Rate Control

This chapter provides a brief description about rate control and the procedures used to set up a Digital Content Manager (DCM) for rate control purposes.

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Introduction

The rate control feature allows rate shaping for bandwidth capacity optimization purposes, such as recompression to lower bit rates of individual services, open loop statistical remultiplexing, and so on. For this option, the DCM needs one or multiple coprocessors or MFP cards.

A coprocessor optimizes the bandwidth capacity for the outgoing transport streams (TSs) that belong to the interface card to which the coprocessor belongs to. For bandwidth capacity optimization by an MFP card, the services must be routed to the output through an MFP card. Services, which are encoded from baseband streams, can also participate in the open loop statistical remultiplexing.

For rate control, a coprocessor is able to handle SD (standard definition) and HD (high definition) MPEG-2 (Motion Picture Experts Group 2) services while an MFP can handle SD and HD MPEG-2 services as well as SD and HD AVC (advanced video coding) services (H.264).

Important

An MFP card in a D9900 and D9901 housing with software version 17.00 or later can no longer be used for open loop statistical remultiplexing.

Licensing

For information about the license keys needed for rate control, see Rate Control Licensing.
Applications

A DCM with the rate control feature is applicable in many applications. Some of these applications are described in the following list:

- **Recompressing of services and transport streams**—To target the bit rate of a TS in which the chosen modulation scheme fits, services can be recompressed. Recompressing of TSs or groups of services in a TS can be done by using statistical remultiplexing or by using bit rate limiting. Recompressing can also be used to free-up bandwidth in the TS for new services like Internet, and so on.

- **Rate limiting of single program transport streams**—In applications where video services are distributed over IP, the maximum bit rates of the single program transport streams (SPTSs) are specified in most situations, for instance, to 3 Mbps in the case of DSL (digital subscriber line) applications. To fulfill these specifications, the bit rates of the individual SPTSs must be limited.

- **Transport stream bit rate overload protection**—The bit rates of incoming services received from different sources and passed to an outgoing TS are not often constantly or not exactly at the agreed specifications. The DCM with this rate control feature can be used to ensure the full utilization of the maximum bandwidth without bit rate overloads.

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**Note**

Only the video part with chroma format 4:2:0 of a service can be processed. The audio part of a service with video or services without video cannot be processed and are passed through.

**Tip**

When PES (packetized elementary stream) headers are missing at the input, the rate control process (bit rate limiting or statistical remultiplexing) creates new headers based on the information of the last received headers.

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**Bit Rate Limiting**

Bit rate limiting is a rate control process on individual services to keep the maximum bit rate lower than or equal to an adjustable bit rate value. Bit rate limiting can be done on services with constant bit rate (CBR) or on services with variable bit rate (VBR). The following figures represent bit rate limiting on a CBR service and on a VBR service.

- **Bit rate limiting on CBR service**

- **Bit rate limiting on VBR service (capped VBR)**
If the maximum bit rate for rate limiting is set to a small value, rate limiting a VBR service may result in a CBR program. In the example above, when the maximum rate limit is set to, for instance, 2 Mbps, the service after rate limiting becomes a CBR service.

When the bit rate of a service does not exceed the maximum bit rate, the service is not rate limited. In this case, the bit rate of the outgoing service matches the bit rate of the incoming service.

Remark that using transcoded services, the generated output bit rate can be much larger than the input bit rate. In such scenarios, rate limited SPTS almost always generates CBR streams.

**Statistical Remultiplexing**

Statistical remultiplexing is a rate control process that keeps the total bit rate of a group of services under control by reducing the bit rate of individual services according to the actual needs of these services compared to the other services in the group. Statistical remultiplexing can be used in applications where the total bit rate of a group of services must be reduced or where the TS must be protected against bit rate overflow.

**Bit Rate Reduction**

When several services must be passed to an outgoing TS of which the maximum bit rate is lower than the sum of the bit rates of these services, statistical remultiplexing can be done on all services or on a part of these services. The following figure shows a graphical representation of bit rate reduction on a complete TS using statistical remultiplexing.
Statistical remultiplexing can also be used to free up some bandwidth for new services.

**Bit Rate Overload Protection**

When services from different TSs must be aggregated into a new multiplex and one or more of these services are available with variable bitrate, the total bit rate of the outgoing TS is out of control. Statistical remultiplexing can be used to protect a TS against bit rate overload. The following figure shows a graphical representation of a statistical remultiplexing process on a TS to keep the total bit rate under control.
The services, which must participate into a rate control process, must be added to a group (rate control group). The bit rate variation of each service in a rate control group can be limited by adding a minimum and a maximum bit rate limit. Because high-quality services require more bandwidth than low quality services, each service in a rate control group can be provided with a priority. Services with higher priority are allocated more bandwidth than services with lower priority.

The DCM allows statistical remultiplexing on multiple SPTSs. For instance, this is useful in DSL applications where the backbone capacity is limited, for instance, 40 SPTSs of 3 Mbps through a backbone limited to 100 Mbps.
Card Settings

For open loop statistical remultiplexing using an MFP, two algorithms can be used, an algorithm for performance optimization (high-density statmux) and an algorithm for quality optimization (premium picture quality statmux). For statistical remultiplexing using the high-density statmux algorithm, the MFP mode of the card must be set to high-density transcoding, and for statistical remultiplexing using the premium picture quality statmux algorithm, the MFP mode must be set to premium picture quality transcoding. See Changing the Card Settings of an MFP Card.

For rate controlling services using a coprocessor, particular card settings must be configured. See Configuring the Coprocessor Functionality of an Interface Card.

Working with Rate Control Groups

For rate controlling services, DCM provides six different rate control groups:

- **TR all services rate control group**—A TR all services rate control group is used to protect the total bit rate of an outgoing TS against bit rate overshots and for which the services in the TS must be processed by a coprocessor. When an incoming or processed service is passed to the outgoing TS, the service is automatically added to the rate control group. Only one TR all services rate control group can be created for an outgoing TS. This rate control group is indicated by 🟢.

- **TR selective services rate control group**—A TR selective services rate control group is used to protect a part or multiple parts of the bit rate of an outgoing TS against bit rate overshots and for which the services in the TS must be processed by a coprocessor. A TR selective services rate control group must be created for each part that must be protected against bit rate overshots. This rate control group is indicated by 🟡.

- **TR multiple SPTS rate control group**—A TR multiple SPTS rate control group is used for rate limiting of individual SPTSs or for statistical remultiplexing of a group of SPTSs using a coprocessor. This rate control group is indicated by 🟢.

- **MFP all services rate control group**—An MFP all service rate control group is used if the total bit rate of an outgoing TS should be protected against bit rate overshots by statistical remultiplexing of individual services by an MFP. When an incoming, processed, or encoded service is passed to the outgoing TS, the service is automatically added to the rate control group. Only one MFP all service rate control group can be created for an outgoing TS. This rate control group is indicated by 🟢.

- **MFP selective services rate control group**—An MFP selective services rate control group is used if one or multiple parts of the bit rate of an outgoing TS must be protected against bit rate overshots by statistical remultiplexing of individual services by an MFP. An MFP selective services rate control group must be created for each part that must be protected against bit rate overshots. This rate control group is indicated by 🟡.

- **MFP multiple SPTS rate control group**—An MFP multiple SPTS rate control group is used for rate limiting of individual SPTSs or for statistical remultiplexing of a group of SPTSs by using an MFP. This rate control group is indicated by 🟢.
Note

- Rate limiting of SPTSs limits the total bit rate of the service in the SPTSs while rate limiting of services within a TR selective service or TR all services rate control group only limits the bandwidth of the video component.

- In contrast with recompressing services using a coprocessor that needs a rate control group, recompressing services by an MFP card can be done without creating a rate control group. For more information about recompressing services using an MFP card, see Transcoding Using the MFP Card.

Important

- If a PiP stream, which is created by an MFP, is dragged in an MFP rate control group, no bit rate is allocated. To deal with this, bit rate must be reserved for this stream by allocating the necessary TS overhead bandwidth.

- Because rate control gives a small delay to services, a service that does not participate in the rate control process and that must be synchronized with the processed services, must be added to the rate control group and passed through. For a rate control group for which the services are processed by an MFP, the services that do not participate into the rate control process must also be routed through the MFP to the output and delayed (also called pass-through service).

- For a DCM with software version earlier than V11.10 for High Density Transcode or earlier than 16.0 for Premium Picture Quality Transcode, the bandwidth of services or components, which were routed from the input to an MFP all services rate control group through an MFP without processing, was not automatically charged to the bandwidth of the rate control group. Therefore, enough TS overhead bandwidth had to be allocated for such services/components. After upgrading a DCM to software version V11.10 or later for High Density Transcode or to 16.0 or later for Premium Picture Quality Transcode, the bandwidth of these services or components will not automatically be charged to the bandwidth of the rate control group and the rate mode of the services will be set to Pass Through (Manual). Services, which are routed on a DCM with later software version from the input to an MFP all services rate control group through an MFP without processing, are automatically charged to the bandwidth of the rate control group and the rate mode of the services is set to Pass Through (Auto).

- Services or components directly routed from the input to an MFP selective service or MFP multiple SPTS rate control group is not supported and give bit rate overshoots.

- In contrast with MPTS all services type rate control group which includes all components, a selective services type rate control group does not include TS components, such as PAT (program association table), CAT (conditional access module), SDT (service description table), NIT (network information table), and so on. A selective services type rate control group with all services of a TS is not the same as an MPTS all services type rate control group.

Restriction

- An MFP rate control group can handle a maximum of 64 services.

- The premium picture quality statmux algorithm cannot combine MPEG2 and AVC services in the same rate control group.
Creating Rate Control Groups

The way that a rate control group must be created at the output of the DCM depends on the rate control group type. An MFP multiple SPTS and a TR multiple SPTS rate control group, which control SPTSs, must be created on the port level while TR selective services, TR all services, MFP selective services, or MFP all services rate control groups, which controls services of an MPTS, must be created on the TS level.

<table>
<thead>
<tr>
<th>Important</th>
</tr>
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<tbody>
<tr>
<td>All components that are part of a service, which is processed by an MFP that uses the high-density statmux algorithm, are included in the statistical remultiplexing calculation and must not be taken into account for the TS overhead. All components that are part of a service, which is processed by an MFP that uses the premium PQ statmux rate control mode, are included in the statistical remultiplexing calculation for the premium PQ statmux algorithm and must not be taken into account for the TS overhead. Overhead bit rate must be allocated for PSI/SI (program-specific information / service information) at the output and for other services and components that are part of the output but not processed by an MFP. For an MFP, all services and an MFP selective services rate control group, this TS overhead bandwidth can only be allocated once the rate control group is created. See Changing Rate Control Group Settings, on page 10. For the SPTSs that belong to an MFP multiple SPTS rate control group, the TS overhead bandwidth must be allocated for each individual SPTS. See Configuring SPTSs for a Multiple SPTS Rate Control Group, on page 23.</td>
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Creating an All Service or Selective Service Rate Control Group

**Procedure**

1. In the DCM GUI, choose **Service > Tree View** from the main menu. The **Tree View** page appears.
2. In the **Outputs** tree, double-click the TS for which a rate control group must be created. The **Output TS** page of this TS appears.
3. Click the **TS/Rate Control** tab.
4. Refer to the **Add New Rate Control Group** area.
5. In the **Name** field, enter a name (maximum of 30 characters). A logical name facilitates the identification of the rate control group in the application.
6. In the **Total Bit Rate (Mbps)** field, enter the total bit rate that can be used by the rate control group. The total bit rate of a rate control group can vary between 1 and 950 Mbps.
   **Note:** The sum of the total bit rates of the rate control groups and the bit rates of the services, which do not belong to a rate control group, can never exceed the total bit rate of the outgoing TS. When the sum is less than the total bit rate of the TS, the difference between both bit rates can then be used further down in the chain.
7. From the **Type** drop-down list, choose the desired rate control group type.
   - **TR All Services**—All services of the outgoing TS are added to the rate control group and rate control is done by the coprocessor of the corresponding interface card.
• **MFP All Services**—Similar to the TR All Services type rate control group but processing is done by an MFP.

• **TR Selective Services**—An empty rate control group is created and the operator can decide which services must be added to the rate control group. Processing is done by the coprocessor of the corresponding interface card.

• **MFP Selective Services**—Similar to the TR Selective Services type rate control group but processing is done by an MFP.

**Step 8** For an MFP all services or MFP selective services rate control group, choose the desired algorithm from the Algorithm drop-down list, **Premium PQ Statmux** or **High Density Statmux**. The Algorithm drop-down list is not available if the Type parameter is set to TR All Services or TR Selective Services.

**Step 9** Click **Add**.

**Result**

• Rate control group settings are added to the **Rate Control Group Settings** table.

![Rate Control Group Settings](image)

**Hint**: The arrow in the **Detail** column is a link to the **Rate Control Group Setting** table with the rate control parameters of the services within the selected rate control group. For more information about the **Rate Control Group Setting** table, see **Configuring the Population of a Rate Control Group**, on page 20.

• In the **Outputs** tree, the rate control group is added to the corresponding outgoing TS.

**Creating a Multiple SPTS Rate Control Group**

**Procedure**

**Step 1** In the DCM GUI, choose **Service > Tree View** from the main menu.
The **Tree View** page appears.

**Step 2** In the **Outputs** tree, double-click the Ethernet port for which a multiple SPTS rate control group must be created.

The **Output TS** page appears.

**Step 3** Click **Rate Control**.

The **Output Port Rate Control** page appears.

**Step 4** Refer to the **Add New Rate Control Group** area.

**Step 5** In the **Name** field, enter a name (maximum of 30 characters). A logical name facilitates the identification of the rate control group in the application.

**Step 6** In the **Total Bit Rate (Mbps)** field, enter the total bit rate that can be used by this rate control group. The total bit rate of a multi-TS rate control group can be set between 1 and 950 Mbps.

**Step 7** From the **Type** drop-down list, choose **TR Multiple SPTS** or **MFP Multiple SPTS**.

- **TR Multiple SPTS**—An empty rate control group is created for SPTS rate control using a coprocessor.

- **MFP Multiple SPTS**—An empty rate control group is created for SPTS rate control using an MFP.

For a GbE MK2 and 10GE card, the **Type** parameter is set to **MFP Multiple SPTS** and cannot be changed.

**Step 8** For an MFP multiple SPTS rate control group, choose the desired algorithm from the **Algorithm** drop-down list: **Premium PQ Statmux** or **High Density Statmux**.

The **Algorithm** drop-down list is not available if the **Type** parameter is set to **TR Multiple SPTS**.

**Step 9** Click **Add**.

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**Result:**

The rate control group is added to the **Rate Control Group Settings** table.

| Rate Control Group Settings | Name: Rate Control Group 1 | Total Bit Rate (Mbps): 1000.0 | Type: TR Multiple SPTS | Algorithm: | Detail: *

The arrow in the **Detail** column is a link to the **Rate Control Group Setting** table with the rate control parameters of the SPTSs in the selected rate control group.

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### Changing Rate Control Group Settings

The settings of a rate control group can be changed in different ways. For an MFP multiple SPTS or a TR multiple SPTS rate control group, changing group settings can be done on the **Output Port Rate Control** page, which is used to create these groups, or on the **Output Port Rate Control Detail** page. For the other rate control group types, modifications must be done in the **Output TS Rate Control Detail** or in the **Output TS** page.

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### Changing Selective Services or All Services Rate Control Group Settings

- By using the **Output TS Rate Control Detail** page:

  1. In the DCM GUI, choose **Service > Tree View** from the main menu.
The Tree View page appears.

2 In the Outputs tree, double-click the rate control group for which settings must be changed.
   The Output TS Rate Control Detail page of this rate control group appears.

3 Modify the parameters and click Apply.

• By using the Output TS page:

1 In the DCM GUI, choose Service > Tree View from the main menu.
   The Tree View page appears.

2 In the Outputs tree, double-click the TS that contains the rate control group for which settings must
   be changed.
   The TS Output page appears.

3 In the Rate Control Group Settings table, modify the parameters.

4 Click Apply.

The Algorithm parameter is dimmed if the rate control group is provided with services or if the device
is only equipped with MFP cards for which the MFP mode matches the statmux algorithm.

**Changing Settings of a Multiple SPTS Rate Control Group**

• By using the Output TS Rate Control Detail page:

1 In the DCM GUI, choose Service > Tree View from the main menu. The Tree View page appears.

2 In the Outputs tree, double-click the rate control group for which settings must be changed. The
   Output TS Rate Control Detail page of the selected rate control group appears.

3 Modify the parameters and click Apply.

The Algorithm parameter is dimmed if the rate control group is provided with services or if the device
is only equipped with MFP cards for which the MFP mode matches the statmux algorithm.

• By using the Output Port Rate Control page

1 In the DCM GUI, choose Service > Tree View from the main menu.
   The Tree View page appears.

2 In the Outputs tree, double-click the Ethernet port for which the rate control group settings must be
   changed.

3 Click Rate Control.
   The Output Port Rate Control page appears.

4 Modify the parameters and click Apply.

The Algorithm parameter is dimmed if the rate control group is provided with services or if the
device is only equipped with MFP cards for which the MFP mode matches the statmux algorithm.
The arrow in the Detail column is a link to the Rate Control Group Setting table with the rate control parameters of the SPTSs in the selected group. For more information about the Rate Control Group Setting table, see Changing Settings of a Multiple SPTS Rate Control Group, on page 11.

**Hint:** When particular parameters of all rate control groups on a port must be changed to similar values, the Update All Rate Control Groups function of the GUI can be used.

1. In the **Update All Rate Control Groups** area, enter the desired value in the field of the parameter or choose the desired value from the drop-down list of the parameter that must be changed for all rate control groups of the selected port.

2. Click **Update**.
   
   The settings are changed in the **Rate Control Group Settings** table.

   **Hint:** Particular values in the **Rate Control Group Settings** table can still be changed manually if needed.

3. Click **Apply**.

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### Removing Rate Control Groups

Similar to adding and changing rate control groups, removing groups can also be done in different ways:

- Right-click the rate control group in the **Outputs** tree on the **Tree View** page and choose **Delete**.

- Select the branch of the rate control in the **Outputs** tree on the **Tree View** page and drag and drop the branch in the wastebasket.

- For select services or all services rate control groups using the **Outputs TS** page, see Removing Selective Services or All Services Rate Control Groups Using the Outputs TS Page, on page 13.

- For multiple SPTS rate control groups using the **Output Port Rate Control** page, see Removing Multiple SPTS Rate Control Groups Using the Output Port Rate Control Page, on page 13.

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**Note**

To protect the application from accidentally removing of rate control groups from the **Outputs** tree, an extra confirmation can be asked. To enable or disable this confirmation feature, see Changing the Tree Settings.

**Important**

Removing a rate control group from a TS do not remove the services, which are member of this rate control group, from the output.
Removing Selective Services or All Services Rate Control Groups Using the Outputs TS Page

Procedure

Step 1 In the DCM GUI, choose Service > Tree View from the main menu. The Tree View page appears.

Step 2 In the Outputs tree, double-click the TS for which a rate control group must be removed. The Output TS page of this TS appears.

Step 3 Click the TS/Rate Control tab.

Step 4 In the Rate Control Group Settings table, check the check box of each rate control group that must be removed and click Remove Checked Items.

Removing Multiple SPTS Rate Control Groups Using the Output Port Rate Control Page

Procedure

Step 1 In the DCM GUI, choose Service > Tree View from the main menu. The Tree View page appears.

Step 2 In the Outputs tree, double-click the Ethernet port for which multiple SPTS rate control groups must be removed. The Output TS page appears.

Step 3 Click Rate Control. The Output Port Rate Control page appears.

Step 4 In the Rate Control Group Settings table, check the check box of each rate control group that must be removed and click Remove Checked Items.

Handling the Rate Control Group Population

After creating the correct rate control groups for your application, the groups must be populated with services or SPTSs. This topic describes how to add and remove services/SPTSs to or from a rate control group.
During creating an all services rate control group for an outgoing TS, all services that belong to this TS are automatically added to this rate control group. That in contrast with selective service or multiple SPTS rate control groups, which are empty after creation.

If services come from two or more MFP engines, the **End to End Delay** setting of these engines must be equal.

Populating a rate control group with services (or SPTS for multiple SPTS rate control groups) can be done using the drag-and-drop method on the **Tree View** page or using the muxing method. The muxing method can be used:

- To pass individual incoming services to an all services or selective services rate control group.
- To pass the service population of an incoming TS to an all services or selective services rate control group.
- To pass individual incoming services as SPTSs to a multiple SPTS rate control group.
- To pass the service population of an incoming TS as SPTSs to a rate control group.

The muxing method cannot be used to pass services from the **Processing** tree to a rate control group.

The rate mode of the services or the SPTSs that are passed from the input to an MFP rate control group is set to pass through. No rate control can be performed on these services or SPTSs.

Passing an incoming or processed service to a multiple SPTS rate control group automatically creates an outgoing SPTS from this service.

Passing a complete incoming TS on a multiple SPTS rate control group automatically creates individual outgoing SPTSs from all incoming service.

If the incoming TS is provided with unreferenced components and the TS is dropped in an all services rate control group, these components are automatically passed to the corresponding outgoing TS. That in contrast with dropping in a selective services or multiple SPTS rate control group where the unreferenced components are not routed to the output.

As long as the SD/HD parameter of an HD service is not set to HD, the service cannot participate in a TR rate control group that is processed by a coprocessor. To change the SD/HD parameter of a service, see **Changing Settings of Outgoing Services**.
Adding Services to a Rate Control Group Using Drag and Drop on the Tree View Page

- Drag and drop an incoming service to the rate control group.

**Result:** The incoming service is added to the rate control group.

- Drag and drop a service from the Processing tree to the rate control group.

- Drag and drop a complete incoming TS to the rate control group.

- Drag and drop a service that is part of an outgoing TS to a selective service rate control group that belongs to same stream.
Note: Dropping a service of an outgoing TS to a selective service rate control group that belongs to another stream is not allowed.

Tip
For an outgoing TS with an all service rate control group, passing an incoming or processed service to the TS branch automatically adds the service to the rate control group (see dashed line).

Passing Individual Incoming Services to an All Services or Selective Services Rate Control Group Using the Muxing Method

Procedure

Step 1
In the DCM GUI, choose Service > Muxing from the main menu. The Muxing page appears.

Step 2
From the Actions drop-down list, choose Add Services to Group. The Input Services and Output Rate Control Groups tables appear.

Step 3
In the Source Filter area, configure the source filter as follows:
   a) From the Card drop-down list, choose the card that receives the corresponding services.
   b) From the Port drop-down list, choose the corresponding port.
   c) Click Load.

Result: The Input Services table is populated with the services that match the configured source filter.

Step 4
In the Target Filter area, configure the target filter as follows:
   a) From the Card drop-down list, choose the card to which the rate control group belongs to.
   b) From the Port drop-down list, choose the corresponding port.
   c) Click Load.

Result: The Output Rate Control Groups table is populated with the rate control groups that match the configured target filter.
Step 5  In the Input Services table, click the services that must be passed.

Step 6  In the Output Rate Control Groups table, click the rate control group to which the services must be passed.

Step 7  Click Pass.
   The corresponding services are passed to the selected rate control group.

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Passing the Services of an Incoming TS to an All Services or Selective Services Rate Control Group

Procedure

Step 1  In the DCM GUI, choose Service > Muxing from the main menu. The Muxing page appears.

Step 2  From the Actions drop-down list, choose Pass all Services from TS to Group. The Input Transport Streams and Output Rate Control Groups tables appear.

Step 3  In the Source Filter area, configure the source filter as follows:
   a) From the Card drop-down list, choose the card that receives the corresponding TS.
   b) From the Port drop-down list, choose the corresponding port.
   c) Click Load.

   Result: The Input Transport Streams table is populated with the TSs that match the configured source filter.

Step 4  In the Target Filter area, configure the target filter as follows:
   a) From the Card drop-down list, choose the card to which the rate control group belongs to.
   b) From the Port drop-down list, choose the corresponding port.
   c) Click Load.

   Result: The Output Rate Control Groups table is populated with the rate control groups that match the configured target filter.
Step 5  In the Input Transport Streams table, click the TS with the services that must be passed.
Step 6  In the Output Rate Control Groups table, click the rate control group to which the services must be passed.
Step 7  Click Pass.  
The corresponding services are passed to the selected rate control group.

Passing Individual Incoming Services as SPTSs to a Multiple SPTS Rate Control Group

Procedure

Step 1  In the DCM GUI, choose Service > Muxing from the main menu.  
The Muxing page appears.

Step 2  From the Actions drop-down list, choose Pass Services as SPTS.  
The Input Services, Output GbE Ports, and Output Multiple SPTS Groups tables appear.

Step 3  In the Source Filter area, configure the source filter as follows:  
a) From the Card drop-down list, choose the card that receives the corresponding services.  
b) From the Port drop-down list, choose the corresponding port.  
c) Click Load.  
Result: The Input Services table is populated with the services that match the configured source filter.

Step 4  In the Target Filter area, configure the target filter as follows:  
a) From the Card drop-down list, choose the card to which the rate control group belongs to.  
b) From the Port drop-down list, choose the corresponding port.  
c) Click Load.  
Result: The Output Multiple SPTS Groups table is populated with the rate control groups that match the configured target filter.
Step 5 In the **Input Services** table, click the services that must be passed.

Step 6 In the **Output Multiple SPTS Groups** table, click the SPTS rate control group to which the services must be passed.

Step 7 Click **Pass**.
The corresponding services are passed to the selected SPTS rate control group.

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### Passing the Service Population of an Incoming TS as SPTSs to a Rate Control Group

**Procedure**

**Step 1** In the DCM GUI, choose **Service > Muxing** from the main menu. The **Muxing** page appears.

**Step 2** From the **Actions** drop-down list, choose **Pass all Services from TS as SPTS**. The **Input Transport Streams**, **Output GbE Ports**, and **Output Multiple SPTS Groups** tables appear.

**Step 3** In the **Source Filter** area, configure the source filter as follows:
   a) From the **Card** drop-down list, choose the card that receives the corresponding TS.
   b) From the **Port** drop-down list, choose the corresponding port.
   c) Click **Load**.

**Result:** The **Input Transport Streams** table is populated with the TSs that match the configured source filter.

**Step 4** In the **Target Filter** area, configure the target filter as follows:
   a) From the **Card** drop-down list, choose the card to which the SPTS rate control group belongs to.
   b) From the **Port** drop-down list, choose the corresponding port.
   c) Click **Load**.

**Result:** The **Output Multiple SPTS Groups** table is populated with the SPTS rate control groups that match the configured target filter.
Step 5  In the **Input Transport Streams** table, click the TS with the services that must be passed.

Step 6  In the **Output Multiple SPTS Groups** table, click the SPTS rate control group to which the services must be passed.

Step 7  Click **Pass**.

All services of the selected TS are passed to the selected SPTS rate control group.

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**Configuring the Population of a Rate Control Group**

After populating a rate control group with services, rate control specific settings must be configured. The following topics explain how to configure these settings for the services that are part of a TR all services, TR selective services, MFP all services, or MFP selective services rate control group and for the SPTSs that are part of a TR multiple SPTS or MFP multiple SPTS rate control group.

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**Note**

Before configuring the rate control-specific settings for the services/SPTSs that are part of an MFP all services, MFP selective services, or MFP multiple SPTS rate control group, the basic video settings of the services must be correctly configured. See [Configuring the Video Components](#).

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**Configuring the Services of a Selective Services or All Services Rate Control Group**

The following list describes the rate control specific settings of services that participate in a TR selective service, TR all services, MFP selective services, or MFP all services rate control group.

- **Rate Mode**:
  
  For services that belong to a TR all services or TR selective services rate control group, the **Rate Mode** parameter determines the rate control process:
  
  - **Pass Through**—No rate control processes are executed on this service, only delayed. This delay depends on the **Coarse Delay** parameter defined for the coprocessor (**Standard**: 1400 ms, **Extended**: 1800 ms, or **Predefined**).
  
  - **Statmuxed**—The service participates in the statistical remultiplexing group of the rate control group.
• **Rate Limited**—The service is recompressed in such a way that the total bit rate of the service matches the configured maximum bit rate (Max Bit Rate (Mbps) parameter).

For services that participate in an MFP selective services or MFP all services rate control group and that are routed through the MFP without processing, this parameter determines if the bit rates of the services are charged to the bandwidth of the rate control group or not.

• **Min Bit Rate (Mbps)**—This parameter determines the minimum bit rate limit for the video component of a service that participates in the statistical remultiplexing group of a rate control group.

• **Max Bit Rate (Mbps)**—This parameter determines the maximum bit rate limit for the video component of a service that participates in the statistical remultiplexing pool of the rate control group and the maximum bit rate for a service that is rate limited (TR selective service or TR all services rate control group only). This parameter is not applicable for passed through services and CBR services that participate in an MFP selective services or MFP all services rate control group.

• **Priority**—This parameter is used to prioritize the services for bandwidth allocation. Services with a higher priority are allocated more bandwidth than services with a lower priority.

• **Closed Caption**—This parameter is only applicable for services that belong to a TR selective services or TR all services rate control group and determines if SCTE20 or SCTE21 user data conversion is done or not.

  • **Off**—No SCTE20 or SCTE21 user data conversion is done and the user data of the incoming video stream is present in the outgoing video stream.

  • **SCTE 20 and 21**—The SCTE20 user data of the incoming video stream is converted to SCTE21 user data or SCTE21 user data of the incoming video stream is converted to SCTE20 user data and the SCTE20 and SCTE21 user data is inserted in the outgoing video stream.

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**Important**

For statistical remultiplexing with an MFP Card for which the **MFP Mode** is set to **Premium Picture Quality Transcode**, bit rate overshoots may occur during a service backup transition. To prevent these bit rate overshoots, we advise you to define a tracking rule, to force the backup video component to the main video component, for each service in the statistical remultiplexing group.

### Changing the Rate Control Specific Settings

**Procedure**

**Step 1**
In the DCM GUI, choose Service > Tree View from the main menu. The Tree View page appears.

**Step 2**
In the Outputs tree, double-click the TS with the rate control group. The Output TS page appears.

**Step 3**
In the Rate Control Group Settings table, click the Detail arrow of this rate control group. The Output TS Rate Control Detail page appears.

**Step 4**
In the Rate Control Group Settings table, double-click each row for which settings must be changed. The rows become editable.
Hint: The following figure shows the Rate Control Group Settings table for a TR multiple SPTS rate control group. The table for an MFP multiple SPTS rate control group is similar.

![Rate Control Group Settings Table](image)

**Step 5** From the Rate Mode drop-down list, choose one of the following settings:

- For a TR selective services or TR multiple SPTS rate control group:
  - **Statmuxed**—The service participates in the statistical remultiplexing group of the rate control group.
  - **Rate Limited**—The service is processed with a maximum bit rate limit.
  - **Pass Through**—No rate control is performed on this service.

- For an MFP selective service or MFP all services rate control group:
  - **Pass Through (Auto)** (default)—The bit rate of the service, which is routed through the MFP card without processing, is charged to the bandwidth of the rate control group.
  - **Pass Through (Manual)**—The bit rate of the service, which is routed through the MFP without processing, is not charged to the bandwidth of the rate control group. Overhead bandwidth to the TS must be allocated for this service.

**Note:** For an MFP selective service or MFP all services rate control group, this parameter is dimmed except if the service is delayed only (without processing) over the MFP. For delayed only services, the end-to-end delay must be equal to or greater than 2500 ms.

**Step 6** In the Min Bit Rate (Mbps) field, enter the minimum bit rate for the video component of this service. This parameter is only applicable when the Rate Mode parameter is set to Statmuxed.

**Step 7** In the Max Bit Rate (Mbps) field, enter the maximum bit rate for this service (rate limiting) or for the video component of this service (statistical remultiplexing). This parameter is only applicable when the Rate Mode parameter is set to Statmuxed or Rate Limited.

**Step 8** In the Priority field, enter the priority setting for the service. For a service processed by a coprocessor, this parameter can be set between 0 (low) and 10 (high) and the default value is 5 (normal). For a service processed by an MFP card, this parameter can be set between 0 (low) and 6 (high); the default value is 3 (normal).

**Step 9** From the Closed Caption Update drop-down list (TR all services or TR selective services rate control group only), choose one of the following values:

- **Off**—No SCTE20 or SCTE21 user data conversion is done and the user data of the incoming video stream is present in the outgoing video stream.

- **SCTE 20 and 21**—The SCTE20 user data of the incoming video stream is converted to SCTE21 user data or SCTE21 user data of the incoming video stream is converted to SCTE20 user data and the SCTE20 and SCTE21 user data is inserted in the outgoing video stream.
Step 10 Click Apply.

**Changing the Rate Control Specific Settings Using the Update Function**

When particular parameters of multiple services of the rate control group must be changed to similar values, the Update All function of the GUI can be used.

**Procedure**

**Step 1** In the DCM GUI, choose Service > Tree View from the main menu. The Tree View page appears.

**Step 2** In the Outputs tree, double-click the TS with the rate control group. The Output TS page appears.

**Step 3** In the Rate Control Group Settings table, click the Detail arrow of this rate control group. The Output TS Rate Control Detail page appears.

**Step 4** In the Rate Control Group Settings table, select each row for which settings must be changed.

**Step 5** In the Update Rate Control Group Settings area, enter or choose the desired value in the field or drop-down list of the parameter that must be changed for all SPTS of this rate control group.

**Step 6** Click Update All Selected. The settings are changed in the Rate Control Group Settings table.

**Hint:** Particular values in the Rate Control Group Settings table can still be changed manually if necessary.

**Step 7** Click Apply.

**Configuring SPTSs for a Multiple SPTS Rate Control Group**

For SPTSs part of an MFP multiple SPTS or TR multiple SPTS rate control group, the following rate control-specific settings must be configured.

- **Rate Mode:**

  - **TR multiple SPTS rate control group:**
    
    This parameter determines the rate control process that must be executed to the service before SPTS encapsulation.
    
    - **Statmuxed**—The service participates in the statistical remultiplexing group of the rate control group.
    
    - **Rate Limited**—The video component is recompressed in such a way that the total bit rate of the SPTS matches the configured maximum bit rate (Max Bit Rate (Mbps) parameter). The bit rate of the video component is adapted if the bit rate of the TS overhead various.
Pass Through—No rate control processes are executed to this service, only delayed. This delay depends on the Coarse Delay parameter defined for the coprocessor (Standard: 1400 ms, Extended: 1800 ms, or Predefined).

MFP multiple SPTS rate control group:

For a service for which the Rate Mode (Processing tree) is set to Statmux, this parameter determines the rate control process on the service before SPTS encapsulation.

- Statmuxed—The outgoing SPTS participates in the statistical remultiplexing group of the rate control group.
- Rate Limited—The video component of the service is recompressed in such a way that the bit rate of the complete service remains constant and matches a particular bit rate. This bit rate is determined by the maximum bit rate that is configured for the SPTS in which the service is encapsulated minus the part of the bit rate that is allocated for the TS overhead.

Rate limiting cannot be combined with the premium picture quality algorithm for an MFP multiple SPTS rate control group.

The Rate Mode parameter represents CBR if the Rate Mode parameter (Processing tree) is set to CBR, and Pass Through if a service is passed from the input or from the input through the MPF for delaying without enabling Transcode.

For more information about the Rate Mode parameter in the MFP Video page, see Configuring the Video Components.

- Min Bit Rate (Mbps)—This parameter is only applicable if the SPTS participates in a statmux pool and determines the minimum bit rate for this SPTS.
- Max Bit Rate (Mbps)—This parameter determines the maximum bit rate that can be used for the SPTS during statistical remultiplexing or rate limiting. For an SPTS that belongs to an MFP multiple SPTS rate control group, a fixed amount of this bandwidth must be allocated for the overhead that is required for TS encapsulation of the service (TS Overhead (Mbps) parameter).
- Priority—This parameter is used to prioritize the SPTSs for bandwidth allocation. SPTSs with a higher priority are allocated more bandwidth than SPTSs with a lower priority. For an SPTS in a TR multiple SPTS rate control group, this parameter can be set between 0 (low) and 10 (high); the default value is 5 (normal). For an SPTS in an MFP multiple SPTS rate control group, this parameter can vary between 0 (low) and 6 (high); the default value is 3 (normal).
- Closed Caption—This parameter is only applicable for SPTSs that belong to a TR multiple SPTS rate control group and determines if SCTE20 or SCTE21 user data conversion is done or not.
  - Off—No SCTE20 or SCTE21 user data conversion is done and the user data of the incoming video stream is present in the outgoing video stream.
  - SCTE 20 and 21—The SCTE20 user data of the incoming video stream is converted to SCTE21 user data or SCTE21 user data of the incoming video stream is converted to SCTE20 user data and the SCTE20 and SCTE21 user data is inserted into the outgoing video stream.

- TS Overhead (Mbps)—This parameter determines the bit rate that must be allocated for the overhead that is added during TS encapsulation of the corresponding service, the TS level components, and for all pass-through services. This parameter is only applicable for SPTSs that participate in an MFP multiple SPTS rate control group and for which the Rate Mode is set to Statmuxed or Rate Limited.
Important: Stuffing is added if the TS overhead is lower than this allocated bit rate; bit rate overshoots arise if the overhead exceeds this allocated bit rate.

### Changing the Rate Control Specific Settings

**Procedure**

**Step 1**

In the DCM GUI, choose Service > Tree View from the main menu. The Tree View page appears.

**Step 2**

In the Outputs tree, double-click the rate control group and then click Rate Control. The Output Port Rate Control page appears.

**Step 3**

In the Rate Control Group Settings table, double-click the row of each SPTS for which settings must be changed. The rows become editable.

**Hint:** The following figure shows the Rate Control Group Settings table for an MFP multiple SPTS rate control group. The table for a TR multiple SPTS rate control group is similar.

**Step 4**

From the Rate Mode drop-down list, choose one of the following settings:

- **Statmuxed**—The SPTS participates in the statistical remultiplexing group of the rate control group.
- **Rate Limited**—The SPTS is processed with a maximum bit rate limit.
- **Pass Through** (TR Multiple SPTS rate control group)—No rate control is performed on this SPTS, only delayed.

For an MFP multiple SPTS rate control group, this parameter is only applicable if the Rate Mode parameter on the MFP Video page is set to Statmux.

**Step 5**

In the Min Bit Rate (Mbps) field, enter the minimum bit rate for this SPTS. The Min Bit Rate (Mbps) parameter is only applicable when the Rate Mode parameter is set to Statmuxed.

**Step 6**

In the Max Bit Rate (Mbps) field, enter the maximum bit rate for this SPTS. The Max Bit Rate (Mbps) is only applicable when the Rate Mode parameter is set to Statmuxed or Rate Limited.

**Step 7**

In the Priority field, enter the priority for the SPTS.

**Step 8**

From the Closed Caption Update drop-down list (TR multiple SPTS rate control group only), choose one of the following values:

- **Off**—No SCTE20 or SCTE21 user data conversion is done and the user data of the incoming video stream is present in the outgoing video stream.
• **SCTE 20 and 21**—The SCTE20 user data of the incoming video stream is converted to SCTE21 user data or SCTE21 user data of the incoming video stream is converted to SCTE20 user data and the SCTE20 and SCTE21 user data is inserted into the outgoing video stream.

**Step 9**  
In the **TS Overhead (Mbps)** field (MFP multiple SPTS rate control group only), enter the amount of bit rate that must be allocated for the TS overhead.

**Step 10**  
Click **Apply**.

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**Important**

- For an SPTS that participates in the statmux pool of the rate control group, both **Min Bit Rate (Mbps)** and **Max Bit Rate (Mbps)** parameters apply to the video component of the service.
- For an SPTS, which is rate limited, the **Max Bit Rate (Mbps)** parameter applies to the complete content of the SPTS.

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### Changing the Rate Control Specific Settings Using the Update Function

When particular parameters of multiple SPTSs of the rate control group must be changed to similar values, the Update All function of the GUI can be used.

**Procedure**

**Step 1**  
In the DCM GUI, choose **Service > Tree View** from the main menu.  
The **Tree View** page appears.

**Step 2**  
In the **Outputs** tree, double-click the rate control group and then click **Rate Control**.  
The **Output Port Rate Control** page appears.

**Step 3**  
In the **Rate Control Group Settings** table, select the row of each SPTS for which settings must be changed.

**Step 4**  
In the **Update Rate Control Group Settings** area, enter or choose the desired value in the field or drop-down list of the parameter that must be changed for all SPTS of this rate control group.

**Step 5**  
Click **Update All Selected**.  
The settings are changed in the **Rate Control Group Settings** table.

**Hint**: Particular values in the **Rate Control Group Settings** table can still be changed manually if necessary.

**Step 6**  
Click **Apply**.

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### Checking the Rate Control Comparison

Once a rate control group is populated with services and the rate control parameters are properly configured, a graphical representation of the bit rates of the services before and after processing is available on the **Output Port Rate Control Graph** page. This page is refreshed automatically every 10 seconds. A manual refresh
can be executed by clicking Reload. The following figure shows an example of an Output Port Rate Control Graph page.

The Incoming Service Bit Rate diagram shows the bit rates of the services before processing and the Outgoing Service Bit Rate diagram shows the bit rates after processing. The red line in the Outgoing Service Bit Rate diagram represents the TS bit rate and the black line represents the total used bit rate of the rate control group. For VBR TSs, the red line is not displayed.

In the Outgoing Service Bit Rate diagram of an MFP rate control group, you can toggle between the normal view (the scale as used by the Incoming Service Bit Rate diagram) and the magnified view (optimal use of the graph) by clicking in the diagram.

The Services table provides the legend of the diagrams together with the input (before processing) and output bit rates (after processing) and average compression ratio (expressed in percent) of the services.
• When the total bit rate of the TR rate control group is higher than the sum of the bit rates of the incoming services for this rate control group, the bit rates of the outgoing services have a larger variation than the bit rates of the incoming services. This is a normal behavior for a TR rate control group (a rate control group that is processed by a coprocessor).

• To determine the current output bit rate of a service, the bit rates of all components are taken into account, including shared components. When components are shared with multiple services of a particular rate control group, the sum of the service bit rates exceeds the black line that indicates the total bit rate of the rate control group.

Perform the following steps to check the Output Port Rate Control Graph page of a multi-TS rate control group:

**Procedure**

**Step 1** In the DCM GUI, choose **Service > Tree View** from the main menu. The **Tree View** page appears.

**Step 2** In the **Outputs** tree, right-click the multi-TS rate control group for which the rate control comparison must be checked and choose **Bit Rates**.
The Output Port Rate Control Graph page appears.

Rate Control Examples

Transport Stream with Multiple Rate Control Groups

Statistical remultiplexing keeps the total bit rate of a group of services under control. In this group, the services have variable bit rates (VBR). When a TS with VBR services is offered to, for instance, our MQAM (multiple quadrature amplitude modulation) modulator, which builds four QAM (quadrature amplitude modulation) channels from one incoming TS, the bit rates of these QAM channels are out of control. By creating a TS with four rate control groups with the services for each individual QAM channel, the bit rate of the TS, and the bit rates of the individual rate control groups can be kept under control.

The following figure shows a graphical representation of a TS with four rate control groups.

![Graphical Representation of TS with Rate Control Groups](image)

In the example, four selective services type rate control groups must be created on the outgoing TS with each having a total bit rate of 38.5 Mbps. The total bit rate of the TS must be set to 154 Mbps. Pass the services to the rate control group belonging to one of the four QAM channels. The following figure shows the tree of an outgoing TS for an MQAM Modulator with four selective services type rate control groups.
Statistical Remultiplexing of an SPTS Rate Control Group

In DSL applications, the output of the DCM contains multiple SPTSs. When the bandwidth of the backbone is limited, statistical remultiplexing can be used to optimize the bandwidth usage efficiency. In the example above, an SPTS rate control group must be created with the SPTSs. The maximum bit rate of the rate control group must be set to 100 Mbps and the bit rate of the individual SPTSs to 4 Mbps. The following figure shows a setup of a rate control group populated with SPTSs.
Statistical Remultiplexing in Combination with Rate Limiting

The DCM allows you to combine bit rate limiting with statistical remultiplexing. When bit rate limiting is combined with statistical remultiplexing, the bit rate allocation for the services that must be bit rate limited has a higher priority than the bit rate allocation used for statistical remultiplexing. If the bit rate of an incoming service, that must be rate limited using a coprocessor, is less than its limit, the bit rate surplus of this service is added to the bit rate pool used for statistical remultiplexing.

In the following example, the shaded services from TS 1 and TS 2 must be remultiplexed into a TS of 29 Mbps. The services of TS 2 must be bit rate limited to 4 Mbps. The services of TS 1 must be statistical multiplexed. A part of the TS bandwidth must be reserved for future services (2 Mbps).
Parameters to set

- Outgoing TS, bit rate = 29 Mbps
- MPTS (multiprogram transport stream) - All Services rate control group, maximum bit rate = 27 Mbps
- Three services TS 2
  - Rate control = rate limited
  - Max bit rate (Mbps) = 4 Mbps
- Five services TS 1
  - Rate control = statmuxed
  - Min bit rate (Mbps) = for instance, 2