

How do I set up STP/RSTP/MSTP and Alpha Ring on an EtherWAN Switch?

Choosing the Spanning Tree Protocols

The Spanning Tree algorithm works by designating a single switch (The Root Bridge) in the network, as the root or the parent to all the switches. All the switches in the network will use the same algorithm to form unique paths all the way back to the Root Bridge. Some switches establish a blocking point (a port on a switch) somewhere along the path to prevent a loop. There are 3 versions of the Spanning Tree protocol, STP, RSTP, MSTP, and they are all backwards compatible with each other.

Spanning Tree Protocol (STP)

This is the original Spanning Tree protocol, and it has been superseded by both the RSTP and MSTP protocol. It is based on a network with a maximum diameter of no more than 17 switches. It uses timers to synchronize any changes in the network topology, and this could take minutes. It is not recommended that you use this version of the Spanning Tree protocol.

Rapid Spanning Tree protocol (RSTP)

The RSTP protocol is the new enhanced version of the original STP protocol. It uses an enhanced negotiation mechanism to directly synchronize any topology changes between switches; it no longer uses timers as in the original STP protocol, which results in a faster re-convergence time. The maximum allowed network diameter for the RSTP protocol is 40 switches.

Multiple Spanning Tree Protocol (MSTP)

The MSTP protocol extends the RSTP protocol by simultaneously running multiple instances of the Spanning Tree Protocol and mapping different VLANs to each instance, thus providing load balance across multiple switches. The MSTP protocol accomplishes this by creating new extended sections within the RSTP protocol, called Regions. Each region runs its own instance of the Spanning Tree Protocol. Within each Region, the MSTP protocol can accommodate a network diameter of up to 40 switches. There can be a maximum of 40 Regions in a single MSTP network.

Configuring RSTP

To navigate to the [STP/Ring Global Configuration](#) page, click on the + next to [STP/Ring](#) and then click on [Global Configuration](#).

Enabling the RSTP Protocol

RSTP is enabled by Default. If RSTP has been disabled and you wish to enable it:

1. Click the dropdown box next to **Spanning Tree** Protocol and choose **Enable**.
2. Click on the dropdown box next to **STP Version** and select **RSTP**.
3. Click on the **Update Setting** button.

Additional Global Configuration page settings

- **Bridge Priority** – Bridge Priority is used to set the Root and backup Root Bridge. For more details see [The Root Bridge & Backup Root Bridge](#).
 - Default is 32768. Range is 0 to 61440.
- **Hello Time** – This tells how often a BPDU (Bridge Protocol Data Unit) is sent. Default is 2 seconds. Range is 1 to 10 seconds.

- **Max Age** – Default is 20. Hop count limit for BPDU packets
- **Forward Delay** - Default is 15 sec.

Note: Bridge Protocol Data Units (BPDUs) are frames that contain information about the Spanning tree protocol (STP). Switches send BPDUs using a unique MAC address from its origin port and a multicast address as destination MAC (01:80:C2:00:00:00). There are three kinds of BPDUs:

- Configuration BPDU, used by Spanning Tree Protocol to provide information to all switches.
- TCN (Topology change), tells about changes in the topology.
- TCA (Topology change Acknowledgment), confirm the reception of the TCN.

The Root Bridge & Backup Root Bridge

To configure the Spanning Tree protocol on your network, you will need to setup a Root Bridge and Backup Root Bridge. In order to configure a switch to be the Root Bridge of a Spanning Tree network, you have to make sure that the Bridge Priority (which is the most significant 4 bits of the Bridge ID) of the switch is the lowest among any of the switches on the network. Similarly for the Backup Root Bridge, it must have the next lowest Bridge Priority of all the switches.

Note: Since the **Bridge Priority** is the most significant 4 bit of the Bridge ID, the lowest **Bridge Priority** will always be the Root Bridge and the second lowest **Bridge Priority** will be the Backup Root Bridge. If all switches have the same **Bridge Priority**, then The 12 bit System ID or MAC Address (if the system ID's are the same) will be used to determine the Root and Backup Root Bridge.

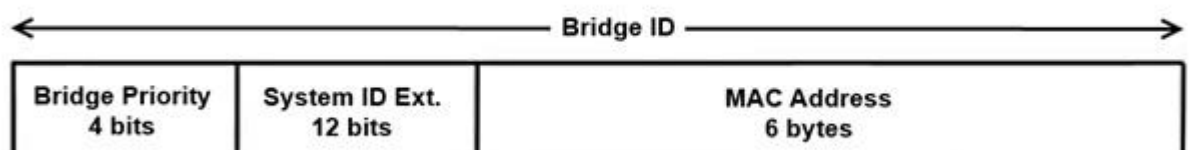


Figure 2: Bridge ID

Bridge ID is a concatenation of 3 values: a 4 bit Bridge Priority (most significant), a 12 bit System ID (less significant), and the 48 bit MAC address of the local switch (least significant).

Setting the Root Bridge and Backup Root Bridge

To set the Bridge Priority:

1. Enter the **Bridge Priority ID** in the text box to the right of **Bridge Priority (0..61440)**
2. Click on the **Update Setting** button.



Note: The valid values for this parameter are from 0 to 61440, in increments of 4096; you will see this value reflected in the first hexadecimal digit of the **Bridge ID** field after you click the **Update Setting** button. Set this value to be less than any other switch on the network, in order to make this switch the Root Switch. To set a **Backup Root Bridge** set the **Bridge ID** to be between the **Root Bridge** and the rest of the network switches.

Setting the MAX Age, Forward Delay and Hello Timer

The Network Diameter

The Diameter of a network depends on the type of topology your network uses. In a ring topology, the Network Diameter is the total number of switches in a network minus the Root Bridge. In a star topology, the Network Diameter is the maximum number of hops to get from Root Bridge to the switch that is the most hops away. In the RSTP protocol, the **Max Age** parameter is used as a hop count limit on how far the Spanning Tree protocol packet can propagate throughout the network topology, therefore, it must be configured with a value that is greater than the network diameter.

Relationship between Max Age, Forward Delay and Hello Time

The following rules must be followed when setting the **Max Age, Forward Delay** and **Hello Timer**:

- Max Age $\geq 2 \times$ (Hello Time + 1.0 second)
- $2 \times$ (Forward Delay – 1.0 second) \geq Max Age

To change the **Max Age**, **Forward Delay** and **Hello Timer**

1. Enter the **Max Age** in the text box to the right of Max Age (6..40 sec) label.
2. Enter the **Hello Time** in the text box to the right of the Hello Time (1..10 sec) label.
3. Enter the **Forward Delay** in the text box to the right of the Forward Delay (4..30 sec) label.
4. Click on the **Update Setting** button.
5. Save the configuration.

RSTP Port Setting Page

Spanning Tree Port Roles

In a stable RSTP topology, each port on a switch can function in any one of 4 different Spanning Tree port roles. These Spanning Tree port roles are:

- Root Port
- Designated Port
- Alternate Port
- Backup Port

Path Cost & Port Priority

By default, each port on a Spanning Tree switch will be assigned a **Path Cost** based on the port's transmission speed according to the IEEE standard below:

Link speed	Recommended value
Less than or equal 100Kb/s	200,000,000
1 Mb/s	20,000,000
10 Mb/s	2,000,000

100 Mb/s	200,000
1 Gb/s	20,000
10 Gb/s	2,000
100 Gb/s	200
1 Tb/s	20
10 Tb/s	2

By default each port on a Spanning Tree switch will be assigned a Port Priority of 128, according to the IEEE standard. This Port Priority is part of the Port ID, which is a concatenation of 2 values: Port Priority (4 bits) + Interface ID (12 bits)



Port Priority is part of the Port ID, which is a concatenation of 2 values: Port Priority (4 bits) + Interface ID (12 bits).

The default values will work fine in most scenarios; however, there are times when you may need to adjust these values manually in order to influence the location of the Alternate Port, the Root Port or the Backup Port.

To adjust the Port Priority value or the Path Cost value on a port:

1. Choose the correct port from the drop down list under **Port**.
2. Enter the proper value under the **Priority (Granularity 16)**
 - a. The Port Priority range is between 0 and 240 in multiples of 16.
3. Enter the proper value under the **Admin. Path Cost** text entry box.
 - a. The Path Cost range is between 1 and 200,000,000.
4. Click on the **Update Setting** button
5. Save your configuration

Point to Point Link

By default, RSTP will assume any full-duplex link as a **Point to Point Link**, but if the switch detects that the neighbor switch is not running the RSTP protocol, it will assume the port to be a **Shared Port**. You can force a port to be a **Shared Port**, if you know in advance that there will be more than one switch connecting to this link (through an unmanaged switch, for example), or if you know in advance that the other switch on this link will be running the older STP protocol.

To manually force a port to be a **Shared Port** or a **Point to Point Link**:

1. Choose the correct port from the drop down list under **Port**, and choose **Enable** or **Disable** under **Point to Point Link**.
2. Click on the **Update Setting** button.
3. Save the configuration

Edge Port

By enabling the **Edge Port** feature on a port, the switch will stop reacting to any linkup event on this port, and will not send out any Topology Change notification to the neighbor bridges.

1. Choose the correct port from the drop down list under **Port**, and choose **Enable** or **Disable** under **Edge Port**.
2. Click on the **Update Setting** button.
3. Save the configuration

RSTP Configuration Using CLI Commands

Enabling the Spanning Tree Protocol

To enable the Spanning Tree function on a switch, use the following CLI commands:

CLI Command Mode: **Global Configuration Mode**

CLI Command Syntax:
no bridge shutdown 1
bridge 1 protocol rstp vlan-bridge

Usage Example:

```
switch_a(config)#no bridge shutdown 1  
switch_a(config)#bridge 1 protocol rstp vlan-bridge
```

Bridge Priority, Max Age, Forward Delay, and Hello

Time

To configure the Bridge Priority, Max Age, Forward Delay, and Hello Time of a Spanning Tree Bridge, please use the following CLI commands:

CLI Command Mode: **Global Configuration Mode**

CLI Command Syntax:
bridge 1 priority <0-61440>
bridge 1 max-age <6-40>
bridge 1 forward-time <4-30>
bridge 1 hello-time <1-10>

Usage Example:

```
switch_a(config)#bridge 1 priority 4096  
switch_a(config)#bridge 1 max-age 20  
switch_a(config)#bridge 1 forward-time 15  
switch_a(config)#bridge 1 hello-time 2
```

Modifying the Port Priority and Path Cost

To modify the Port Priority and Path Cost on a switch, use the below CLI commands:

CLI Command Mode: **Interface Configuration Mode**

CLI Command Syntax:
bridge-group 1 path-cost <1-200000000>
bridge-group 1 priority <0-240>

Usage Example:

```
switch_a(config-if)#bridge-group 1 path-cost 200000  
switch_a(config-if)#bridge-group 1 priority 128
```


Manually Setting a Port to be a Shared or Point to Point Link

To manually force a port to be a **shared** link or **Point-to-point** link, use the below CLI commands:

CLI Command Mode: **Interface Configuration Mode**

CLI Command Syntax:

spanning-tree link-type point-to-point

spanning-tree link-type shared

Usage Example 1: Setting port 1 to be point-to-point:

```
switch_a(config-if)#spanning-tree link-type point-to-point
```

Usage Example 2: Setting port 1 to be shared:

```
switch_a(config-if)#spanning-tree link-type shared
```

Enabling/Disabling a port to be an Edge Port

To manually enable or disable a port to be an **Edge Port**, use the following CLI commands:

CLI Command Mode: **Interface Configuration Mode**

CLI Command Syntax:

spanning-tree edgeport

no spanning-tree edgeport

Usage Example 1: Enabling edge port on port 1:

```
switch_a(config-if)#spanning-tree edgeport
```

Usage Example 2: Disabling edge port on port 1:

```
switch_a(config-if)#no spanning-tree edgeport
```

STP/Ring Page - Configuring MSTP

The MSTP protocol adds a new concept called a **Region** to the Spanning Tree algorithm. Unlike RSTP and STP, inside each MSTP Region, there can be more than one instance of Spanning Tree Protocol running simultaneously. The MSTP protocol can then map multiple VLANs to each instance of Spanning Tree protocol to provide load balancing among the switches. Between Regions, the MSTP runs a single instance of Spanning Tree similar to, and is backward compatible with, the RSTP protocol.

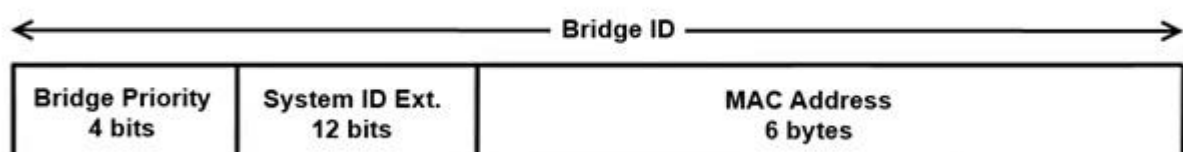
Enabling the MSTP Protocol

Navigate to the **STP/Ring Global Configuration** page:

1. Click on the **+** next to **STP/Ring**.
2. Click on **Global Configuration**.
3. Verify that the Spanning Tree Protocol is enabled, if not, choose **Enabled** from the **Spanning Tree Protocol** drop down list.
4. Choose **MSTP** in the **STP Version** drop down list.
5. Click on the **Update Setting** button.
6. Save the configuration

The CIST Root Bridge & Backup CIST Root Bridge

In order to configure a switch to be the CIST Root Bridge of a Spanning Tree network, you just have to make sure that the Bridge Priority (which is the most significant 4 bits of the Bridge ID) of the switch is the lowest among any of the switches on the network. Similarly for the Backup CIST Root Bridge, it must have the next lowest Bridge Priority of all the switches. This Bridge ID is a concatenation of 3 values: a 4 bit Bridge Priority (most significant), a 12 bit System ID (less significant), and the 48 bit MAC address of the local switch (least significant) (see below).



Setting Bridge Priority

To set the Bridge Priority:

1. Enter the **Bridge Priority ID** in the text box to the right of **Bridge Priority (0..61440)**
2. Click on the **Update Setting** button.

Note: The valid values for this parameter are from 0 to 61440, in increments of 4096; you will see this value reflected in the first hexadecimal digit of the **Bridge ID** field after you click the **Update Setting** button. Set this value to be less than any other switch on the network, in order to make this switch the Root Switch. To set a **Backup Root Bridge** set the **Bridge ID** to be between the **Root Bridge** and the rest of the network switches.

Configuring the CST Network Diameter

When using MSTP, the **Max Age** parameter is used for the CST (Common Spanning Tree) topology simply as a hop count limit on how far the Spanning Tree protocol packet can propagate throughout the CST topology, therefore, the Max Age must be configured with a value that is greater than the network diameter of the CST topology. The Max Age parameter will need to be configured correctly on both the CIST Root Bridge as well as on the Backup CIST Root Bridge (in the event when the CIST Root Bridge fails).

Setting the MAX Age, Forward Delay and Hello Timer

Navigate to the **STP/Ring Global Configuration** page:

1. Click on the **+** next to **STP/Ring**.
2. Click on **Global Configuration**.

Relationship between Max Age, Forward Delay and Hello Time

The following rules must be followed when setting the **Max Age**, **Forward Delay** and **Hello Timer**:

- $\text{Max Age} \geq 2 \times (\text{Hello Time} + 1.0 \text{ second})$
- $2 \times (\text{Forward Delay} - 1.0 \text{ second}) \geq \text{Max Age}$

To change the **Max Age**, **Forward Delay** and **Hello Timer**:

1. Enter the **Max Age** in the text box to the right of Max Age (6..40 sec) label.
2. Enter the **Hello Time** in the text box to the right of the Hello Time (1..10 sec) label.
3. Enter the **Forward Delay** in the text box to the right of the Forward Delay (4..30 sec) label.
4. Click on the **Update Setting** button.
5. Save the configuration.

Configuring an MSTP Region

In order to form a MSTP Region, the switches that will be connected together to form the MSTP Region must have the same values for the configuration parameters listed below. Two of the parameters can be configured directly, the third parameter (Configuration Digest) will be automatically calculated by the switch based on the **VLAN to MSTI (Multiple Spanning Tree Instance)** mapping. The **VLAN to MSTI** instance mapping must be the same for all the switches within the same **MSTP Region**.

- Region name
- Revision level
- Configuration Digest

To navigate to the **STP/Ring MSTP Properties** page:

1. Click on the **+** next to **STP/Ring**.
2. Click on **MSTP Properties**.

To configure both the MSTP Regional Configuration Name and the Revision Level for each of the switches located in the same MSTP Region:

1. Enter the **Region Name** of the Region that the switch will belong to in the **Region Name** text entry box,
2. Enter the **Revision Level** value for the corresponding Region in the **Revision Level** text entry box,

3. Click on the **Update Setting** button.
4. Save the configuration

Configuring the IST Network Diameter

In the MSTP protocol, the **Max Hops** parameter is used for the **IST** (Internal Spanning Tree) and the **MSTI** (Multiple Spanning Tree Instance) topology as a hop count limit on how far the Spanning Tree protocol packet can propagate inside of a MSTP Region, therefore, it must be configured with a value that is greater than the network diameter of the **IST/MSTI** topology. The **Max Hops** parameters should be configured correctly on the CIST Root and the Backup CIST Root switch and on all of the Boundary switches of a MSTP Region (if there are multiple Regions within your MSTP network).

Follow the steps below to configure the **Max Hops** parameter:

1. Enter the desired hop count in the text entry box next to **Max Hops**
 2. Click on the **Update Setting** button
 3. Save the configuration
-

Setting an MSTP Instance

Setting an MSTP Instance

Navigate to the **STP/Ring MSTP Instance Setting** page:

1. Click on the **+** next to **STP/Ring**.
2. Click on **MSTP Instance Setting**.

To create the Spanning Tree instances to be run inside a MSTP Region and its VLAN mappings, follow the below steps.

1. Click on the **VLAN Instance Configuration** button,
2. Choose the **VLAN** that you want to map to a MSTI instance from the **VLAN ID** drop down box.

3. Enter the **Instance ID** that you want the VLAN to map to in the text entry box next to **Instance ID (1..15)**.
4. Click on the **Update Settings** button.
5. Save the configuration

Note: You can enter a new instance number here, which is how a new MSTI instance is created. You can use an existing MSTI instance if it has already been created on another switch.

Modifying MSTP parameters for load balancing

To load balance switches within a MSTP Region, set different switches within the MSTP Region to be the Root Bridge for different MSTI instances. A Root Bridge in a particular MSTI instance is called a MSTI Regional Root Bridge.

To designate a specific switch in a MSTP Region to be the Root Bridge in a specific MSTI instance, the bridge priority must be set to be the lowest number of all the switches in a particular MSTI instance.

To set the bridge priority on the switch for a specific MSTI Instance:

1. Choose the particular instance in the **Instance ID** drop down list for which the switch will be a MSTI Regional Root Bridge;
2. Enter the desired value in the **Bridge Priority** text box
3. Click on the **Update Setting** button. The valid values for this parameter are from 0 to 61440, in increments of 4096.
4. Save the configuration

Adjusting the blocking port in a MSTP network

To navigate to the **STP/Ring MSTP Port Setting** page, click on the **+** next to **STP/Ring**, then click on **MSTP Port Setting**.

You can adjust the location of the blocking port in a MSTP network by modifying the **Port Priority** and the **Path Cost** of the ports on the switch. Modifying the **Port**

Priority adjusts the blocking port between two switches. Modify the **Port Cost** adjusts the location of the blocking port in a MSTP loop.

To modify the Port Priority and the Path Cost of the ports on a MSTP switch for the MSTI instance only, please follow the below steps:

1. Choose the correct MSTI Spanning Tree instance from the drop down list under **Instance ID**.
2. Choose the correct port number from the drop down list under **Port**, and enter the proper value under the **Priority** and the **Admin. Path Cost** text box,
3. Click on the **Update Setting** button.
4. Save the configuration

MSTP Instance Port Membership

If changes have been made to the port membership of a VLAN, you must also reconfigure the MSTP port membership for the MSTP instance that the VLAN maps to.

To reconfigure the MSTP instance port membership:

1. Click on the **Port Instance Configuration** button
 2. Choose the correct MSTP instance from the drop down list next to **Instance ID**
 3. Check the box next to all the ports that should be part of this instance
 4. Click on the **Update Setting** button.
 5. Save the configuration
-

MSTP Configuration Examples Using

CLI Commands

Enabling Spanning Tree for MSTP

To enable the Spanning Tree function on a switch use the below CLI commands.:

CLI Command Mode: **Global Configuration Mode**

CLI Command Syntax:

no bridge shutdown 1

bridge 1 protocol mstp

Usage Example:

```
switch_a(config)#no bridge shutdown 1  
switch_a(config)#bridge 1 protocol mstp
```

Bridge Priority, Max Age, Forward Delay, and Hello Time

To configure the CIST Bridge Priority, Max Age, Forward Delay, and Hello Time of a Spanning Tree Bridge, use the following CLI commands:

CLI Command Mode: **Global Configuration Mode**

CLI Command Syntax:

bridge 1 priority <0-61440>

bridge 1 max-age <6-40>

bridge 1 forward-time <4-30>

bridge 1 hello-time <1-10>

Usage Example:

```
switch_a(config)#bridge 1 priority 4096  
switch_a(config)#bridge 1 max-age 20
```



```
switch_a(config)#bridge 1 forward-time 15  
switch_a(config)#bridge 1 hello-time 2
```

IST MAX Hops

To configure the IST Max Hops parameter on a switch, use the following CLI commands:

CLI Command Mode: **Global Configuration Mode**

CLI Command Syntax: **bridge 1 max-hops <1-40>**

Usage Example:

```
switch_a(config)#bridge 1 max-hops 20
```

MSTP Regional Configuration Name and the Revision Level

To configure both the MSTP Regional Configuration Name and the Revision Level on a switch, use the following CLI commands:

CLI Command Mode: **MSTP Configuration Mode**

CLI Command Syntax:

bridge 1 region <region_name>

bridge 1 revision <revision_number>

Usage Example:

```
switch_a(config)#spanning-tree mst configuration  
switch_a(config-mst)#bridge 1 region R1  
switch_a(config-mst)#bridge 1 revision 0
```

Creating an MSTP Instance

To create a MSTP instance and map it to a VLAN, use the following CLI commands:

CLI Command Mode: **MSTP Configuration Mode**

CLI Command Syntax: **bridge 1 instance <1-15> vlan <vlan_ID>**

Usage Example:

```
switch_a(config)#spanning-tree mst configuration  
switch_a(config-mst)#bridge 1 instance 1 vlan 10
```

Setting MSTP Priority

To set the MSTI priority of a switch in a MSTP Region, use the following CLI commands:

CLI Command Mode: **Global Configuration Mode**

CLI Command Syntax: **bridge 1 instance <1-15> priority <0-61440>**

Usage Example:

```
switch_a(config)#bridge 1 instance 1 priority 0
```

Modifying CIST Port Priority and Port Path Cost

To modify the CIST Port Priority and CIST Port Path Cost on a switch, use the below CLI commands:

CLI Command Mode: **Interface Configuration Mode (port)**

CLI Command Syntax:

bridge-group 1 path-cost <1-200000000>;

bridge-group 1 priority <0-240>

Usage Example:

```
switch_a(config-if)#bridge-group 1 path-cost 200000  
switch_a(config-if)#bridge-group 1 priority 128
```

To modify the MSTP Port Priority and MSTP Port Path Cost for an Instance on a switch, please use the below CLI commands:

CLI Command Mode: **Interface Configuration Mode**

CLI Command Syntax:

bridge-group 1 instance <1-15> path-cost <1-200000000>

bridge-group 1 instance <1-15> priority <0-240>

Usage Example:

```
switch_a(config-if)# bridge-group 1 instance 1 path-cost  
20000
```

```
switch_a(config-if)# bridge-group 1 instance 1 priority 128
```

Adding a Port to an MSTP Instance

To add a port to a MSTP instance (this port must be a member port of the VLAN that is mapped to the MSTP instance), please use the below CLI commands:

CLI Command Mode: **Interface Configuration Mode**

CLI Command Syntax: **bridge-group 1 instance <1-15>**

Usage Example:

```
switch_a(config-if)#bridge-group 1 instance 1
```
