

## Chapter 17

# Configuring Shadow Nodes for Queue Management

This chapter provides information for configuring shadow nodes on E-series routers.

QoS topics are discussed in the following sections:

- Shadow Node Overview on page 155
- Shadow Nodes and Scheduler Behavior on page 156
- Managing System Resources for Shadow Nodes on page 158
- Configuring Shadow Nodes on page 158
- Example: Shadow Nodes over VLAN and IP Queues on page 160
- Example: Shadow Nodes on the Same Traffic-Class Group on page 160
- Example: Shadow Nodes on Different Traffic-Class Groups on page 161

## Shadow Node Overview

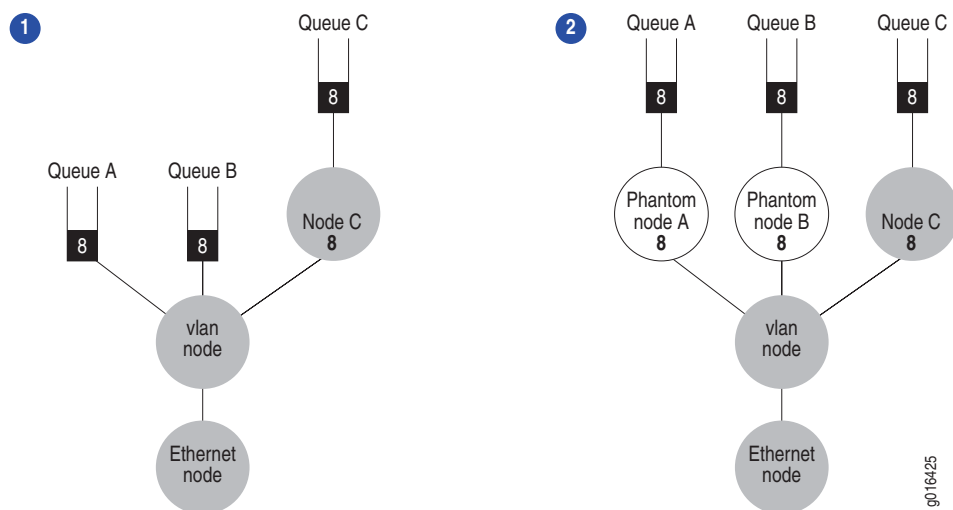
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The frame forwarding ASIC (FFA) and the 10-Gigabit Ethernet forwarding ASIC (TFA) require that all queues be above the port scheduler node with two additional scheduler nodes. The router implicitly creates *phantom nodes* when you do not specify two scheduler nodes above the port interface. Phantom nodes cannot be monitored using **show** commands.

Phantom nodes have the same weight as the associated queues and are not shaped, which preserves the behavior of the queues as if they are at their original level.

Figure 41 compares a scheduler hierarchy with and without phantom nodes.

**Figure 41: Phantom Nodes**



The first scheduler hierarchy displayed in Figure 41 shows Queue A, Queue B, and Node C at the same scheduler level and with the same weight of 8. They equally share the bandwidth available to the level 1 node.

The second scheduler hierarchy in Figure 41 shows the phantom nodes the router added for Queue A and Queue B. It also shows the weight associated with Queue A and Queue B. As the result, Phantom A, Phantom B, and Node C share the bandwidth of the level 1 node. The phantom nodes do not change the behavior of Queue A and Queue B.

## Shadow Nodes and Scheduler Behavior

You can configure *shadow nodes* when you want to explicitly set the queues at the required scheduler level for any line module with the EFA, EFA2, FFA, or TFA hardware. Shadow nodes enable you to specify the weight and the shaping rate of the added node. Shadow nodes can also conserve scheduler node resources.

You define the shadow node by referencing the shadow node in the QoS profile. Like phantom nodes, the router creates shadow nodes only when the additional node is required to meet the proper queue level.

The router creates shadow nodes after all the nodes and group nodes are created, and only when a node of the same interface type has existed in the same group of the scheduler hierarchy.

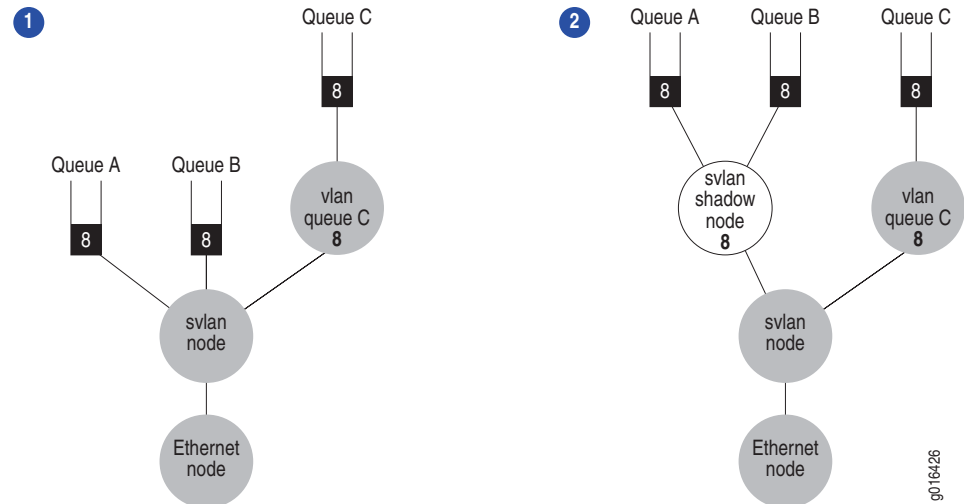
Shadow nodes can be configured for all interface types available for nodes.



**NOTE:** Shadow nodes ignore any shared-shaping rates in a scheduler profile.

Figure 42 compares a scheduler hierarchy with and without shadow nodes.

**Figure 42: Shadow Nodes**



Unlike phantom nodes, shadow nodes can alter the behavior of the scheduler.

The first scheduler hierarchy in Figure 42 shows VLAN interfaces A, B and C stacked above the same S-VLAN interface. Interfaces A and B have the same scheduler hierarchy (referencing qos-profile AB) and have a VLAN queue stacked directly above the S-VLAN node. In this case, VLAN interfaces A, B and C share the same 33 percent bandwidth available to the S-VLAN node.

Interface C has a VLAN queue stacked above a VLAN node and the S-VLAN node (referencing qos-profile C).

Specifying a shadow node forces the VLAN queue to the proper scheduler level. The second scheduler hierarchy in Figure 42 shows the shadow node that is applied after QoS profile AB-shadow is assigned to interfaces A and B. As a result, interfaces A and B have 25 percent of the S-VLAN bandwidth and interface C has 50 percent of the S-VLAN bandwidth.

The S-VLAN shadow node uses the same scheduler profile as the queue.

To provide interfaces A and B with the proper weight, configure the weight of the shadow node to the sum of its queue weight. You can use hierarchical parameter instances and weight expressions to configure an appropriate weight.

## Related Topics

- For a list of interface types supported for shadow nodes, see *Supported Interface Types for QoS Profiles* on page 137
- For more information about hierarchical parameters, see *Hierarchical QoS Parameters Overview* on page 257

## Managing System Resources for Shadow Nodes

Each ASIC hardware type provides different node and queue resources.

Level 1 queues stack directly above the port; level 2 queues stack above a node and the port. The router implicitly creates the level 1 and level 2 queues.

Shadow node queues stack above a port node, a level 1 node, and a shadow node. Therefore, the shadow node queue is at level 3. The router does not implicitly create any nodes for the queues.

You can configure 64,000 level 1 queues using shadow nodes by specifying the group and shadow node rules in the QoS profile. Each level 1 queue is stacked above the port, the group node, and the shadow node; therefore, it requires 64,002 descriptors.

Table 16 lists the number of nodes required to create a queue.

**Table 16: Shadow Node Consumption of Node and Queue Resources**

	Level 1 Queues (at Port)	Level 2 Queues (at Node)	Shadow Node Queue
<b>Required Nodes</b>	3	2	1

### Related Topics

- Managing System Resources for Nodes and Queues on page 134
- Scaling Subscribers on the TFA ASIC with QoS on page 134

## Configuring Shadow Nodes

Before you configure shadow nodes:

- Configure the traffic classes.  
See *Configuring Traffic Classes That Define Service Levels* on page 15.
- Configure the queuing hierarchy.  
See *Configuring Queue Profiles to Manage Buffers and Thresholds* on page 23.
- Configure the scheduler hierarchy and shaping with scheduler profiles.  
See *Configuring a Scheduler Hierarchy* on page 49.

To add a shadow node to a QoS profile:

1. Create a QoS profile and enter QoS Profile Configuration mode.

```
host1(config)#qos-profile shadowNode
host1(config-qos-profile)#
```

2. Configure a scheduler node for each interface of the specified type.

```
host1(config-qos-profile)#atm node scheduler-profile default
```

3. Configure a shadow node for each interface of the specified type.

```
host1(config-qos-profile)#atm shadow-node scheduler-profile default
```

4. Configure a queue for interfaces in the specified traffic class.

```
host1(config-qos-profile)#atm queue traffic-class strict-priority scheduler-profile scheduler1
```

5. (Optional) Configure a traffic-class group and reference a scheduler profile in the QoS profile.

```
host1(config-qos-profile)#atm group default scheduler-profile default
```

The router creates the shadow node when the following conditions are met:

- After all the nodes and group nodes are created.
- If the queues are not at the required scheduler level.
- When a node of the same interface type has existed in the same group of the scheduler hierarchy.

## **Related Topics**

- Shadow Node Overview on page 155
- Shadow Nodes and Scheduler Behavior on page 156
- Managing System Resources for Shadow Nodes on page 158
- Monitoring a Scheduler Hierarchy on an Interface with QoS Profiles on page 163
- **group** command
- **node** command
- **qos-profile** command
- **queue** command
- **shadow-node** command

## Example: Shadow Nodes over VLAN and IP Queues

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This example illustrates how and when the system creates shadow node after you configure it.

In the first part, you specify an Ethernet node, an Ethernet group node, a VLAN node, a VLAN shadow node, and an IP queue. Because the IP queue is at a proper scheduler level without the shadow node, the system does not create a shadow node.

```
host1(config-qos-profile)#ethernet node
host1(config-qos-profile)#ethernet group default scheduler-profile default
host1(config-qos-profile)#vlan node
host1(config-qos-profile)#vlan shadow-node
host1(config-qos-profile)#ip queue traffic-class best-effort scheduler-profile default
```

In the second part, you specify an Ethernet node, a VLAN node, a shadow node, and a VLAN queue. The system creates the shadow node so that the VLAN queue is at the proper scheduler level.

```
host1(config-qos-profile)#ethernet node
host1(config-qos-profile)#vlan node
host1(config-qos-profile)#vlan shadow-node
host1(config-qos-profile)#vlan queue traffic-class best-effort scheduler-profile default
```

## Example: Shadow Nodes on the Same Traffic-Class Group

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This example demonstrates how to configure the shadow nodes on the same traffic-class group.

You specify a VLAN node, an IP node, an IP video queue, and a best-effort Ethernet queue. The system adds the Ethernet node, the VLAN node, the IP node, and the IP video queue to the scheduler hierarchy. Even though the two queues belong to the same traffic-class group, the Ethernet best-effort queue is stacked above the shadow node and the IP video queue is stacked above the IP node.

```
host1(config-qos-profile)#ethernet node
host1(config-qos-profile)#ethernet shadow-node scheduler profile shadow
host1(config-qos-profile)#ethernet queue traffic-class best-effort scheduler-profile default
host1(config-qos-profile)#vlan node
host1(config-qos-profile)#ip node
host1(config-qos-profile)#ip queue traffic-class video scheduler-profile default
```

## Example: Shadow Nodes on Different Traffic-Class Groups

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This example shows how to configure shadow nodes on different traffic-class groups. After adding the voice queue in the auto-strict priority group named strict, the system stacks the IP voice queue above the Ethernet port, the voice group, and the phantom node.

```
host1(config-qos-profile)#ethernet node
host1(config-qos-profile)#ethernet shadow-node scheduler profile shadow
host1(config-qos-profile)#ethernet queue traffic-class best-effort scheduler-profile
default
host1(config-qos-profile)#vlan node
host1(config-qos-profile)#ip node
host1(config-qos-profile)#ip queue traffic-class video scheduler-profile default
host1(config-qos-profile)#ethernet group voice-group scheduler-profile strict
host1(config-qos-profile)#ip queue traffic-class voice scheduler-profile default
```

