redirecting control traffic to the CPU. Such protocol ACLs also referred to as trap rules, are automatically created by the respective protocol, and do not need to be configured.
- Classifying traffic for differentiated QoS treatment. This is a special form of ACL referred to as a multi-field (MF) classifier. For more information about MF classifiers, please refer to the HQoS Configuration Guide.

1.2. ACL Components and Processing

User-defined ACLs consist of rules and ordinals. In case of multiple matching ACL rules, you can use priorities to define the result of the ACL.

- Rules - A rule is a named ACL entry that typically contains one or multiple match criteria and an action.
- Ordinals - An ordinal is solely a numbered configuration object. A rule can consist of multiple ordinals. Ordinals help to structure the configuration. In RBFS, it makes no difference if you configure one rule with multiple ordinals or multiple rules with one ordinal each. Please note ordinals do not define the order of processing.
- Scope - ACLs generally apply globally. In particular, they are not applied to interfaces. You can, however configure an interface as a match criteria.
- Priorities - ACL entry priorities are used to define the processing of multiple matching ACL rules. In RBFS, by default, all ACL entries have the same priority, and there is no specific order. For example, if one ACL rule shall permit ICMP traffic from a specific prefix, and another rule shall deny any other ICMP traffic, it will by default result in a conflict as an ICMP packet matches both rules. To ensure that the more specific rule matches first, you can set its priority to higher. When the ACL priority value is set to a lower number, priority is higher.

1.3. Prefix Lists

A prefix list is a named list of prefixes. Instead of listing multiple individual prefixes in a match rule of the ACL itself, you can reference a list that contains the prefixes, and thereby apply a common action to all matching prefixes. This helps to maintain lists and reuse them in multiple ACL rules.

Prefix lists can be used in ACL for permitting/denying traffic and in Multifield Classifier (MFC) for classifying traffic. This guide describes how to configure prefix lists and apply them in user-defined ACLs as firewall filters and apply prefix lists in MFC for traffic classification. For more information about applying prefix lists to MF classifiers, please refer to the *HQoS configuration Guide*.

When a prefix list is configured and referenced in an ACL, it is internally first added to an intermediate ACL configuration table. For each prefix, one separate rule is added to the final ACL configuration table. This is different from a prefix match in the ACL rule itself that is directly added to the ACL configuration table. A dedicated range of ordinals (200001-4294967295) is reserved to expand ACL rules when using prefix lists. If configured, the priority will be copied from the prefix list ACL configuration to all the expanded ACL rules.

When using prefix lists, the following restrictions apply:

- You cannot configure the same prefix-list name to match the source prefix list and destination prefix list.
- You cannot configure both the source prefix and source prefix list on the same ACL configuration.
- You cannot configure both the destination prefix and destination prefix list on the same ACL configuration.

1.4. Supported Platforms

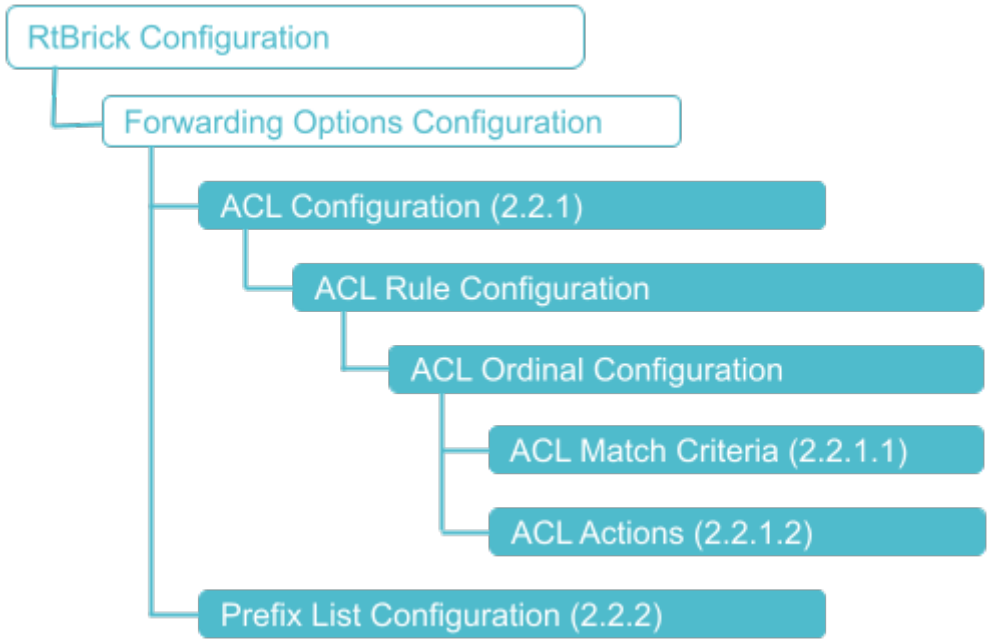
Not all features are necessarily supported on each hardware platform. Refer to the Platform Guide for the features and the sub-features that are or are not supported by each platform.

2. Configuring Access Control Lists

For configuring an access control list, you define filter criteria (with match conditions) for the packets and an action for the device to take if the packets match the filtering criteria.

2.1. Configuration Hierarchy

The diagram illustrates the ACL configuration hierarchy.



2.2. Configuration Syntax and Commands

The following sections describe the ACL configuration syntax and commands.

2.2.1. Configuring ACLs

Syntax:

set forwarding-options acl [**l2** | **l3v4** | **l3v6**] **rule** <name> **ordinal** <number> <option> <attribute> <value>

Options	Description
<name>	Name of the ACL rule.
<number>	Specifies the ordinal number.
match <...>	Match configuration hierarchy. Please refer to section 2.2.1.1 for the ACL match criteria configuration.

Options	Description
action <...>	Action configuration hierarchy. Please refer to section 2.2.1.2 for the ACL actions configuration.
priority <priority>	Specifies the ACL priority value. The default entry priority for user-defined ACLs changes to 500. The configurable ACL entry priority range becomes 100 - 20000. A lower number indicates higher priority.

2.2.1.1. Configuring ACL Match Criteria

set forwarding-options acl [**l2** | **l3v4** | **l3v6**] **rule** <rulename> **ordinal** <ordinal_value> **match** <attribute> <value>

Attribute	Description
destination-mac <destination-mac>	ACL L2 destination mac match.
destination-ipv4-prefix <destination-ipv4-prefix>	ACL L3 IPv4 destination prefix match.
destination-ipv4-prefix-list <destination-ipv4-prefix-list>	ACL destination IPv4 prefix-list name. You can apply a prefix list that is previously configured. Refer to section [configure-prefix-list].
destination-l4-port <destination-l4-port>	ACL L4 destination port match.
destination-ipv4-local [true|false]	Indicates whether match support is enabled for all traffic destined for the routers' IP addresses
destination-ipv6-prefix <destination-ipv6-prefix>	ACL L3 IPv6 destination prefix match.
destination-ipv6-prefix-list <destination-ipv6-prefix-list>	ACL destination IPv6 pref ix list name. You can apply a prefix list that is previously configured. Refer to section [configure-prefix-list].
destination-ipv6-local [true|false]	Indicates whether match support is enabled for all traffic destined for the routers' IP addresses
direction ingress	ACL L2/L3 direction match. Currently, only the ingress direction is supported.
ethertype <ethertype>	ACL L2 EtherType match.
inner-tag-protocol-id <inner-tag-protocol-id>	ACL L2 inner TPID match.
inner-vlan <inner-vlan>	ACL L2 inner-VLAN match.
inner-vlan-cfi <inner-vlan-cfi>	ACL L2 inner-VLAN CFI match.

Attribute	Description
inner-vlan-priority <inner-vlan-priority>	ACL L2 inner-VLAN priority match.
interface <interface>	Interface match.
ip-options true	Match if the IPv4 packet has options. Supported value: true.
ip-protocol <protocol>	ACL IP protocol value match such as TCP, UDP, ICMP.
ipv4-dscp <ipv4-dscp>	IPv4 DSCP value.
ipv4-tos <ipv4-tos>	IPv4 ToS value.
ipv6-tc <ipv6-tc>	Codepoint class value.
logical-interface <logical-interface>	Logical interface match.
source-ipv4-prefix <source-ipv4-prefix>	ACL L3 IPv4 source prefix match.
source-ipv4-prefix-list <source-ipv4-prefix-list>	ACL source IPv4 prefix-list name. You can apply a prefix list that is previously configured. Refer to section [configure-prefix-list].
source-ipv6-prefix <source-ipv6-prefix>	Configure ACL L3 IPv6 source prefix match.
source-ipv6-prefix-list <source-ipv6-prefix-list>	ACL source IPv6 prefix-list name. You can apply a prefix list that is previously configured. Refer to section [configure-prefix-list].
source-l4-port <source-l4-port>	ACL L4 source port match.
outer-tag-protocol-id <outer-tag-protocol-id>	ACL L2 outer TPID match.
outer-vlan <outer-vlan>	ACL L2 outer-VLAN match.
outer-vlan-cfi <outer-vlan-cfi>	ACL L2 outer VLAN CFI match.
outer-vlan-priority <outer-vlan-priority>	ACL L2 outer VLAN priority match.
source-mac <source-mac>	ACL L2 source MAC match.
traffic-class <class>	Forward class value. Supported values: class-0 to class-7, class-all.
ttl <ttl>	IPv4 time-to-live value.
match-mpls-traffic [true/false]	Match single MPLS label termination.

Example 1: Layer 2 Match Configuration

```
{
    "rtbrick-config:acl": {
       "l2": {
          "rule": [
            {
              "rule-name": "a10nsp-drop-lag-2",
              "ordinal": [
                {
                  "ordinal-value": 1,
                  "match": {
                    "direction": "ingress",
                    "interface": "lag-2",
                    "outer-vlan-priority": 1
                  },
                  "action": {
                    "drop": "true",
                    "statistics": "true"
                  }
                },
```

Example 2: Layer 3 IPv4 Match Configuration

```
{
    "rtbrick-config:acl": {
      "l3v4": {
        "rule": [
          {
            "rule-name": "rtb_firewall_two",
            "ordinal": [
              {
                "ordinal-value": 1000,
                "match": {
                  "direction": "ingress",
                  "source-ipv4-prefix": "198.51.100.50/24",
                  "source-l4-port": 8080
                },
                "action": {
                  "drop": "true"
                }
              }
            ]
          },
          {
            "rule-name": "rule2",
            "ordinal": [
              {
                "ordinal-value": 5,
                "match": {
                  "direction": "ingress",
                  "interface": "ifp-0/0/1"
                }
              }
            ]
          }
        ]
      }
    }
  }
```

Example 3: Layer 3 IPv6 Match Configuration

```
{
    "rtbrick-config:l3v6": {
      "rule": [
        {
          "rule-name": "rtb_firewall_two",
          "ordinal": [
            {
              "ordinal-value": 1000,
              "match": {
                "direction": "ingress",
                "source-ipv6-prefix": "2001:db8:0:11::/32",
                "source-l4-port": 8080
              },
              "action": {
                "permit": "true"
              }
            }
          ]
        }
      ]
    }
  }
```

Example 4: Match support for all traffic destined for any of the router's IP addresses

```
{
    "rtbrick-config:acl": {
      "l3v4": {
        "rule": [
          {
            "rule-name": "rule4",
            "ordinal": [
              {
                "ordinal-value": 4,
                "match": {
                  "direction": "ingress",
                  "destination-ipv4-local": "true"
                },
                "action": {
                  "drop": "true"
                }
              }
            ]
          }
        ]
      },
      "l3v6": {
        "rule": [
          {
            "rule-name": "rule2",
            "ordinal": [
              {
                "ordinal-value": 2,
                "match": {
                  "direction": "ingress",
                  "destination-ipv6-local": "true"
                },
                "action": {
                  "drop": "true"
                }
              }
            ]
          }
        ]
      }
    }
  }
```

2.2.1.2. Configuring ACL Actions

Syntax:

set forwarding-options acl [**l3v4** | **l3v6**] **rule** <rulename> **ordinal** <ordinal_value> **action** <attribute> <value>

Attribute	Description
drop [true/false]	If the ACL rule specifies drop true, the system will discard any packets that match that rule. The system will ignore the rule if drop false is specified. It is not advised to use the drop false option as it is ignored internally.
permit [true/false]	If the ACL rule specifies permit true, the system forwards traffic matching that rule. The system will ignore the rule if permit false is specified. It is not advised to use the permit false option as it is ignored internally.
action statistics [true/false]	Configure action, enable statistics.  A limited number of counter resources are available in a common pool for user-defined ACLs, protocol ACLs, L3, and L2X logical interfaces.
forward-class <class>	Specifies forward class value (class-0 to class-7, class-all)
mirror <mirror>	Specifies ACL action mirror name.  Currently, ACLs with mirror actions are not supported.
capture [true/false]	You can enable the capture action when using the RBFS built-in capture feature with an ACL to more granularly specify the traffic to be captured. For more information and an example, refer to the *RBFS NOC Troubleshooting Guide*.
policer-name <policer-name>	Specifies policer profile name.
redirect-to-cpu [true/false]	Configure action, redirect packets to CPU.

Example

```
{
            "rule-name": "rtb_firewall_two",
            "ordinal": [
              {
                "ordinal-value": 1000,
                "match": {
                  "direction": "ingress",
                  "source-ipv4-prefix": "198.51.100.50/24",
                  "source-l4-port": 8080
                },
                "action": {
                  "drop": "true"
                }
              }
            ]
          }
```

Configuring Prefix Lists

Configuring IPv4/IPv6 Prefix List for ACL and Multifield Classifier

Syntax:

set forwarding-options prefix-list <prefix-list-name> <attribute> <value>

Attribute	Description
<prefix-list-name>	Name of the prefix list, which will be later used to attach with ACL configuration.
ipv4-prefix <ipv4_prefix>	Specifies the IPv4 prefix address.
ipv6-prefix <ipv6_prefix>	Specifies the IPv6 prefix address.

Example 1: Prefix List Configuration

```
supervisor@rtbrick>LEAF01: op> show config forwarding-options prefix-list
{
    "rtbrick-config:prefix-list": [
      {
        "prefix-list-name": "ipv4-list",
        "ipv4-prefix": [
          {
            "ipv4-prefix": "198.51.100.50/24"
          },
          {
            "ipv4-prefix": "198.51.101.60/24"
          },
          {
            "ipv4-prefix": "198.51.102.70/24"
          }
        ]
      }
    ]
  }
```

Example 2: Using Prefix-list in Multifield-Classifier

```
supervisor@rtbrick>LEAF01: op> show config forwarding-options prefix-list pta-
iptv-multicast
{
  "rtbrick-config:prefix-list": [
    {
      "prefix-list-name": "ipv4-list",
      "ipv4-prefix": [
          {
            "ipv4-prefix": "198.51.100.50/24"
          },
          {
            "ipv4-prefix": "198.51.101.60/24"
          },
          {
            "ipv4-prefix": "198.51.102.70/24"
          }
      ]
    }
  ]
}
```

Example 3: Viewing Multifield-Classifier Details

```
supervisor@rtbrick>LEAF01: op> show config forwarding-options class-of-service
multifield-classifier acl l3v4 rule pta-triple-play-8queues ordinal 6000
{
  "rtbrick-config:ordinal": [
    {
      "ordinal-value": 6000,
      "match": {
        "destination-ipv4-prefix-list": "ipv4-list"
      },
      "action": {
        "forward-class": "class-1",
        "remark-codepoint": 248
      }
    }
  ]
}
```

3. Operational Commands

3.1. ACL Show and Statistics Commands

ACL statistics are currently not supported for PIM, IGMP, and L2TP protocol traffic.

Syntax:

show acl <option>

Option	Description
-	Without any option, this command displays brief information about access-control list (ACL).
detail	Displays detailed information about access-control list (ACL).
<acl-rule-name>	Displays detailed information for a specified ACL rule name.
statistics	Displays ACL statistics information.
<acl-name> statistics	Displays ACL statistics information for the specified ACL.

Example 1: Show information about ACLs

```
supervisor@rtbrick>LEAF01: op> show acl
ACL                          Ordinal    Type         Attach Point
rule4                        4          l3v4         -
                             8          l3v4         -
lldp.ifp-0/0/0.trap.rule     -          l2           ifp-0/0/0
lldp.ifp-0/1/0.trap.rule     -          l2           ifp-0/1/0
lldp.ifp-0/1/1.trap.rule     -          l2           ifp-0/1/1
lldp.ifp-0/1/4.trap.rule     -          l2           ifp-0/1/4
lldp.ifp-0/1/5.trap.rule     -          l2           ifp-0/1/5
lldp.ifp-0/1/6.trap.rule     -          l2           ifp-0/1/6
lldp.ifp-0/1/12.trap.rule    -          l2           ifp-0/1/12
lldp.ifp-0/1/13.trap.rule    -          l2           ifp-0/1/13
lldp.ifp-0/1/22.trap.rule    -          l2           ifp-0/1/22
lldp.ifp-0/1/23.trap.rule    -          l2           ifp-0/1/23
```

Example 2: Show detailed information about ACLs

```
supervisor@rtbrick>LEAF01: op> show acl detail
Rule: rule4
  ACL type: l3v4
  Ordinal: 4
    Match:
      Direction: ingress
      Source IPv4 prefix: 198.51.100.35/24
    Action:
      Drop: True
    Result:
      Trap ID: User Defined
    Statistics:
      Units      Total       Accepted    Dropped
      Packets    4           0           4
      Bytes      424         0           424
  Ordinal: 8
    Match:
      Direction: ingress
      Source IPv4 prefix: 198.51.100.45/24
    Action:
      Drop: True
    Result:
      Trap ID: User Defined
    Statistics:
      Units      Total       Accepted    Dropped
      Packets    9           0           9
      Bytes      990         0           990
Rule: lldp.ifp-0/0/0.trap.rule
  ACL type: l2
  Ordinal: -
    Match:
      Attachment point: ifp-0/0/0
      Direction: ingress
      Destination MAC: 01:80:c2:00:00:0e
    Action:
      Redirect to CPU: True
    Result:
      Trap ID: LLDP
    Statistics:
      Units      Total       Accepted    Dropped
      Packets    105         105         0
      Bytes      12915       12915       0
Rule: lldp.ifp-0/1/0.trap.rule
  ACL type: l2
  Ordinal: -
    Match:
      Attachment point: ifp-0/1/0
      Direction: ingress
      Destination MAC: 01:80:c2:00:00:0e
    Action:
      Redirect to CPU: True
    Result:
      Trap ID: LLDP
    Statistics:
      Units      Total       Accepted    Dropped
      Packets    220         220         0
      Bytes      19140       19140       0
```

Example 3: Show detailed information for a specified ACL Rule

```
supervisor@rtbrick>LEAF01: op> show acl rule4
Rule: rule4
  ACL type: l3v4
  Ordinal: 4
    Match:
      Direction: ingress
      Source IPv4 prefix: 198.51.100.35/24
    Action:
      Drop: True
    Result:
      Trap ID: User Defined
    Statistics:
      Units      Total       Accepted    Dropped
      Packets    4           0           4
      Bytes      424         0           424
  Ordinal: 8
    Match:
      Direction: ingress
      Source IPv4 prefix: 198.51.100.45/24
    Action:
      Drop: True
    Result:
      Trap ID: User Defined
    Statistics:
      Units      Total       Accepted    Dropped
      Packets    9           0           9
      Bytes      990         0           990
```

Example 4: Display ACL statistics information

```
supervisor@rtbrick>LEAF01: op> show acl statistics
ACL                             Units      Total       Accepted    Dropped
rule4                           Packets    4           0           4
                                Bytes      424         0           424
rule4                           Packets    9           0           9
                                Bytes      990         0           990
lldp.ifp-0/0/0.trap.rule        Packets    107         107         0
                                Bytes      13161       13161       0
lldp.ifp-0/1/0.trap.rule        Packets    221         221         0
                                Bytes      19227       19227       0
lldp.ifp-0/1/1.trap.rule        Packets    221         221         0
                                Bytes      19227       19227       0
lldp.ifp-0/1/4.trap.rule        Packets    214         214         0
                                Bytes      31672       31672       0
lldp.ifp-0/1/5.trap.rule        Packets    214         214         0
                                Bytes      31672       31672       0
lldp.ifp-0/1/6.trap.rule        Packets    214         214         0
                                Bytes      31672       31672       0
lldp.ifp-0/1/12.trap.rule       Packets    107         107         0
                                Bytes      13375       13375       0
lldp.ifp-0/1/13.trap.rule       Packets    107         107         0
                                Bytes      13375       13375       0
lldp.ifp-0/1/22.trap.rule       Packets    107         107         0
                                Bytes      13375       13375       0
lldp.ifp-0/1/23.trap.rule       Packets    107         107         0
                                Bytes      13375       13375       0
```

Example 5: Display ACL statistics information for the specified ACL

```
supervisor@rtbrick>LEAF01: op> show acl rule4 statistics
ACL         Units      Total       Accepted    Dropped
rule4       Packets    4           0           4
            Bytes      424         0           424
rule4       Packets    9           0           9
            Bytes      990         0           990
```