FortiGate-5000 Series
Version 3.0 MR5
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Introduction

This FortiGate-5000 Series Backplane Communications Guide contains information, instructions and example configurations involving the base backplane network interfaces of FortiGate-5000 series systems.

FortiGate-5140, FortiGate-5050 and FortiGate-5020 chassis base backplanes can provide a communications medium between blade modules. FortiGate-5140 and FortiGate-5050 chassis base backplanes can also provide a communications medium to other chassis' base backplanes, or to the network. Supported base backplane use varies by configuration and by chassis and module types, but can include:

• high availability (HA) cluster connection
• multi-channel HA cluster connection failover
• inter-chassis HA cluster connection
• multi-channel inter-chassis HA cluster connection failover
• network connection between modules
• inter-chassis network connection between modules
• network connection to the Internet or other network

For specific instructions and examples of your model’s supported features, see the chapter for your chassis model.

Note: This guide assumes basic familiarity with FortiGate-5000 series hardware. For hardware and other available documentation, see “Fortinet documentation” on page 7.

This guide does not discuss fabric backplane communications, or configurations involving FortiController. For information on FortiController, see the FortiController-5208 System Guide.

This section includes the following topics:

• Warnings and cautions
• About this document
• Fortinet documentation
• Customer service and technical support

Warnings and cautions

Only trained and qualified personnel should be allowed to install or maintain FortiGate-5000 series equipment. Read and comply with all warnings, cautions and notices in this document.

Caution: You should be aware of the following cautions and warnings before installing FortiGate-5000 series hardware.
Warnings and cautions

Introduction

- Turning off all power switches may not turn off all power to the FortiGate equipment. Except where noted, disconnect the FortiGate equipment from all power sources, telecommunications links and networks before installing, or removing FortiGate components, or performing other maintenance tasks. Failure to do this can result in personal injury or equipment damage. Some circuitry in the FortiGate equipment may continue to operate even though all power switches are off.

- An easily accessible disconnect device, such as a circuit breaker, should be incorporated into the data center wiring that connects power to the FortiGate equipment.

- Install FortiGate chassis at the lower positions of a rack to avoid making the rack top-heavy and unstable.

- Do not insert metal objects or tools into open chassis slots.

- Electrostatic discharge (ESD) can damage FortiGate equipment. Only perform the procedures described in this document from an ESD workstation. If no such station is available, you can provide some ESD protection by wearing an anti-static wrist or ankle strap and attaching it to an ESD connector or to a metal part of a FortiGate chassis.

- Some FortiGate components may overload your supply circuit and impact your overcurrent protection and supply wiring. Refer to nameplate ratings to address this concern.

- Make sure all FortiGate components have reliable grounding. Fortinet recommends direct connections to the branch circuit.

- If you install a FortiGate component in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Make sure the operating ambient temperature does not exceed the manufacturer's maximum rated ambient temperature.

- Installing FortiGate equipment in a rack should be such that the amount of airflow required for safe operation of the equipment is not compromised.

- This equipment is for installation only in a Restricted Access Location (dedicated equipment room, service closet or the like), in accordance with the National Electrical Code.

- Per the National Electrical Code, sizing of a Listed circuit breaker or branch circuit fuse and the supply conductors to the equipment is based on the marked input current rating. A product with a marked input current rating of 25 A is required to be placed on a 40 A branch circuit. The supply conductors will also be sized according to the input current rating and also derated for the maximum rated operating ambient temperature, Tma, of the equipment.

- FortiGate equipment shall be installed and connected to an electrical supply source in accordance with the applicable codes and regulations for the location in which it is installed. Particular attention shall be paid to use of correct wire type and size to comply with the applicable codes and regulations for the installation / location. Connection of the supply wiring to the terminal block on the equipment may be accomplished using Listed wire compression lugs, for example, Pressure Terminal Connector made by Ideal Industries Inc. or equivalent which is suitable for AWG 10. Particular attention shall be given to use of the appropriate compression tool specified by the compression lug manufacturer, if one is specified.
About this document

This document includes the following chapters:

- FortiGate-5140 base backplane communication describes supported configurations and features for FortiGate-5140 chassis backplane communications.
- FortiGate-5050 base backplane communication describes supported configurations and features for FortiGate-5050 chassis backplane communications.
- FortiGate-5020 base backplane communication describes supported configurations and features for FortiGate-5020 chassis backplane communications.

Fortinet documentation

The most up-to-date publications and previous releases of Fortinet product documentation are available from the Fortinet Technical Documentation web site at http://docs.forticare.com. All FortiGate-5000 information is available from the FortiGate-5000 page.

Fortinet Tools and Documentation CD

All Fortinet documentation is available from the Fortinet Tools and Documentation CD shipped with your Fortinet product. The documents on this CD are current at shipping time. For up-to-date versions of Fortinet documentation see the Fortinet Technical Documentation web site at http://docs.forticare.com.

Fortinet Knowledge Center

Additional Fortinet technical documentation is available from the Fortinet Knowledge Center. The knowledge center contains troubleshooting and how-to articles, FAQs, technical notes, and more. Visit the Fortinet Knowledge Center at http://kc.forticare.com.

The FortiGate Log Message Reference is available exclusively from the Fortinet Knowledge Center, the FortiGate Log Message Reference describes the structure of FortiGate log messages and provides information about the log messages that are generated by FortiGate units.

Comments on Fortinet technical documentation

Please send information about any errors or omissions in this document, or any Fortinet technical documentation, to techdoc@fortinet.com.

Customer service and technical support

Fortinet Technical Support provides services designed to make sure that your Fortinet systems install quickly, configure easily, and operate reliably in your network.

Please visit the Fortinet Technical Support web site at http://support.fortinet.com to learn about the technical support services that Fortinet provides.
FortiGate-5140 base backplane communication

Both the FortiGate-5140 and the FortiGate-5050 chassis have two base backplane Ethernet channels. Available connections to these channels vary by slot number.

- Slot 1 can connect to the chassis’ first base backplane channel, and thereby all other slots, except slot 2.
- Slot 2 can connect to the chassis’ second base backplane channel, and thereby all other slots, except slot 1.
- Other slots can connect to either or both channels, but only directly reach slot 1 or slot 2. Connections to other slots through the base backplane channels must pass through slot 1 or slot 2.

**Note:** For more information on chassis architecture, see ATCA (Advanced Telecom Computing Architecture) specifications.

Because of the base backplane’s dual star topology, connecting to or through the base backplane typically involves FortiSwitch modules installed in slot 1, slot 2, or both slots. FortiSwitch-5003 modules switch base backplane traffic between modules in other slots. FortiSwitch-5003 front panel ZRE interfaces can also connect the chassis’ base backplane to external entities, such as a management computer, the network, or the base backplane of another chassis.

**Figure 1:** FortiSwitch-5003 front panel, including ZRE interfaces

**Note:** FortiSwitch-5003 modules do not support VLAN tagging, so VLAN traffic cannot occur through the FortiGate-5050 and FortiGate-5140 chassis base backplanes.

When viewing a FortiGate module’s web-based manager, names of base backplane interfaces connecting through a FortiSwitch module vary by FortiGate model.
This section contains example HA and network configurations for each hardware combination. It also discusses how to choose an appropriate amount and slot number of FortiSwitch modules for base backplane HA.

This section includes the following topics:

- HA configurations
- Network configurations

### HA configurations

Valid HA hardware configurations can be formed from FortiGate modules located in either the same or multiple FortiGate-5050 or FortiGate-5140 chassis, with either one or two FortiSwitch modules per chassis.

Inter-chassis HA configuration requirements are identical to HA configuration within the same chassis, except for these additional requirements.

- Link multiple chassis’ base backplanes by connecting ZRE interfaces of FortiSwitch modules which have the same slot number.
- If each chassis contains only one FortiSwitch module, install each FortiSwitch module in matching slot numbers. For example, you could link HA members in separate FortiGate-5140 and FortiGate-5050 chassis. If one chassis has only one FortiSwitch module installed in slot 2, the other chassis’ FortiSwitch module must also be installed in slot 2. For details, see “Choosing the slot position” on page 20.

  If you do not install each chassis’ FortiSwitch module in matching slot numbers, instead of forming a single cluster, this forms multiple clusters, some using port9 (or base1) for HA heartbeat communication, and some using port10 (or base2).

It makes no difference whether you use the ZRE0, ZRE1, or ZRE2 interface to link the base backplanes. You can connect an Ethernet cable, either straight-through or crossover, from any of these interfaces on one FortiSwitch-5003 module to any of these interfaces on another FortiSwitch-5003 module installed in the other chassis. You can also use the ZRE interfaces to connect more than two chassis together.

The model of connected chassis does not necessarily have to be the same. Because the base backplane architectures of the FortiGate-5050 and FortiGate-5140 chassis are the same, and because their base backplanes can be connected through FortiSwitch modules, you can connect FortiGate-5140 and FortiGate-5050 chassis together and form clusters between these different model chassis.

<table>
<thead>
<tr>
<th>Model</th>
<th>Name of base backplane interface 1 (to slot 1)</th>
<th>Name of base backplane interface 2 (to slot 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>port9</td>
<td>port10</td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>port9</td>
<td>port10</td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>base1</td>
<td>base2</td>
</tr>
</tbody>
</table>

Table 1: Names of base backplane interfaces by FortiGate model
Default heartbeat interfaces vary by the model of the FortiGate modules, and are not always base backplane interfaces. For example, FortiGate-5005FA2 modules use fabric1 and fabric2, the fabric backplane rather than the base backplane, as the default heartbeat interfaces. If this is the case, to send heartbeat communications through the base backplane, you must enable and adjust the priority of the base backplane interfaces.

**Two FortiSwitch modules per chassis**

Installing two FortiSwitch-5003 modules provides two base backplane HA heartbeat and synchronization channels, and two configuration options:

- Configure heartbeat interface failover to maintain communications through the base backplane. For example, if you have FortiGate-5001SX clusters, you could configure clusters to use port10 as the primary heartbeat interface, and port9 as a backup if port10 fails or is disconnected, such as could occur if a FortiSwitch module fails or is removed.
- Separate multiple sensitive or high volume communications, such as HA communications for multiple clusters. For example, if you have two busy FortiGate-5001SX clusters, you might configure one cluster to use port9 for HA heartbeat traffic and the other to use port10.

Required steps vary by which way you want to use the two channels.

**Note:** More than one cluster can use the same base backplane channel for HA communication. To separate HA communications of multiple clusters using the same channel, configure a different HA Group Name and Password for each cluster.
Figure 3: Inter-chassis HA cluster with two available base backplane heartbeat interfaces (through FortiSwitch-5003 modules in slot 1 and slot 2)

Separating HA clusters by channel
Configuring HA clusters to use separate channels essentially causes each cluster to behave as if it has only one available FortiSwitch module. For instructions on configuring each cluster to use a separate base backplane interface, see "One FortiSwitch module per chassis" on page 15.

Heartbeat failover between channels
To configure your HA cluster with a heartbeat that fails over between the two base backplane interfaces, both base backplane interfaces must be enabled and:

- if priorities are not equal, must have the highest priorities of all heartbeat interfaces
- if priorities are equal, be the first interfaces on the indexed Heartbeat Interface list
If you also want to specify which FortiSwitch module is used as the primary or failover, its priority must be greater than the failover interface, or it must have a higher position in the Heartbeat Interface list. Position in the Heartbeat Interface list varies by the model of the FortiGate modules.

You can satisfy these requirements in multiple ways by adjusting interface priority or by disabling heartbeats over other interfaces. Required steps vary by the model of your FortiGate modules, and the number and Heartbeat Interface list position of other interfaces enabled as HA heartbeat interfaces.

**Figure 4:** FortiGate-5001SX/FortiGate-5001FA2 heartbeat failover from slot 2 (port10) to slot 1 (port9)
Figure 5: FortiGate-5005FA2 heartbeat failover from slot 1 (base1) to slot 2 (base2)

To configure HA interface failover to use two FortiSwitch modules

1. Insert FortiSwitch modules into slot 1 and slot 2 of each chassis.

   If you want to form HA clusters between FortiGate modules in separate chassis, link the base backplanes of each chassis by connecting FortiSwitch modules’ front panel ZRE interfaces with an Ethernet cable.

   For example hardware installations, see Figure 2 on page 11 and Figure 3 on page 12. For details on hardware installation and related warnings and cautions, see the FortiGate-5000 Series Introduction.

2. Insert FortiGate modules into any remaining chassis slot.

3. Power on each chassis.

4. On each FortiGate module to be included in the HA cluster, go to System > Config > HA.

5. Select the Mode, then enter the Group Name, and Password.

   You may also want to set other options, such as the Device Priority or session pick-up. For detailed instructions, see the FortiGate HA Guide.

6. If the base backplane interfaces do not have heartbeat interface precedence, increase the precedence of the base backplane interfaces so that they are selected as the primary and first failover heartbeat interface.
If interface priorities are not all equal, set the base backplane interfaces’ priority to a higher value than all other interfaces.

If interface priorities are all equal, set the base backplane interfaces’ priority to a higher value than all other interfaces, or disable interfaces listed above the base backplane interfaces in the Heartbeat Interface list. For some FortiGate models, FortiSwitch slot positions, or configurations of other HA interfaces, this may mean that no change is required. The table below describes where changes are required, and if so, what kind.

Table 2: Changes to configure base backplane HA, assuming initially equal interface priorities

<table>
<thead>
<tr>
<th>Model</th>
<th>FortiSwitch slot</th>
<th>Other HA interfaces enabled?</th>
<th>HA interface config change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>1</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

1. If you want to select a different base backplane interface as the primary heartbeat interface, increase its priority.

8. Select OK.

One FortiSwitch module per chassis

Installing a single FortiSwitch-5003 module provides a single base backplane HA heartbeat and synchronization channel.

Note: More than one cluster can use the same base backplane channel for HA communication. To separate HA communications of multiple clusters using the same channel, configure a different HA Group Name and Password for each cluster.
Unlike hardware configurations involving two FortiSwitch modules per chassis, when installing only one FortiSwitch module per chassis, the slot position of the FortiSwitch module becomes an important consideration. Single FortiSwitch-5003 modules should usually be installed in slot 2 for FortiGate-5001SX and FortiGate-5001FA2 clusters, but slot 1 for FortiGate-5005FA2 clusters. For details on the effects of slot positioning of a single FortiSwitch module in HA configurations, see “Slot position and HA heartbeat interface precedence” on page 20.

Note: Using a single FortiSwitch-5003 module for HA heartbeat communication introduces a single point of failure. If this FortiSwitch-5003 module fails or is removed, HA heartbeat communication will be interrupted. For enhanced reliability, you can add a second FortiSwitch-5003 module. You can also improve reliability by connecting and configuring one or more other heartbeat interfaces.

Figure 6: HA cluster with one available base backplane heartbeat interface (through FortiSwitch-5003 module in slot 2)

To configure your HA cluster to use the base backplane interface connected through a single FortiSwitch, the base backplane interface must be enabled as a heartbeat interface and:

- if priorities are not equal, have the highest priority of all heartbeat interfaces
• if priorities are equal, be the first interface on the indexed Heartbeat Interface list

You can satisfy these requirements in multiple ways by adjusting interface priority or by disabling heartbeats over other interfaces. Required steps vary by the slot position of the FortiSwitch module, the model of your FortiGate modules, and the number and Heartbeat Interface list position of other interfaces enabled as heartbeat interfaces.

**Figure 7:** FortiGate-5001SX/FortiGate-5001FA2 HA through slot 2 (port10) with failover to a non-base backplane interface

<table>
<thead>
<tr>
<th>High Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
</tr>
<tr>
<td>Device Priority</td>
</tr>
</tbody>
</table>

**Cluster Settings**

- Group Name: FGT-HA
- Password: ***
- Enable Session Pick-up

<table>
<thead>
<tr>
<th>Port Monitor</th>
<th>Heartbeat Interface</th>
<th>Enable</th>
<th>Priority (0-512)</th>
</tr>
</thead>
<tbody>
<tr>
<td>port1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port0</td>
<td>X</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>port2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>port8</td>
<td>X</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>port9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To configure HA communications to use one FortiSwitch module

1 Insert FortiSwitch modules into slot 1 or slot 2 of each chassis.

When installing only one FortiSwitch module per chassis, recommended slot number varies by the model of the FortiGate modules. For details on the effects of slot number, see “Slot position and HA heartbeat interface precedence” on page 20.

If you want to form HA clusters between FortiGate modules in separate chassis, install each FortiSwitch module into matching slot numbers in each chassis, then link the base backplanes of each chassis by connecting FortiSwitch modules' front panel ZRE interfaces with an Ethernet cable.

For example hardware installations, see Figure 6 on page 16 and Figure 3 on page 12. For details on hardware installation and related warnings and cautions, see the FortiGate-5000 Series Introduction.

2 Insert FortiGate modules into any remaining chassis slot.

3 Power on each chassis.

4 On each FortiGate module to be included in the HA cluster, go to System > Config > HA.
Select the Mode, then enter the Group Name, and Password.
You may also want to set other options, such as the Device Priority or session pick-up. For detailed instructions, see the *FortiGate HA Guide*.

If the base backplane interface does not have heartbeat interface precedence, increase the precedence of the base backplane interface so that it is selected as the primary heartbeat interface.

**Note:** Heartbeat interface precedence can be determined by multiple factors, including Priority and position in the Heartbeat Interface list. For details, see “Slot position and HA heartbeat interface precedence” on page 20.

- If interface priorities are *not* all equal, set the base backplane interface’s priority to a higher value than all other interfaces.
- If interface priorities are all equal, set the base backplane interface’s priority to a higher value than all other interfaces, or disable interfaces listed above the base backplane interface in the Heartbeat Interface list. For some FortiGate models, FortiSwitch slot positions, or configurations of other HA interfaces, this may mean that no change is required. The table below describes where changes are required, and if so, what kind.

Table 3: Changes to configure base backplane HA, assuming initially equal interface priorities

<table>
<thead>
<tr>
<th>Model</th>
<th>FortiSwitch slot</th>
<th>Other HA interfaces enabled?</th>
<th>HA interface config change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>1</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Select OK.
Choosing the slot position

Depending on the types of communications, HA or other, that you want to pass through your FortiSwitch modules, you may choose to install FortiSwitch-5003 modules in different slots: slot 1, slot 2, or both. (Other hardware configurations are possible but often not preferable for various reasons, such as points of failure or base backplane topology.)

When using FortiSwitch modules to provide a network connection to the base backplane, slot position does not matter. However, you can improve robustness by installing FortiSwitch modules in both slots and providing a redundant link.

For all types of communication, using both slots has the advantage of improving reliability of communications through or to the base backplane because no FortiSwitch is a single point of failure. Using both slots also provides the option of separating multiple sensitive or high volume communications, such as HA communications for multiple clusters.

Note: For HA configurations, you can further improve fault tolerance by adding one or more non-base backplane interfaces as heartbeat interface failovers.

However, if you install only one FortiSwitch module, in addition to fault tolerance considerations, the slot position has additional effects specific to HA.

• Inter-chassis HA configurations require that the switch use the same slot number in each chassis so that each cluster member’s configuration uses the same heartbeat interface.
• Slot position affects HA heartbeat interface selection and failover order.

Slot position and HA heartbeat interface precedence

When installing only one FortiSwitch-5003 module with an HA cluster of FortiGate-5001SX or FortiGate-5001FA2 modules, it is usually preferable to use slot 2. This allows you to connect one or more of the other FortiGate-5001SX or FortiGate-5001FA2 interfaces as backup HA heartbeat interfaces.

The preferred FortiSwitch module slot is different for FortiGate-5005FA2 module HA clusters. In this case, it is usually preferable to use slot 1.

The reason for selecting different slots is related to the mechanism for heartbeat interface selection, which is indirectly tied to slot number.

During heartbeat interface selection, the heartbeat interface with the highest priority is selected first. If multiple heartbeat interfaces have highest priority, including when all have equal priority, the HA cluster chooses a heartbeat interface using the Heartbeat Interface list.

This list is sorted into hash map order, rather than purely by alphabetical order or purely by interface number value comparisons. As a result, the list is sorted primarily alphabetically by interface name (for example, base1 is before port1), then secondarily by index numbers:

• 1
• 10
• 2 through 8
• 9
Because interface names, and therefore sort order, vary by FortiGate model, the preferred slot number for single FortiSwitch modules varies by FortiGate model. For example, a FortiGate-5001SX or FortiGate-5001FA2 module has interfaces named port1 through port10; port9 and port10 are equally weighted heartbeat interfaces, connected to the slot 1 FortiSwitch and the slot 2 FortiSwitch, respectively. In the Heartbeat Interface list, port1 is first. However, port10 is not last: due to hash map lookup, port10 is selected after port1 and before port2, not after port9. Failover passes heartbeat communications from the FortiSwitch module in slot 2 to slot 1.

There are additional considerations if you create additional heartbeat backup interfaces connecting FortiGate module interfaces port2 through port8. In this case, if the FortiSwitch module in slot 2 fails or is removed, the FortiGate cluster could fail over to port2 through port8, and lastly fail over to the interface connected to the FortiSwitch module in slot 1.

Because of this behavior, if you install a single FortiSwitch module in slot 1 with those two models of FortiGate modules, and want to give heartbeat selection precedence to the base backplane interface, you must set its heartbeat interface priority to a greater value than the other interfaces. Otherwise, by default, when priorities are equal, the heartbeat link through the base backplane interface will be used only in failover, rather than primary, conditions. This is typically the inverse of intended behavior.

**Network configurations**

In addition to HA traffic, FortiSwitch modules can pass other traffic types through or to the base backplane.

*Note:* FortiSwitch-5003 modules do not support VLAN-tagged packets, so VLAN traffic cannot occur through the FortiGate-5050 and FortiGate-5140 chassis base backplanes.

Like HA scenarios, network configurations can involve one or two FortiSwitch modules per chassis, and one or more chassis.

However, unlike HA scenarios, modules connecting to transfer other traffic types need not use identical interface numbers on each side of the connection, and therefore they do not require FortiSwitch modules installed in the same slot numbers. Because of this, by connecting one of the ZRE interfaces on each slot’s FortiSwitch module to another, you can send non-HA traffic between FortiGate modules that use different base backplane interfaces.

For example, if an HA cluster of FortiGate-5005FA2 modules using base1 (slot 1) for heartbeat traffic need to send some traffic to a second HA cluster of modules in the same chassis that use base2 (slot 2) for their heartbeat traffic, you can connect the two clusters across the two base backplane channels by linking one of the ZRE interfaces on the slot 1 FortiSwitch module to one of the ZRE interfaces on the slot 2 FortiSwitch module.
In addition to linking base backplane traffic between FortiGate modules, you can use FortiSwitch modules to link traffic between FortiGate modules’ base backplane interfaces and your network, or the Internet. Connecting a ZRE interface to the network links the base backplane, and any connected FortiGate modules, to the network.

Required steps vary by whether you want to use the base backplane interfaces to connect FortiGate modules to each other, or to the network. These scenarios are not mutually exclusive; you can simultaneously provide both.

**Note:** You can also combine network configurations with HA configurations to send both traffic types through the base backplane channel(s). However, because heavy heartbeat or network traffic load can interfere with the other traffic type’s performance, it is generally preferable to separate those traffic types to different base backplane interfaces. This requires two FortiSwitch modules per chassis.

### Connecting FortiGate modules to each other

By installing one or two FortiSwitch modules per chassis, you can connect FortiGate modules to each other through their base backplane interfaces.

Hardware configurations are identical to single and multiple chassis configurations for HA traffic, except the additional possibility of connecting FortiSwitch modules that have been installed in different slot numbers. Connecting FortiSwitch modules located in different slot numbers allows communication between the two base backplane channels.

Configure FortiGate modules to communicate through the base backplane interfaces as you would other interfaces.

### Connecting FortiGate modules to the network

By installing one or two FortiSwitch modules per chassis, you can connect FortiGate modules to the network or Internet through their base backplane interfaces.

There are several ways you can connect FortiGate modules to the network, depending on your available hardware and other goals such as hardware redundancy.

- The most basic way to connect FortiGate modules to the network through the base backplane is to connect one of the FortiSwitch module’s ZRE interfaces to the network.
- By installing a second FortiSwitch module per chassis, you can provide a redundant network or Internet connection.
- By connecting ZRE interfaces of other chassis’ FortiSwitch modules to the ZRE interface of the FortiSwitch module connected to the network, you can provide a shared network or Internet connection.

Configure FortiGate modules to communicate with the network through the base backplane interfaces as you would other interfaces.
FortiGate-5050 base backplane communication

Both the FortiGate-5140 and the FortiGate-5050 chassis have two base backplane Ethernet channels. Available connections to these channels vary by slot number:

- Slot 1 can connect to the chassis’ first base backplane channel, and thereby all other slots, except slot 2.
- Slot 2 can connect to the chassis’ second base backplane channel, and thereby all other slots, except slot 1.
- Other slots can connect to either or both channels, but only directly reach slot 1 or slot 2. Connections to other slots through the base backplane channels must pass through slot 1 or slot 2.

Note: For more information on chassis architecture, see ATCA (Advanced Telecom Computing Architecture) specifications.

Because of the base backplane’s dual star topology, connecting to or through the base backplane typically involves FortiSwitch modules installed in slot 1, slot 2, or both slots. FortiSwitch-5003 modules switch base backplane traffic between modules in other slots. FortiSwitch-5003 front panel ZRE interfaces can also connect the chassis’ base backplane to external entities, such as a management computer, the network, or the base backplane of another chassis.

Figure 9: FortiSwitch-5003 front panel, including ZRE interfaces

Note: FortiSwitch-5003 modules do not support VLAN tagging, so VLAN traffic cannot occur through the FortiGate-5050 and FortiGate-5140 chassis base backplanes.

When viewing a FortiGate module’s web-based manager, names of base backplane interfaces connecting through a FortiSwitch module vary by FortiGate model.
This section contains example HA and network configurations for each hardware combination. It also discusses how to choose an appropriate amount and slot number of FortiSwitch modules for base backplane HA.

This section includes the following topics:

- **HA configurations**
- **Network configurations**

## HA configurations

Valid HA hardware configurations can be formed from FortiGate modules located in either the same or multiple FortiGate-5050 or FortiGate-5140 chassis, with either one or two FortiSwitch modules per chassis.

Inter-chassis HA configuration requirements are identical to HA configuration within the same chassis, except for these additional requirements.

- Link multiple chassis’ base backplanes by connecting ZRE interfaces of FortiSwitch modules which have the same slot number.
- If each chassis contains only one FortiSwitch module, install each FortiSwitch module in matching slot numbers. For example, you could link HA members in separate FortiGate-5140 and FortiGate-5050 chassis. If one chassis has only one FortiSwitch module installed in slot 2, the other chassis’ FortiSwitch module must also be installed in slot 2. For details, see “Choosing the slot position” on page 34.

If you do not install each chassis’ FortiSwitch module in matching slot numbers, instead of forming a single cluster, this forms multiple clusters, some using port9 (or base1) for HA heartbeat communication, and some using port10 (or base2).

It makes no difference whether you use the ZRE0, ZRE1, or ZRE2 interface to link the base backplanes. You can connect an Ethernet cable, either straight-through or crossover, from any of these interfaces on one FortiSwitch-5003 module to any of these interfaces on another FortiSwitch-5003 module installed in the other chassis. You can also use the ZRE interfaces to connect more than two chassis together.

The model of connected chassis does not necessarily have to be the same. Because the base backplane architectures of the FortiGate-5050 and FortiGate-5140 chassis are the same, and because their base backplanes can be connected through FortiSwitch modules, you can connect FortiGate-5140 and FortiGate-5050 chassis together and form clusters between these different model chassis.

<table>
<thead>
<tr>
<th>Model</th>
<th>Name of base backplane interface 1 (to slot 1)</th>
<th>Name of base backplane interface 2 (to slot 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>port9</td>
<td>port10</td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>port9</td>
<td>port10</td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>base1</td>
<td>base2</td>
</tr>
</tbody>
</table>
Default heartbeat interfaces vary by the model of the FortiGate modules, and are not always base backplane interfaces. For example, FortiGate-5005FA2 modules use fabric1 and fabric2, the fabric backplane rather than the base backplane, as the default heartbeat interfaces. If this is the case, to send heartbeat communications through the base backplane, you must enable and adjust the priority of the base backplane interfaces.

**Two FortiSwitch modules per chassis**

Installing two FortiSwitch-5003 modules provides two base backplane HA heartbeat and synchronization channels, and two configuration options:

- Configure heartbeat interface failover to maintain communications through the base backplane. For example, if you have FortiGate-5001SX clusters, you could configure clusters to use port10 as the primary heartbeat interface, and port9 as a backup if port10 fails or is disconnected, such as could occur if a FortiSwitch module fails or is removed.
- Separate multiple sensitive or high volume communications, such as HA communications for multiple clusters. For example, if you have two busy FortiGate-5001SX clusters, you might configure one cluster to use port9 for HA heartbeat traffic and the other to use port10.

Required steps vary by which way you want to use the two channels.

**Note:** More than one cluster can use the same base backplane channel for HA communication. To separate HA communications of multiple clusters using the same channel, configure a different HA Group Name and Password for each cluster.

**Figure 10: HA cluster with two available base backplane heartbeat interfaces (through FortiSwitch-5003 modules in slot 1 and slot 2)**
Separating HA clusters by channel

Configuring HA clusters to use separate channels essentially causes each cluster to behave as if it has only one available FortiSwitch module. For instructions on configuring each cluster to use a separate base backplane interface, see “One FortiSwitch module per chassis” on page 29.

Heartbeat failover between channels

To configure your HA cluster with a heartbeat that fails over between the two base backplane interfaces, both base backplane interfaces must be enabled and:

- if priorities are not equal, must have the highest priorities of all heartbeat interfaces
- if priorities are equal, be the first interfaces on the indexed Heartbeat Interface list

If you also want to specify which FortiSwitch module is used as the primary or failover, its priority must be greater than the failover interface, or it must have a higher position in the Heartbeat Interface list. Position in the Heartbeat Interface list varies by the model of the FortiGate modules.
You can satisfy these requirements in multiple ways by adjusting interface priority or by disabling heartbeats over other interfaces. Required steps vary by the model of your FortiGate modules, and the number and Heartbeat Interface list position of other interfaces enabled as HA heartbeat interfaces.

**Figure 12: FortiGate-5001SX/FortiGate-5001FA2 heartbeat failover from slot 2 (port10) to slot 1 (port9)**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Active-Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Priority</td>
<td>129</td>
</tr>
</tbody>
</table>

**Cluster Settings**

- **Group Name**: FG1-HA
- **Password**: ***
- **Enable Session Pid-up**: [ ]

<table>
<thead>
<tr>
<th>Port</th>
<th>Monitor</th>
<th>Heartbeat Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>port1</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port2</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port3</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port4</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port5</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port6</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port7</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port8</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port9</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>port10</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### About the Diagram

- **Mode**: The mode of operation can be either Active or Passive.
- **Device Priority**: The priority assigned to the device.
- **Cluster Settings**
  - **Group Name**: The name of the cluster group.
  - **Password**: The password for the cluster group.
  - **Enable Session Pid-up**: Enables or disables session initiation packets.
- **Heartbeat Interface**
  - **Port**: The port number.
  - **Monitor**: Indicates whether heartbeat monitoring is enabled (checked) or not (unchecked).
  - **Enable**: Indicates whether heartbeat is enabled (checked) or not (unchecked).
  - **Priority**: The priority assigned to the heartbeat interface.
**Figure 13: FortiGate-5005FA2 heartbeat failover from slot 1 (base1) to slot 2 (base2)**

### High Availability

<table>
<thead>
<tr>
<th>Mode</th>
<th>Active-Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Priority</td>
<td>128</td>
</tr>
</tbody>
</table>

#### Cluster Settings

<table>
<thead>
<tr>
<th>Group Name</th>
<th>FGT-HA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Password</td>
<td>****</td>
</tr>
</tbody>
</table>

#### Heartbeat Interface

<table>
<thead>
<tr>
<th>Port Monitor</th>
<th>Heartbeat Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>Priority (0-512)</td>
</tr>
</tbody>
</table>

- `base1`: Enable, Priority 50
- `base2`: Enable, Priority 50
- `fabric1`: Disable, Disable
- `fabric2`: Disable, Disable
- `port1`: Disable, Disable
- `port2`: Disable, Disable
- `port3`: Disable, Disable
- `port4`: Disable, Disable
- `port5`: Disable, Disable
- `port6`: Disable, Disable
- `port7`: Disable, Disable
- `port8`: Disable, Disable

---

**To configure HA interface failover to use two FortiSwitch modules**

1. Insert FortiSwitch modules into slot 1 and slot 2 of each chassis.

If you want to form HA clusters between FortiGate modules in separate chassis, link the base backplanes of each chassis by connecting FortiSwitch modules' front panel ZRE interfaces with an Ethernet cable.

For example hardware installations, see Figure 10 on page 25 and Figure 11 on page 26. For details on hardware installation and related warnings and cautions, see the *FortiGate-5000 Series Introduction*.

2. Insert FortiGate modules into any remaining chassis slot.
3. Power on each chassis.
4. Insert FortiGate modules into any remaining chassis slot.
5. Power on each chassis.
6. On each FortiGate module to be included in the HA cluster, go to **System > Config > HA**.
7. Select the Mode, then enter the Group Name, and Password.

You may also want to set other options, such as the Device Priority or session pick-up. For detailed instructions, see the *FortiGate HA Guide*. 
If the base backplane interfaces do not have heartbeat interface precedence, increase the precedence of the base backplane interfaces so that they are selected as the primary and first failover heartbeat interface.

**Note:** Heartbeat interface precedence can be determined by multiple factors, including Priority and position in the Heartbeat Interface list. For details, see “Slot position and HA heartbeat interface precedence” on page 34.

- If interface priorities are not all equal, set the base backplane interfaces’ priority to a higher value than all other interfaces.
- If interface priorities are all equal, set the base backplane interfaces’ priority to a higher value than all other interfaces, or disable interfaces listed above the base backplane interfaces in the Heartbeat Interface list. For some FortiGate models, FortiSwitch slot positions, or configurations of other HA interfaces, this may mean that no change is required. The table below describes where changes are required, and if so, what kind.

**Table 5: Changes to configure base backplane HA, assuming initially equal interface priorities**

<table>
<thead>
<tr>
<th>Model</th>
<th>FortiSwitch slot</th>
<th>Other HA interfaces enabled?</th>
<th>HA interface config change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>1</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

9. If you want to select a different base backplane interface as the primary heartbeat interface, increase its priority.

10. Select OK.

**One FortiSwitch module per chassis**

Installing a single FortiSwitch-5003 module provides a single base backplane HA heartbeat and synchronization channel.
HA configurations

**Note:** More than one cluster can use the same base backplane channel for HA communication. To separate HA communications of multiple clusters using the same channel, configure a different HA Group Name and Password for each cluster.

Unlike hardware configurations involving two FortiSwitch modules per chassis, when installing only one FortiSwitch module per chassis, the slot position of the FortiSwitch module becomes an important consideration. Single FortiSwitch-5003 modules should usually be installed in slot 2 for FortiGate-5001SX and FortiGate-5001FA2 clusters, but slot 1 for FortiGate-5005FA2 clusters. For details on the effects of slot positioning of a single FortiSwitch module in HA configurations, see “Slot position and HA heartbeat interface precedence” on page 34.

**Note:** Using a single FortiSwitch-5003 module for HA heartbeat communication introduces a single point of failure. If this FortiSwitch-5003 module fails or is removed, HA heartbeat communication will be interrupted. For enhanced reliability, you can add a second FortiSwitch-5003 module. You can also improve reliability by connecting and configuring one or more other heartbeat interfaces.

**Figure 14:** HA cluster with one available base backplane heartbeat interface (through FortiSwitch-5003 module in slot 2)

To configure your HA cluster to use the base backplane interface connected through a single FortiSwitch, the base backplane interface must be enabled as a heartbeat interface and:

- if priorities are not equal, have the highest priority of all heartbeat interfaces
- if priorities are equal, be the first interface on the indexed Heartbeat Interface list

You can satisfy these requirements in multiple ways by adjusting interface priority or by disabling heartbeats over other interfaces. Required steps vary by the slot position of the FortiSwitch module, the model of your FortiGate modules, and the number and Heartbeat Interface list position of other interfaces enabled as heartbeat interfaces.
Figure 15: FortiGate-5001SX/FortiGate-5001FA2 HA through slot 2 (port10) with failover to a non-base backplane interface

<table>
<thead>
<tr>
<th>Mode</th>
<th>Active-Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Priority</td>
<td>128</td>
</tr>
</tbody>
</table>

### Cluster Settings

- Group Name: FGT-HA
- Password: ***
- Enable Session Pick-up

<table>
<thead>
<tr>
<th>Port Monitor</th>
<th>Heartbeat Interface</th>
<th>Enable</th>
<th>Priority (0-512)</th>
</tr>
</thead>
<tbody>
<tr>
<td>port1</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port10</td>
<td>False</td>
<td>True</td>
<td>50</td>
</tr>
<tr>
<td>port2</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port3</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port4</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port5</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port6</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port7</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>port8</td>
<td>False</td>
<td>True</td>
<td>50</td>
</tr>
<tr>
<td>port9</td>
<td>False</td>
<td>False</td>
<td>0</td>
</tr>
</tbody>
</table>
To configure HA communications to use one FortiSwitch module

1 Insert FortiSwitch modules into slot 1 or slot 2 of each chassis.

When installing only one FortiSwitch module per chassis, recommended slot number varies by the model of the FortiGate modules. For details on the effects of slot number, see “Slot position and HA heartbeat interface precedence” on page 34.

If you want to form HA clusters between FortiGate modules in separate chassis, install each FortiSwitch module into matching slot numbers in each chassis, then link the base backplanes of each chassis by connecting FortiSwitch modules’ front panel ZRE interfaces with an Ethernet cable.

For example hardware installations, see Figure 14 on page 30 and Figure 11 on page 26. For details on hardware installation and related warnings and cautions, see the FortiGate-5000 Series Introduction.

2 Insert FortiGate modules into any remaining chassis slot.

3 Power on each chassis.

4 On each FortiGate module to be included in the HA cluster, go to System > Config > HA.
5 Select the Mode, then enter the Group Name, and Password.
You may also want to set other options, such as the Device Priority or session pick-up. For detailed instructions, see the *FortiGate HA Guide*.

6 If the base backplane interface does not have heartbeat interface precedence, increase the precedence of the base backplane interface so that it is selected as the primary heartbeat interface.

**Note:** Heartbeat interface precedence can be determined by multiple factors, including Priority and position in the Heartbeat Interface list. For details, see “Slot position and HA heartbeat interface precedence” on page 34.

- If interface priorities are *not* all equal, set the base backplane interface’s priority to a higher value than all other interfaces.
- If interface priorities are all equal, set the base backplane interface’s priority to a higher value than all other interfaces, or disable interfaces listed above the base backplane interface in the Heartbeat Interface list. For some FortiGate models, FortiSwitch slot positions, or configurations of other HA interfaces, this may mean that no change is required. The table below describes where changes are required, and if so, what kind.

### Table 6: Changes to configure base backplane HA, assuming initially equal interface priorities

<table>
<thead>
<tr>
<th>Model</th>
<th>FortiSwitch slot</th>
<th>Other HA interfaces enabled?</th>
<th>HA interface config change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>No</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>1</td>
<td>No</td>
<td>Increase priority of port9, or disable other HA interfaces.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>No</td>
<td>If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>1</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

7 Select OK.
Choosing the slot position

Depending on the types of communications, HA or other, that you want to pass through your FortiSwitch modules, you may choose to install FortiSwitch-5003 modules in different slots: slot 1, slot 2, or both. (Other hardware configurations are possible but often not preferable for various reasons, such as points of failure or base backplane topology.)

When using FortiSwitch modules to provide a network connection to the base backplane, slot position does not matter. However, you can improve robustness by installing FortiSwitch modules in both slots and providing a redundant link.

For all types of communication, using both slots has the advantage of improving reliability of communications through or to the base backplane because no FortiSwitch is a single point of failure. Using both slots also provides the option of separating multiple sensitive or high volume communications, such as HA communications for multiple clusters.

However, if you install only one FortiSwitch module, in addition to fault tolerance considerations, the slot position has additional effects specific to HA.

- Inter-chassis HA configurations require that the switch use the same slot number in each chassis so that each cluster member’s configuration uses the same heartbeat interface.
- Slot position affects HA heartbeat interface selection and failover order.

Slot position and HA heartbeat interface precedence

When installing only one FortiSwitch-5003 module with an HA cluster of FortiGate-5001SX or FortiGate-5001FA2 modules, it is usually preferable to use slot 2. This allows you to connect one or more of the other FortiGate-5001SX or FortiGate-5001FA2 interfaces as backup HA heartbeat interfaces.

The preferred FortiSwitch module slot is different for FortiGate-5005FA2 module HA clusters. In this case, it is usually preferable to use slot 1.

The reason for selecting different slots is related to the mechanism for heartbeat interface selection, which is indirectly tied to slot number.

During heartbeat interface selection, the heartbeat interface with the highest priority is selected first. If multiple heartbeat interfaces have highest priority, including when all have equal priority, the HA cluster chooses a heartbeat interface using the Heartbeat Interface list.

This list is sorted into hash map order, rather than purely by alphabetical order or purely by interface number value comparisons. As a result, the list is sorted primarily alphabetically by interface name (for example, base1 is before port1), then secondarily by index numbers:

- 1
- 10
- 2 through 8
- 9
Because interface names, and therefore sort order, vary by FortiGate model, the preferred slot number for single FortiSwitch modules varies by FortiGate model. For example, a FortiGate-5001SX or FortiGate-5001FA2 module has interfaces named port1 through port10; port9 and port10 are equally weighted heartbeat interfaces, connected to the slot 1 FortiSwitch and the slot 2 FortiSwitch, respectively. In the Heartbeat Interface list, port1 is first. However, port10 is not last: due to hash map lookup, port10 is selected after port1 and before port2, not after port9. Failover passes heartbeat communications from the FortiSwitch module in slot 2 to slot 1.

There are additional considerations if you create additional heartbeat backup interfaces connecting FortiGate module interfaces port2 through port8. In this case, if the FortiSwitch module in slot 2 fails or is removed, the FortiGate cluster could fail over to port2 through port8, and lastly fail over to the interface connected to the FortiSwitch module in slot 1.

Because of this behavior, if you install a single FortiSwitch module in slot 1 with those two models of FortiGate modules, and want to give heartbeat selection precedence to the base backplane interface, you must set its heartbeat interface priority to a greater value than the other interfaces. Otherwise, by default, when priorities are equal, the heartbeat link through the base backplane interface will be used only in failover, rather than primary, conditions. This is typically the inverse of intended behavior.

**Network configurations**

In addition to HA traffic, FortiSwitch modules can pass other traffic types through or to the base backplane.

**Note:** FortiSwitch-5003 modules do not support VLAN-tagged packets, so VLAN traffic cannot occur through the FortiGate-5050 and FortiGate-5140 chassis base backplanes.

Like HA scenarios, network configurations can involve one or two FortiSwitch modules per chassis, and one or more chassis.

However, unlike HA scenarios, modules connecting to transfer other traffic types need not use identical interface numbers on each side of the connection, and therefore they do not require FortiSwitch modules installed in the same slot numbers. Because of this, by connecting one of the ZRE interfaces on each slot's FortiSwitch module to another, you can send non-HA traffic between FortiGate modules that use different base backplane interfaces.

For example, if an HA cluster of FortiGate-5005FA2 modules using base1 (slot 1) for heartbeat traffic need to send some traffic to a second HA cluster of modules in the same chassis that use base2 (slot 2) for their heartbeat traffic, you can connect the two clusters across the two base backplane channels by linking one of the ZRE interfaces on the slot 1 FortiSwitch module to one of the ZRE interfaces on the slot 2 FortiSwitch module.
In addition to linking base backplane traffic between FortiGate modules, you can use FortiSwitch modules to link traffic between FortiGate modules’ base backplane interfaces and your network, or the Internet. Connecting a ZRE interface to the network links the base backplane, and any connected FortiGate modules, to the network.

Required steps vary by whether you want to use the base backplane interfaces to connect FortiGate modules to each other, or to the network. These scenarios are not mutually exclusive; you can simultaneously provide both.

**Note:** You can also combine network configurations with HA configurations to send both traffic types through the base backplane channel(s). However, because heavy heartbeat or network traffic load can interfere with the other traffic type’s performance, it is generally preferable to separate those traffic types to different base backplane interfaces. This requires two FortiSwitch modules per chassis.

### Connecting FortiGate modules to each other

By installing one or two FortiSwitch modules per chassis, you can connect FortiGate modules to each other through their base backplane interfaces.

Hardware configurations are identical to single and multiple chassis configurations for HA traffic, except the additional possibility of connecting FortiSwitch modules that have been installed in different slot numbers. Connecting FortiSwitch modules located in different slot numbers allows communication between the two base backplane channels.

Configure FortiGate modules to communicate through the base backplane interfaces as you would other interfaces.

### Connecting FortiGate modules to the network

By installing one or two FortiSwitch modules per chassis, you can connect FortiGate modules to the network or Internet through their base backplane interfaces.

There are several ways you can connect FortiGate modules to the network, depending on your available hardware and other goals such as hardware redundancy.

- The most basic way to connect FortiGate modules to the network through the base backplane is to connect one of the FortiSwitch module’s ZRE interfaces to the network.
- By installing a second FortiSwitch module per chassis, you can provide a redundant network or Internet connection.
- By connecting ZRE interfaces of other chassis’ FortiSwitch modules to the ZRE interface of the FortiSwitch module connected to the network, you can provide a shared network or Internet connection.

Configure FortiGate modules to communicate with the network through the base backplane interfaces as you would other interfaces.
FortiGate-5020 base backplane communication

The FortiGate-5020 chassis has two base backplane Ethernet channels. FortiGate modules installed in each slot can directly connect to the other slot through either channel.

Because of the base backplane’s topology, connecting FortiGate modules to each other through the base backplane does not require any additional hardware (that is, FortiSwitch modules are not required). Modules connect to each other directly through the base backplane as soon as they are installed.

The FortiGate-5020 base backplane can only be used to connect FortiGate modules located in the same chassis. You cannot link the base backplanes of multiple chassis to form inter-chassis HA clusters, and you cannot connect FortiGate modules to the network through their base backplane interfaces.

Instead, inter-chassis HA or network traffic must pass through a FortiGate module front panel interface. In these cases, additional hardware, such as an external switch or Ethernet cables, may be required.

This section includes the following topics:

- HA configurations
- Inter-chassis HA configurations
- Network configurations

HA configurations

For a single FortiGate-5020 chassis, configuring HA between two FortiGate modules through their base backplane interfaces is identical to configuring HA between their front panel interfaces, except that their base backplane interfaces are used. No additional hardware or cabling is required.

Because there are two available base backplane interfaces, you can configure heartbeat interface failover to maintain communications through the base backplane in the event of interface failure. For example, if you have a FortiGate-5001SX cluster, you could configure the cluster to use port10 as the primary heartbeat interface, and port9 as a backup if port10 fails.

**Note:** For enhanced reliability, connect and configure heartbeat failover to one or more non-base backplane interfaces.

Heartbeat interface failover order is contingent on heartbeat interface Priority and/or position in the Heartbeat Interface list. For details, see "Slot position and HA heartbeat interface precedence" on page 34.
Heartbeat failover between channels

To configure your HA cluster with a heartbeat that fails over between the two base backplane interfaces, both base backplane interfaces must be enabled and:

- if priorities are not equal, must have the highest priorities of all heartbeat interfaces
- if priorities are equal, be the first interfaces on the indexed Heartbeat Interface list

If you also want to specify which base backplane channel is used as the primary or failover, its priority must be greater than the failover interface, or it must have a higher position in the Heartbeat Interface list. Position in the Heartbeat Interface list varies by the model of the FortiGate modules.

You can satisfy these requirements in multiple ways by adjusting interface priority or by disabling heartbeats over other interfaces. Required steps vary by the model of your FortiGate modules, and the number and Heartbeat Interface list position of other interfaces enabled as heartbeat interfaces.

Default heartbeat interfaces vary by the model of the FortiGate modules, and are not always base backplane interfaces. For example, FortiGate-5005FA2 modules use the fabric backplane (fabric1 and fabric2), rather than the base backplane, by default. If this is the case, to send heartbeat traffic through the base backplane, you must enable and adjust the priority of the base backplane interfaces. Conversely, FortiGate-5001SX and FortiGate-5001FA2 modules use base backplane heartbeat interfaces by default, and do not require modification.

Figure 17: HA cluster with two available base backplane heartbeat interfaces (directly connected through the base backplane)
Figure 18: FortiGate-5001SX/FortiGate-5001FA2 heartbeat failover between base backplane channels

<table>
<thead>
<tr>
<th>Port Monitor</th>
<th>Heartbeat Interface</th>
<th>Enable</th>
<th>Priority (0-512)</th>
</tr>
</thead>
<tbody>
<tr>
<td>port1</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port10</td>
<td></td>
<td>✔</td>
<td>50</td>
</tr>
<tr>
<td>port2</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port3</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port4</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port5</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port6</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port7</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port8</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>port9</td>
<td></td>
<td>✔</td>
<td>50</td>
</tr>
</tbody>
</table>
To configure heartbeat interface failover between two base backplane channels

1. Insert FortiGate modules into the chassis slots.
   For details on hardware installation and related warnings and cautions, see the FortiGate-5000 Series Introduction.

2. Power on each chassis.

3. On each FortiGate module to be included in the HA cluster, go to System > Config > HA.

4. Select the Mode, then enter the Group Name, and Password.
   You may also want to set other options, such as the Device Priority or session pick-up. For detailed instructions, see the FortiGate HA Guide.

5. If the base backplane interfaces do not have heartbeat interface precedence, increase the precedence of the base backplane interfaces so that they are selected as the primary and first failover heartbeat interface.

Note: Heartbeat interface precedence can be determined by multiple factors, including Priority and position in the Heartbeat Interface list. For details, see “Slot position and HA heartbeat interface precedence” on page 20.
• If interface priorities are not all equal, set the base backplane interfaces' priority to a higher value than all other interfaces.
• If interface priorities are all equal, set the base backplane interfaces' priority to a higher value than all other interfaces, or disable interfaces listed above the base backplane interfaces in the Heartbeat Interface list. For some FortiGate models or configurations of other HA interfaces, this may mean that no change is required. The table below describes where changes are required, and if so, what kind.

Table 7: Changes to configure base backplane HA, assuming initially equal interface priorities

<table>
<thead>
<tr>
<th>Model</th>
<th>Other HA interfaces enabled?</th>
<th>HA interface config change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FortiGate-5001SX</td>
<td>No</td>
<td>Increase priority of port9, or disable non-base backplane HA interfaces. If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5001FA2</td>
<td>No</td>
<td>Increase priority of port9, or disable non-base backplane HA interfaces. If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
<tr>
<td>FortiGate-5005FA2</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Increase priority of port9, or disable non-base backplane HA interfaces. If port1 is an HA interface, increase priority of port10 or disable port1.</td>
</tr>
</tbody>
</table>

6 If you want to select a different base backplane interface as the primary heartbeat interface, increase its priority.
7 Select OK.

Inter-chassis HA configurations

Base backplane HA clustering between multiple FortiGate-5020 chassis is not supported. To configure HA for FortiGate modules installed in separate FortiGate-5020 chassis, you must instead connect the heartbeat through FortiGate module front panel interfaces.

Note: For enhanced reliability, connect and configure heartbeat failover between two or more non-base backplane interfaces.

Figure 20 on page 42 shows an HA cluster of four FortiGate-5001SX modules installed in two separate FortiGate-5020 chassis. For each FortiGate module in the example cluster:
• port1 connects to an internal network switch
• port2 connects to an external network switch, which is connected to the Internet
• port7 and port8 connect to switches that handle only heartbeat traffic
• port3 to port6 are not used
Inter-chassis HA configurations

Figure 20: FortiGate-5020 inter-chassis network and heartbeat connections

By default, FortiGate-5001SX modules use port9 and port10 (the base backplane interfaces) as heartbeat interfaces. Because base backplane interfaces cannot be used in inter-chassis configurations, if you want to form an inter-chassis HA cluster, these default heartbeat interfaces should be disabled. In the above example, the front panel interfaces port7 and port8 are enabled as heartbeat interfaces, and port9 and port10 are disabled.
Network configurations

In addition to HA traffic, the FortiGate-5020 chassis base backplane can pass other traffic types, including VLAN tagged network traffic.

FortiGate modules do not necessarily have to be the same model. For example, if you install a FortiGate-5005FA2 and a FortiGate-5001SX module in the same FortiGate-5020 chassis, you can send network traffic between base1 of the FortiGate-5005FA2 module and port9 of the FortiGate-5001SX module. You can also send network traffic between base2 of the FortiGate-5005FA2 and port10 on the FortiGate-5001SX module.

Traffic cannot traverse base backplane channels. For example, if you have installed two FortiGate-5001SX modules in the same FortiGate-5020 chassis, port9 on the module in slot1 can only send traffic to port9 in slot 2; port9 in slot 1 cannot send traffic to port10 in slot 2.

The FortiGate-5020 chassis base backplane only supports networking between FortiGate modules located in the same FortiGate-5020 chassis. Unlike FortiGate-5140 and FortiGate-5050 chassis, you cannot use the FortiGate-5020 base backplane to connect FortiGate modules to modules in another chassis, or to the network, through their base backplane interfaces. Inter-chassis traffic and traffic with the Internet or internal network must pass through a FortiGate module front panel interface. In these cases, additional hardware, such as an external switch or Ethernet cables, may be required.

Configure FortiGate modules to send network traffic through the base backplane interfaces as you would other interfaces.

Figure 22: Network connection between two modules in the same chassis
Figure 23: Network connection between modules in separate chassis, to the Internet, and to the internal network
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