Introduction to `firewalld`

`firewalld` is a dynamic firewall management service in SUSE Linux Enterprise Server that provides precise control over incoming and outgoing network traffic. By abstracting complex netfilter rules into intuitive zones and predefined services, `firewalld` enables administrators to modify network security policies dynamically without disrupting active client connections or requiring full system restarts.

Prerequisites

- The `firewalld` package installed on the system
- Basic familiarity with the Linux command-line terminal

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1 About `firewalld`

`firewalld` is a dynamic firewall management service that provides a flexible and efficient way to control network traffic on Linux systems. It allows modifications without interrupting existing connections. The benefits of using `firewalld` are:

- *Dynamic configuration:* Apply changes instantly without breaking existing connections.
- *User-friendly interface:* Zones and services simplify complex firewall rules.
- *Abstraction:* There is no need to directly manipulate `nftables` rules for common scenarios.
- *Persistent configuration:* Easy management of rules that survive reboots.
- *Persistent configuration:* By default, `firewalld` operates on a `deny-all` principle by blocking all incoming traffic unless explicitly allowed.

1.1 `firewalld` zones

A firewall zone is a predefined set of rules that dictate how incoming and outgoing network traffic is handled for a specific network interface or source IP address. Each zone represents a different level of trust for the network it is associated with. You can apply different security policies based on where the network connection originates.

Zones are like security profiles. For example, you would want to apply different firewall rules for a public Wi-Fi connection and your secure home network. `firewalld` zones allow you to define these distinct sets of rules and apply them accordingly. A network connection is subject to the rules of only one `firewalld` zone. A `firewalld` zone can have many network interfaces or source IP addresses.

The `/usr/lib/firewalld/zones/` directory stores the predefined zones. For example:

```
>  /usr/lib/firewalld/zones ls
block.xml  dmz.xml  docker.xml  drop.xml  external.xml  home.xml  internal.xml  nm-
shared.xml  public.xml  trusted.xml  work.xml
```

Some of the default settings of the predefined zones are as follows:

`drop`

- *Trust level:* Completely untrusted.
- *Behavior:* All incoming network packets are dropped without any reply. Only outgoing connections initiated from the system are allowed. This provides a “stealth” mode where the system appears nonexistent to external attackers.
- *Use Case:* Used for maximum stealth and security, completely ignoring unwanted traffic. Suitable as a strict default for a server that should never accept incoming connections.

`block`

- *Trust level:* Very low.
- *Behavior:* All incoming network connections are rejected with an `icmp-host-prohibited` message for IPv4 and `cmp6-adm-prohibitedi` for IPv6. This informs the sender that their connection was explicitly rejected. Only outgoing connections initiated from the system are possible.
- *Use Case:* Applied when you want to explicitly signal to senders that their connection attempts are being blocked.

`public`

- *Trust level:* Untrusted or public.
- *Behavior:* Represents public, untrusted networks where you do not trust other systems. Only selected incoming connections are accepted by default for example, SSH, DHCPv6 client, etc.
- *Use Case:* Common default zone for interfaces connected directly to the Internet, such as your router's WAN interface. Also includes being connected to a network where you have no control over other devices.

`external`

- *Trust level:* External with masquerading.
- *Behavior:* Intended for external networks when the firewall acts as a gateway or router. Usually, NAT masquerading is enabled by default.Only selected incoming connections are accepted, under the assumption that you do not trust other systems on this network.
- *Use Case:* Used when your Linux machine acts as a router, connecting an internal private network to the public Internet. The external interface is placed in this zone to hide internal network topology while allowing internal clients to access external resources such as the Internet.

`dmz (Demilitarized Zone)`

- *Trust level:* Limited public access.
- *Behavior:* For systems in a DMZ zone that are publicly accessible but with limited access to the internal network. Only selected incoming connections are accepted. The default usually includes SSH and other services you expose.
- *Use Case:* Suitable for public-facing servers such as Web, mail and DNS servers. These servers are intentionally exposed to the Internet but are isolated from your internal, more trusted networks. Useful when you want to host services that need to be Internet-accessible while minimizing the risk to your core internal infrastructure.

`work`

- *Trust level:* Mostly trusted (work environment).
- *Behavior:* In a work environment, you usually trust other computers on the network. Allows selected incoming connections that are common in a work environment, such as SSH and DHCPv6 client.
- *Use Case:* Suitable for office networks and systems on a corporate LAN.

`home`

- *Trust level:* Mostly trusted (home environment).
- *Behavior:* In a home environment, you mostly trust the other systems on the network. Allows more services than public or external zones, often including common home network services like file sharing, media servers, and printers, along with SSH and DHCPv6 client.
- *Use case:* Best for home networks and small home office setups.

`trusted`

- *Trust level:* Highest.
- *Behavior:* All network connections are accepted without any filtering. Firewalling is not implemented for connections assigned to this zone.
- *Use Case:* Reserved for highly trusted connections.

1.2 `firewalld` policies and rules

`firewalld` policies provide a more advanced and flexible way to manage network traffic compared to traditional zones. They allow you to define rich rules that specify the source and destination of traffic, services, ports and actions such as accept, reject and drop. These policies are useful for setting up complex routing, port forwarding or creating isolated network segments within a single host.

`firewalld` policies leverage zones to define rule sets. They apply rules statefully and in one direction, which means you define traffic flow in one direction, and `firewalld` implicitly permits the return path. These policies link an ingress zone (where traffic enters) with an egress zone (where traffic exits). This defines the specific path and direction a policy's rules apply to. You can view the policies, for example:

```
>  /usr/lib/firewalld/policies ls
allow-host-ipv6.xml
```

Firewall rules let you precisely control network traffic, allowing or blocking it to protect your system from security threats. Firewall rules define certain criteria based on various attributes such as, source and destination IP addresses, ports and network interfaces. `firewalld` segregates firewall rules into zones and policies. Each zone in `firewalld` has a unique set of rules that dictates the traffic permissions for its associated network interfaces.

1.3 Services and ports

Services are recommended when a predefined service is available. For example, instead of remembering that HTTP uses TCP port 80, you can simply add the `http` service. This is less error-prone and easier to manage. Use ports when a service is not predefined or when you are using a custom port for a service. You can view the active services and ports for the default zones with the following:

```
> sudo  firewall-cmd --list-services
```

```
> sudo  firewall-cmd --list-ports
```

2 Managing firewall rules and zones

You can configure `firewalld` zones and their rules with the graphical Web interface Cockpit or the **`firewall-cmd`**utility for command-line control.

2.1 Managing firewall rules and zones using the **`firewalld-cmd`** utility

You can use the CLI interface to manage `firewalld` zones.

2.1.1 Adding `firewalld` zones

To add a new `firewalld` zone:

1. Create a new zone, for example:

```
> sudo firewall-cmd --permanent --new-zone=test
```

2. Set the trust level of the zone that defines the default behavior:

```
> sudo firewall-cmd --permanent --zone=example --set-target=trusted
```

3. Reload the `firewalld` service to apply the new configuration:

```
> sudo firewall-cmd --reload
```

2.1.2 Adding a service to a zone

To add a service to a zone:

1. List all services to check if your service is already predefined:

```
> sudo firewall-cmd --get-services
      0-AD RH-Satellite-6 RH-Satellite-6-capsule afp alvr amanda-client amanda-k5-
client amqp amqps anno-1602
      anno-1800 apcupsd audit ausweisapp2 bacula bacula-client bareos-director
 bareos-filedaemon bareos-storage bb bgp bitcoin bitcoin-rpc bitcoin-testnet
```

```
 bitcoin-testnet-rpc bittorrent-lsd ceph ceph-exporter ceph-mon cfengine checkmk-
agent civilization-iv civilization-v cockpit collectd condor-collector cratedb ctdb
 dds dds-multicast dds-unicast dhcp dhcpv6 dhcpv6-client distcc dns dns-over-quic
 dns-over-tls docker-registry docker-swarm dropbox-lansync elasticsearch etcd-client
 etcd-server factorio finger foreman foreman-proxy freeipa-4 freeipa-ldap freeipa-
ldaps freeipa-replication freeipa-trust ftp galera
      ganglia-client ganglia-master git gpsd grafana gre http http3 https ident imap
 imaps ipfs ipp ipp-client ipsec irc ircs
      [...]
```

2. You can add a service either temporarily for the runtime session or permanently, for example:

```
> sudo  firewall-cmd --zone=public --add-service=http
```

```
> sudo  firewall-cmd --zone=public --permanent --add-service=http
```

   The `--permanent` flag ensures the change persists across all reboots.

3. Reload the `firewalld` service to apply the new configuration:

```
> sudo firewall-cmd --reload
```

4. Verify the results:

```
> sudo firewall-cmd --zone=public --list-services
```

2.1.3 Adding a port to a zone

If your application does not have a predefined service, you can open a specific port or a range of ports.

1. You can either add a port temporarily for the runtime session or permanently, for example:

```
> sudo  firewall-cmd --zone=public --add-port=8080/tcp
```

```
> sudo  firewall-cmd --zone=public --permanent --add-port=8080/tcp
```

   The `--permanent`flag ensures the change persists across all reboots.

2. Reload the `firewalld` service to apply the new configuration:

```
> sudo firewall-cmd --reload
```

3. Verify the results:

```
> sudo firewall-cmd --zone=public --list-ports
```

2.1.4 Deleting `firewalld` zones

To delete a zone:

1. Verify the zone is not the default or in use:

```
> sudo  firewall-cmd --get-default-zone
```

   If the zone is in use or default, set a different zone, for example:

```
> sudo  firewall-cmd --set-default-zone=NEW_DEFAULT_ZONE
```

2. Check if any network interfaces are bound to the zone:

```
> sudo firewall-cmd --zone=ZONE_TO_BE_DELETED --list-all
```

3. The `interfaces` field in the output lists all the interfaces. Theses interfaces need to be reassigned to another zone. For example:

```
> sudo firewall-cmd --zone=public --permanent --change-interface=ITERFACE_NAME
```

4. Delete the zone:

```
> sudo firewall-cmd --permanent --delete-zone=ZONE_TO_BE_DELETED
```

5. Reload the `firewalld` service to apply the new configuration:

```
> sudo firewall-cmd --reload
```

2.2 Managing firewall rules and zones with Cockpit

Cockpit enables you to create new zones or update the existing ones. In the firewall settings, you can add services to a zone or allow access to ports.



Note: Cockpit service is mandatory

Do not remove the Cockpit service from the default firewall zone as the Cockpit service may get blocked, and you may get disconnected from the server.

2.2.1 Adding firewall zones

The *public zone* is the default firewall zone. To add a new zone, proceed as follows:

PROCEDURE 1: ADDING NEW FIREWALL ZONES

1. Navigate to the *Networking* page.
2. Click *Edit rules and zones*.
3. Click *Add new zone*.
4. Select *Trust level*. Each trust level of network connections has a predefined set of included services (the Cockpit service is included in all trust levels). The description for each trust level appears in the *Description* section.
5. Define allowed addresses within the zone. Select one of the values:
   - *Entire subnet* to allow all addresses in the subnet.
   - *Range*—a comma-separated list of IP addresses with the routing prefix, for example, 192.0.2.0/24, 2001:db8::/32.
6. Click *Add zone*.

2.2.2 Adding allowed services and ports to a zone

You can add services to an existing firewall zone as described below:

PROCEDURE 2: ADDING SERVICES TO A FIREWALL ZONE

1. Navigate to the *Networking* page.
2. Click *Edit rules and zones*.
3. Click *Add services*.
4. To add a service, select *Services* and choose the services from the list.
5. To allow custom ports, select *Custom ports* and specify the port value for UDP and/or TCP. You can assign an identifier to this port.
6. To confirm the changes, click *Add services* or *Add ports*, respectively.

3 Common `firewalld` commands

The **`firewall-cmd`** command-line tool is used to configure and manage the `firewalld` daemon. It is a powerful, dynamic utility that allows for the creation, modification, and deletion of firewall rules without requiring a full service restart, which prevents interruption of active network connections.

Some common **`firewall-cmd`** command examples include:

- Checking if `firewalld` is running. The outputs are `running`, `not running` or `RUNNING_BUT_FAILED`. For example:

```
> sudo firewall-cmd --state
running
```

- Listing all available zones, for example:

```
> sudo firewall-cmd --get-zones
 block dmz docker drop external home internal nm-shared public trusted work
```

- Viewing the default zone, for example:

```
> sudo firewall-cmd --get-default-zone
public
```

- Viewing the active zones and the assigned, for example:

```
> sudo firewall-cmd --get-active-zones
docker
interfaces: docker0
public (default)
interfaces: lo enp1s0
```

- Viewing all rules for the default zone, for example:

```
> sudo firewall-cmd --list-all
public (default, active)
target: default
ingress-priority: 0
egress-priority: 0
icmp-block-inversion: no
interfaces: enp1s0 lo
sources:
services: cockpit dhcpv6-client ssh
ports:
```

```
protocols:
forward: yes
masquerade: no
forward-ports:
source-ports:
icmp-blocks:
rich rules:
rule family="ipv4" source address="192.168.1.100" service name="ssh" accept
```

- Viewing all rules for a specific zone, for example:

```
> sudo firewall-cmd --zone=public --list-all
public (default, active)
target: default
ingress-priority: 0
egress-priority: 0
icmp-block-inversion: no
interfaces: enp1s0 lo
sources:
services: cockpit dhcpv6-client ssh
ports:
protocols:
forward: yes
masquerade: no
forward-ports:
source-ports:
icmp-blocks:
rich rules:
rule family="ipv4" source address="192.168.1.100" service name="ssh" accept
```

- Listing all available predefined services, for example:

```
> sudo firewall-cmd --get-services
  0-AD RH-Satellite-6 RH-Satellite-6-capsule afp alvr amanda-client amanda-k5-client
 amqp amqps anno-1602 anno-1800
  apcupsd audit ausweisapp2 bacula bacula-client bareos-director bareos-filedaemon
 bareos-storage bb bgp bitcoin bitcoin-rpc
  bitcoin-testnet bitcoin-testnet-rpc bittorrent-lsd ceph ceph-exporter ceph-mon
 cfengine checkmk-agent civilization-iv civilization-v
  cockpit collectd condor-collector cratedb ctdb dds dds-multicast dds-unicast dhcp
 dhcpv6 dhcpv6-client distcc dns dns-over-quic dns-over-tls
  docker-registry docker-swarm dropbox-lansync elasticsearch etcd-client etcd-server
 factorio finger foreman foreman-proxy freeipa-4 freeipa-ldap
  freeipa-ldaps freeipa-replication freeipa-trust ftp galera ganglia-client ganglia-
master git gpsd grafana gre http http3 https ident imap imaps
  ipfs ipp ipp-client ipsec irc ircs iscsi-target isns jenkins kadmin kdeconnect
 kerberos kibana klogin kpasswd kprop kshell kube-api kube-apiserver
```

```
  kube-control-plane kube-control-plane-secure kube-controller-manager kube-
controller-manager-secure kube-nodeport-services kube-scheduler kube-scheduler-
secure
  [...]
```

- Listing the services currently allowed in the default zone, for example:

```
> sudo firewall-cmd --list-services
cockpit dhcpv6-client ssh
```

- Adding a service to the default zone permanently, for example:

```
> sudo  firewall-cmd --permanent --add-service=http
success
```

- Removing a service permanently, for example:

```
> sudo firewall-cmd --permanent --remove-service=http
success
```

- Listing the ports currently open in the default zone, for example:

```
> sudo firewall-cmd --list-ports
22/tcp
```

- Opening a specific TCP port temporarily, for example:

```
> sudo firewall-cmd --add-port=8080/tcp
success
```

- Removing an open port permanently, for example:

```
> sudo firewall-cmd --permanent --remove-port=8080/tcp
success
```

- Adding an interface to a specific zone temporarily, for example:

```
> sudo firewall-cmd --zone=trusted --add-interface=eth1 f
success
```

4 `firewalld` troubleshooting

Troubleshooting `firewalld` involves checking its status, verifying rules, and restarting or reloading the service. If you encounter issues, you can enable debugging, examine logs and adjust firewall rules as needed.

4.1 Check `firewalld` status

- Use the **`systemctl status`** command, for example:

```
> sudo systemctl status  firewalld.service
● firewalld.service - firewalld - dynamic firewall daemon
Loaded: loaded (/usr/lib/systemd/system/firewalld.service; enabled; preset: enabled)
Active: active (running) since Thu 2025-07-17 09:47:36 CEST; 5min ago
Invocation: a7ea482f16d2431fa92d6204c297ebd9
Docs: man:firewalld(1)
Main PID: 921 (firewalld)
Tasks: 2
CPU: 262ms
CGroup: /system.slice/firewalld.service
        └─921 /usr/bin/python3.13 /usr/sbin/firewalld --nofork --nopid
```

- The **`firewall-cmd --state`** command gives a quick status check with `running`, `not running` or `RUNNING_BUT_FAILED` outputs. For example:

```
> sudo firewall-cmd --state
running
```

- If `firewalld` is not running, use the **`systemctl start firewalld`** command.

```
> sudo  systemctl start firewalld
```

- If the `firewalld` service is masked, unmask it first, then enable and start it, for example:

```
> sudo systemctl unmask --now firewalld
```

```
> sudo systemctl enable firewalld
```

```
> sudo systemctl start firewalld
```

4.2 Check `firewalld` rules

- The **`firewall-cmd --list-all-zones`** command displays all zones and their rules, for example:

```
> sudo firewall-cmd --list-all-zones
        block
          target: %%REJECT%%
          ingress-priority: 0
          egress-priority: 0
          icmp-block-inversion: no
          interfaces:
          sources:
          services:
          ports:
          protocols:
          forward: yes
          masquerade: no
          forward-ports:
          source-ports:
          icmp-blocks:
          rich rules:

        dmz
          target: default
          ingress-priority: 0
          egress-priority: 0
          icmp-block-inversion: no
          interfaces:
          sources:
          services: ssh
          ports:
          protocols:
          forward: yes
          masquerade: no
          forward-ports:
          source-ports:
          icmp-blocks:
          rich rules:

        docker (active)
          target: ACCEPT
          ingress-priority: 0
          egress-priority: 0
          icmp-block-inversion: no
```

```
          [...]
```

- The **`firewall-cmd --list-ports`** command shows open ports,for example:

```
> sudo firewall-cmd --list-ports
22/tcp
```

- The **`firewall-cmd --zone=`***`YOUR_ZONE`* **`--list-all.`** command lists ports for specific zones, for example:

```
> sudo firewall-cmd --zone=dmz --list-all
               dmz
                 target: default
                 ingress-priority: 0
                 egress-priority: 0
                 icmp-block-inversion: no
                 interfaces:
                 sources:
                 services: ssh
                 ports:
                 protocols:
                 forward: yes
                 masquerade: no
                 forward-ports:
                 source-ports:
                 icmp-blocks:
                 rich rules:
```

4.3 Debugging `firewalld`

- Enable debugging in `/etc/sysconfig/firewalld` by adding `--debug=[level]` to `FIREWALLD_ARGS`, for example:

```
> sudo  vi /etc/sysconfig/firewalld
# firewalld command line args
# possible values: --debug
FIREWALLD_ARGS=--debug=[level]
```

- Start `firewalld` with the `--debug`option, for example:

```
> sudo firewalld --nofork --debug
2025-07-23 11:10:05 DEBUG1: start()
2025-07-23 11:10:05 DEBUG1: Loading firewalld config file '/etc/firewalld/
firewalld.conf'
```

```
2025-07-23 11:10:05 DEBUG1: CleanupOnExit is set to 'True'
2025-07-23 11:10:05 DEBUG1: CleanupModulesOnExit is set to 'False'
2025-07-23 11:10:05 DEBUG1: IPv6 rpfilter is enabled
2025-07-23 11:10:05 DEBUG1: LogDenied is set to 'off'
2025-07-23 11:10:05 DEBUG1: FirewallBackend is set to 'nftables'
2025-07-23 11:10:05 DEBUG1: FlushAllOnReload is set to 'False'
2025-07-23 11:10:05 DEBUG1: RFC3964_IPv4 is set to 'True'
2025-07-23 11:10:05 DEBUG1: NftablesFlowtable is set to 'off'
2025-07-23 11:10:05 DEBUG1: NftablesCounters is set to 'False'
2025-07-23 11:10:05 DEBUG1: Loading lockdown whitelist
2025-07-23 11:10:05 ipset not usable, disabling ipset usage in firewall. Other set
 backends (nftables) remain usable.
2025-07-23 11:10:05 iptables-restore and iptables are missing, IPv4 direct rules
 won't be usable.
2025-07-23 11:10:05 ip6tables-restore and ip6tables are missing, IPv6 direct rules
 won't be usable.
2025-07-23 11:10:05 ebtables-restore and ebtables are missing, eb direct rules won't
 be usable.
2025-07-23 11:10:05 DEBUG1: Loading icmptype file '/usr/lib/firewalld/icmptypes/
address-unreachable.xml'
2025-07-23 11:10:05 DEBUG1: Loading icmptype file '/usr/lib/firewalld/icmptypes/bad-
header.xml'
2025-07-23 11:10:05 DEBUG1: Loading icmptype file '/usr/lib/firewalld/icmptypes/
beyond-scope.xml'
2025-07-23 11:10:05 DEBUG1: Loading icmptype file '/usr/lib/firewalld/icmptypes/
communication-prohibited.xml'
2025-07-23 11:10:05 DEBUG1: Loading icmptype file '/usr/lib/firewalld/icmptypes/
destination-unreachable.xml'
[...]
```

All log files are available at `/var/log/firewalld`.

5 More information

To learn more about `firewalld`, refer to the following resources:

- The official source for concepts, architecture, how-to and links to all man pages. (https://firewalld.org/documentation/)
- Man page essential for understanding command-line interaction with `firewalld` (https://firewalld.org/documentation/man-pages/firewall-cmd.html)
- A comprehensive resource with excellent explanations and practical examples that also cover `nftables`. (https://wiki.archlinux.org/title/Firewalld)

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