

Cisco MURAL User Guide

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Cisco MURAL User Guide

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Analyzing Traffic Distribution Across Network Sites

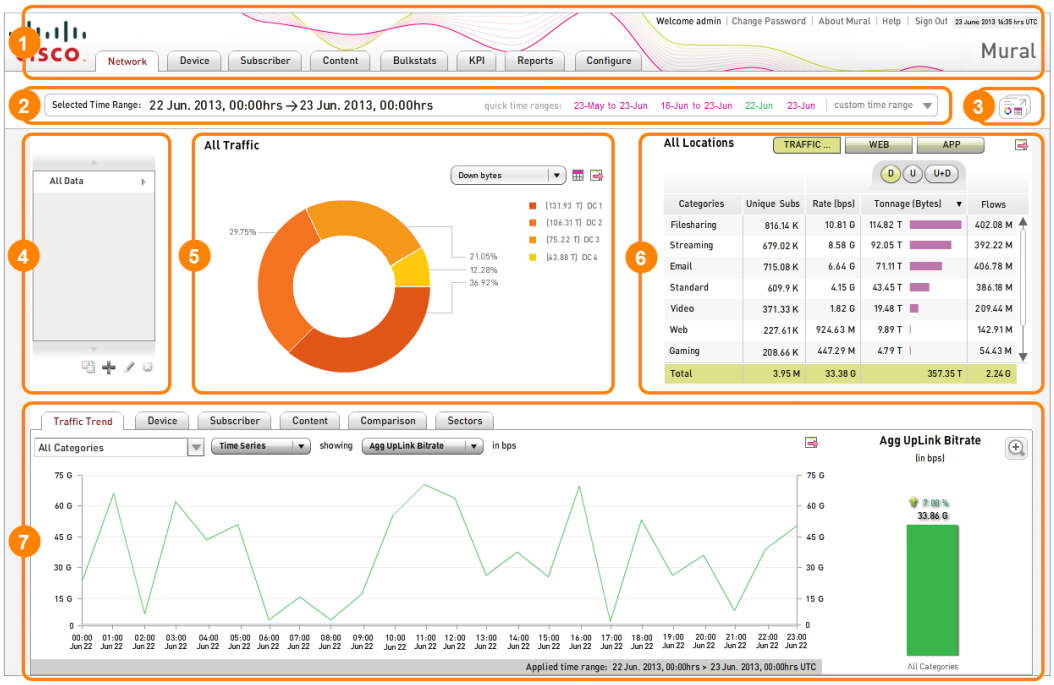
The **Network** tab in Mobility Unified Reporting and Analytics (MURAL) reports the distribution of network traffic across the sites where your network equipment is physically located (also referred to as *gateways*). By tracking traffic patterns at a gateway over time, you can anticipate demand and provision efficiently to meet customer requirements at minimal cost.

Use the **Network** tab to answer questions like the following:

- What is the distribution of traffic across the geographical network?
- What particular usage trends are developing at a gateway?
- Which categories of web content are most popular at a gateway?
- Which mobile applications are generating the most traffic at a gateway? Which mobile devices?
- How does network usage compare between gateways?

Navigating the Network Tab

The **Network** tab is divided functionally into several panes, numbered **1** through **7** in the following figure.



The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Network** to access the **Network** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing the Main Tabs and Controlling the Session" on page 25.

2. Time range selector—Reports and sets the period of time for which data is reported on the tab. See "Setting the Time Range for Displayed Data" on page 29.

3. Palette icon—Opens the palette, which is a pop-up window where you can store and compare multiple images during the MURAL session. See "Comparing Images on the Palette" on page 121.

4. Filter panel—Provides the interface for defining and applying filters that limit the data in

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boxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the sites that match the filter criteria. When no filter is applied, the data includes all sites. See "Using Filters to Fine-tune the Reported Data" on page 37.

5. Traffic distribution—Indicates the proportion of total network traffic that was generated by each site. When you first access the **Network** tab, the data is presented in a doughnut chart, but you can also view it in table format. For more information, see "Analyzing Traffic Distribution" on page 54.

6. Content categories table—Categorizes traffic according to the icon selected above the table:

   - **TRAFFIC**—Traffic is categorized by transport protocol, such as **VOIP** (voice over IP) or **Web**, referring to Hypertext Transfer Protocol (HTTP)
   - **WEB**—Traffic is categorized by subject matter (type of content), such as **Sports** or **Entertainment**
   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   See "Analyzing Traffic by Category" on page 64.

7. Subtabs—Provide detailed information about individual content categories, gateways, or network sectors. The format and type of information depend on the subtab:

   - On the **Traffic Trend** subtab, traffic patterns over time are tracked in a time-series line chart for up to three of the categories in box **6**. See "Analyzing Traffic Trend Data" on page 73.
   - On the **Device**, **Subscriber**, and **Content** subtabs, traffic distribution is reported across the same kind of entity as on the top-level tab with the same name, along with summary statistics in a table. The information is reported for the selected row in box **6**, which represents either a single content category, or all categories in the case of the **Total** row. See "Analyzing Traffic Distribution" on page 54 and "Interpreting Usage Statistics" on page 97.
   - On the **Comparison** subtab, traffic patterns over time are tracked in a time-series

line chart for two of the sites in box **5**. See "Comparing Two Network Entities" on page 89.

- On the **Sectors** subtab, statistics for network sectors are presented in a table. See "Analyzing Traffic in Mobile Network Sectors" on page 107.

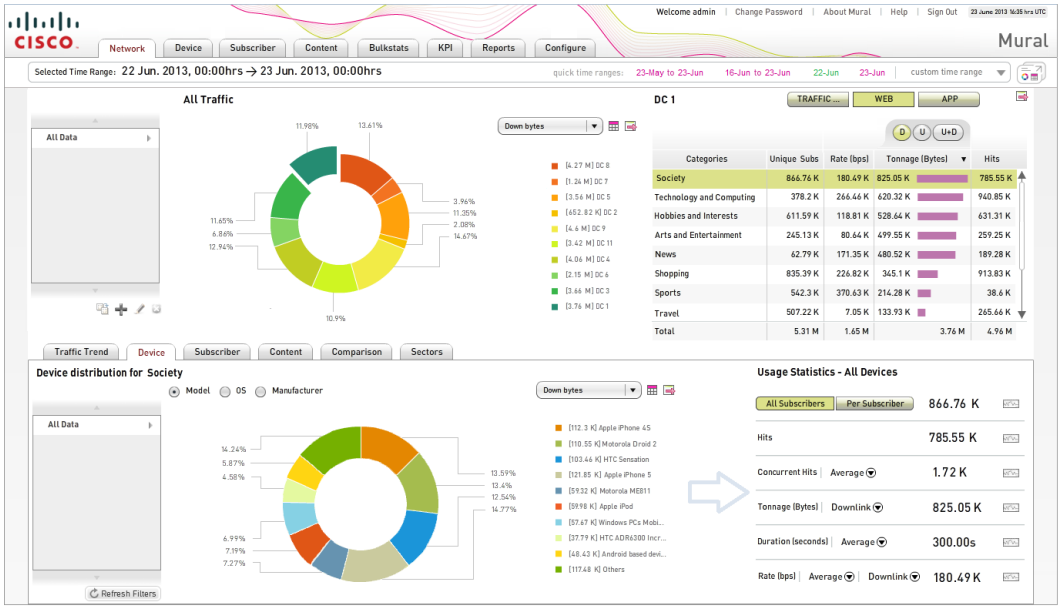
For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 111.

Use Case: Explaining a Traffic Spike

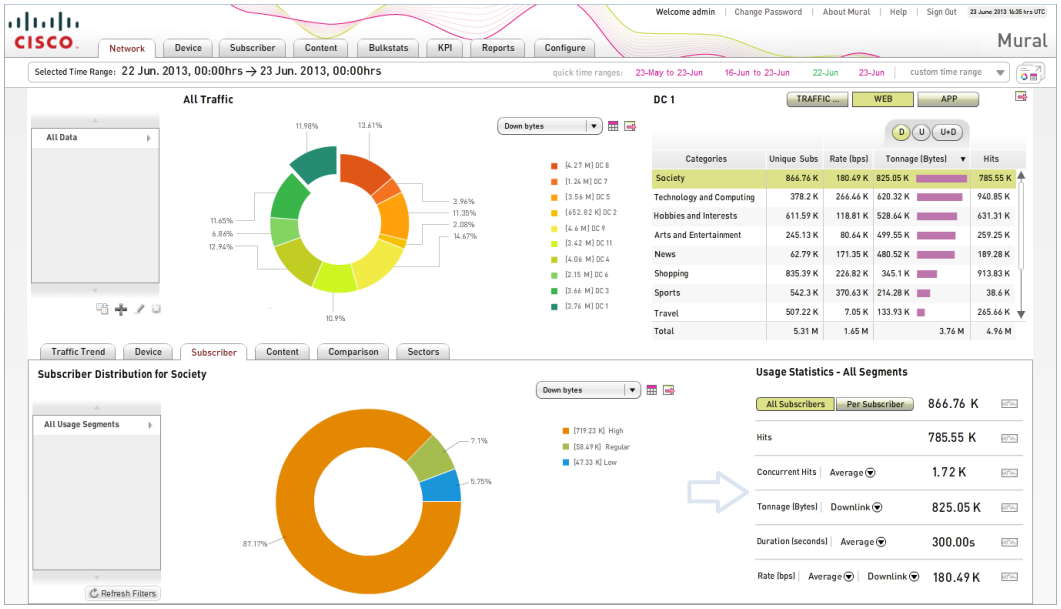
You notice a sudden traffic spike in traffic at one gateway, but nowhere else. As detailed in the following figures, the content categorization information on the **Network** tab suggests that a video relating to a controversial local sales tax increase in the town served by the gateway has gone viral, and that it is being shared primarily among mobile phone users. Armed with this information, you decide that the spike is likely temporary, requiring no provisioning changes.

The green wedge that is popped out from the doughnut in the upper left quadrant of the following figure represents the **DC 1** gateway, which started to experience the current unexpectedly high traffic volume during the selected time range. The categories table in the upper right quadrant indicates heavy traffic of type **WEB** at **DC 1** for several content categories including **Society**, which accounted for the largest amount of download traffic. To learn more about the **Society** category, you click its row in the categories table to select it, which is indicated by the gold background color. You then click the **Device** subtab in the lower half of the tab to open it. The doughnut chart in the **Device** subtab shows that the devices being used to access content categorized as **Society** have recently skewed toward smart phones, on which many subscribers are likely to download video.

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You switch to the **Subscriber** subtab to examine subscriber distribution for the **Society** category, where you notice that the subscribers in the **Heavy** segment accounted for the majority of the traffic, and that the average duration is far higher than normal. This indicates that the spike in network traffic at **DC 1** is the result of a viral video, which is most likely temporary and so does not warrant provisioning additional permanent capacity.



Analyzing Traffic Distribution Across Mobile Devices

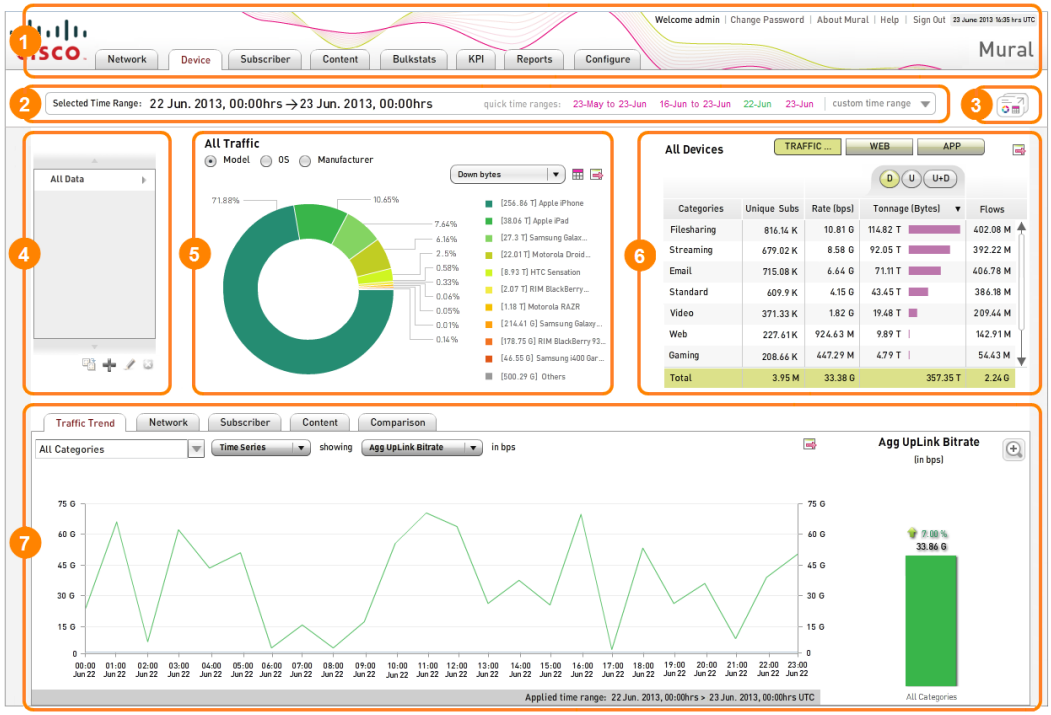
The **Device** tab in Mobility Unified Reporting and Analytics (MURAL) reports the distribution of network traffic across the mobile devices (such as phones and tablet computers) used by your network subscribers. By tracking traffic patterns, you can determine how best to optimize content delivery for different devices.

Use the **Device** tab to answer questions like the following:

- Which devices do subscribers use most?
- Is one type of device generating the most traffic?
- Are the most popular categories of web content different on particular device models or types?
- What mobile apps are the most popular on a device?
- Where in my network are specific device models generating the most traffic?
- Is there a correlation between the amount of traffic that subscribers generate and the type of device they use?

Navigating the Device Tab

The **Device** tab is divided functionally into several panes, numbered **1** through **7** in the following figure.



The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Device** to access the **Device** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing the Main Tabs and Controlling the Session" on page 25.

2. Time range selector—Reports and sets the period of time for which data is reported on the tab. See "Setting the Time Range for Displayed Data" on page 29.

3. Palette icon—Opens the palette, which is a pop-up window where you can store and compare multiple images during the MURAL session. See "Comparing Images on the Palette" on page 121.

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4. Filter panel—Provides the interface for defining and applying filters that limit the data in boxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the devices that match the filter criteria. When no filter is applied, the data includes all devices. See "Using Filters to Fine-tune the Reported Data" on page 37.

5. Traffic distribution—Indicates the proportion of total network traffic that was generated by mobile devices. Click the appropriate radio button to aggregate devices of the same specific model (the default, as shown in the figure), by operating system (OS), or by manufacturer (brand). When you first access the **Device** tab, the data is presented in a doughnut chart, but you can also view it in table format. For more information, see "Analyzing Traffic Distribution" on page 54.

6. Content categories table—Categorizes traffic according to the icon selected above the table:

   - **TRAFFIC**—Traffic is categorized by transport protocol, such as **VOIP** (voice over IP) or **Web**, referring to Hypertext Transfer Protocol (HTTP)
   - **WEB**—Traffic is categorized by subject matter (type of content), such as **Sports** or **Entertainment**
   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   See "Analyzing Traffic by Category" on page 64.

7. Subtabs—Provide detailed information about one or more content categories or two mobile devices. The format and type of information depend on the subtab:

   - On the **Traffic Trend** subtab, traffic patterns over time are tracked in a time-series line chart for up to three of the categories in box **6**. See "Analyzing Traffic Trend Data" on page 73.
   - On the **Network**, **Subscriber**, and **Content** subtabs, traffic distribution is reported across the same kind of entity as on the top-level tab with the same name, along with summary statistics in a table. The information is reported for the selected row in box **6**, which represents either a single content category, or all categories in the

case of the **Total** row. See "Analyzing Traffic Distribution" on page 54 and "Interpreting Usage Statistics" on page 97.

- On the **Comparison** subtab, traffic patterns over time are tracked in a time-series line chart for two of the devices in box **5**. See "Comparing Two Network Entities" on page 89.

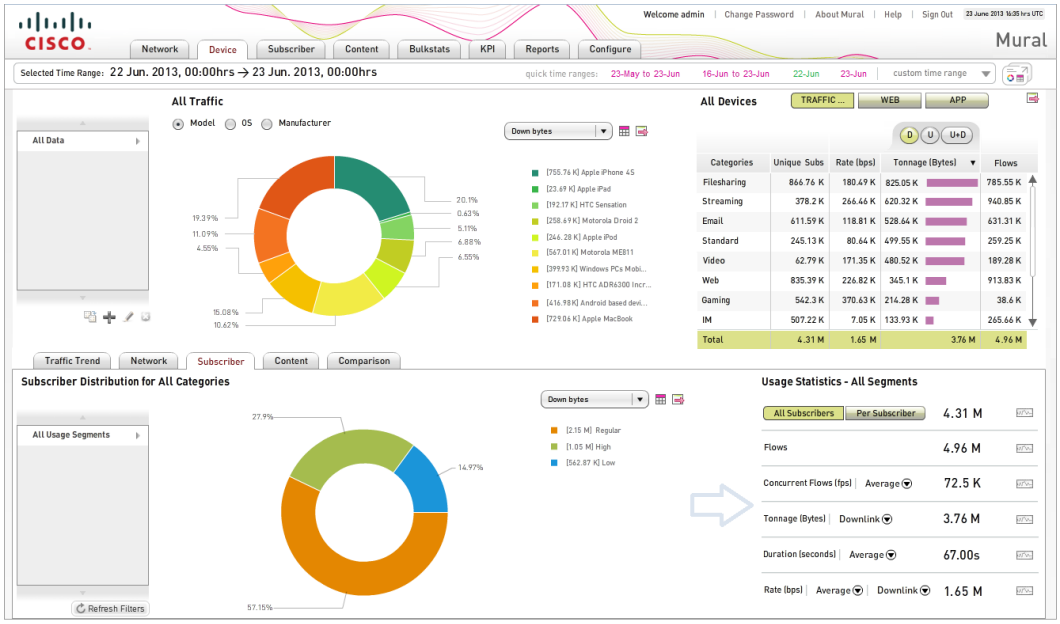
For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 111.

Use Case: Preparing for the Launch of a New Device

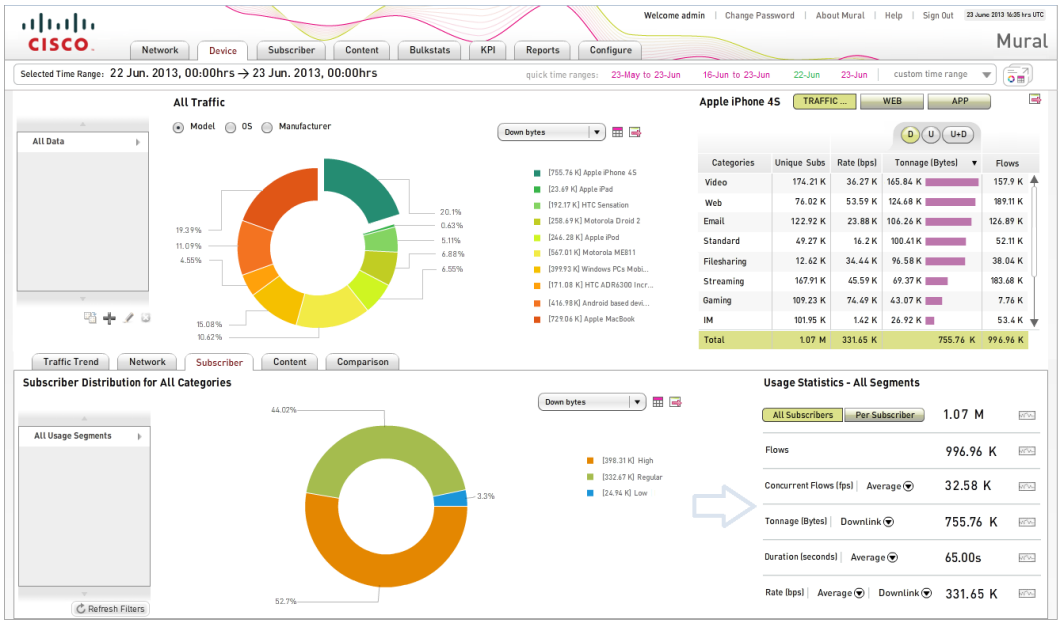
Apple has announced the launch date for its newest iPhone and you need to predict the effect on traffic on your network. Using MURAL, you can determine what percentage of your subscribers are using an iPhone currently, which types of web sites and applications are most popular with those users, and how your network usage was impacted by past iPhone introductions, all of which helps you make better decisions about how best to allocate your resources prior to the launch.

In the following figure, the doughnut chart in the upper left quadrant of the **Device** tab reports traffic distribution across the most popular mobile device models. The table to its right lists the most popular categories of content. Because the **Total** row is currently selected, the **Subscriber** subtab in the lower half of the tab reports the distribution of subscribers for all content categories.

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When you click on the wedge for the iPhone 4S in the doughnut chart, popping it outward from the doughnut as shown in the following figure, the data in the categories table and **Subscriber** subtab change to represent iPhone 4S users only. At a glance you can see the most popular content categories for iPhone users, how active iPhone users tend to be, the total number of iPhone subscribers, and how (and for how long) they typically use network resources. Armed with these facts, you can make better provisioning plans prior to the launch of the newest iPhone.



Analyzing Traffic Distribution Across Subscriber Segments

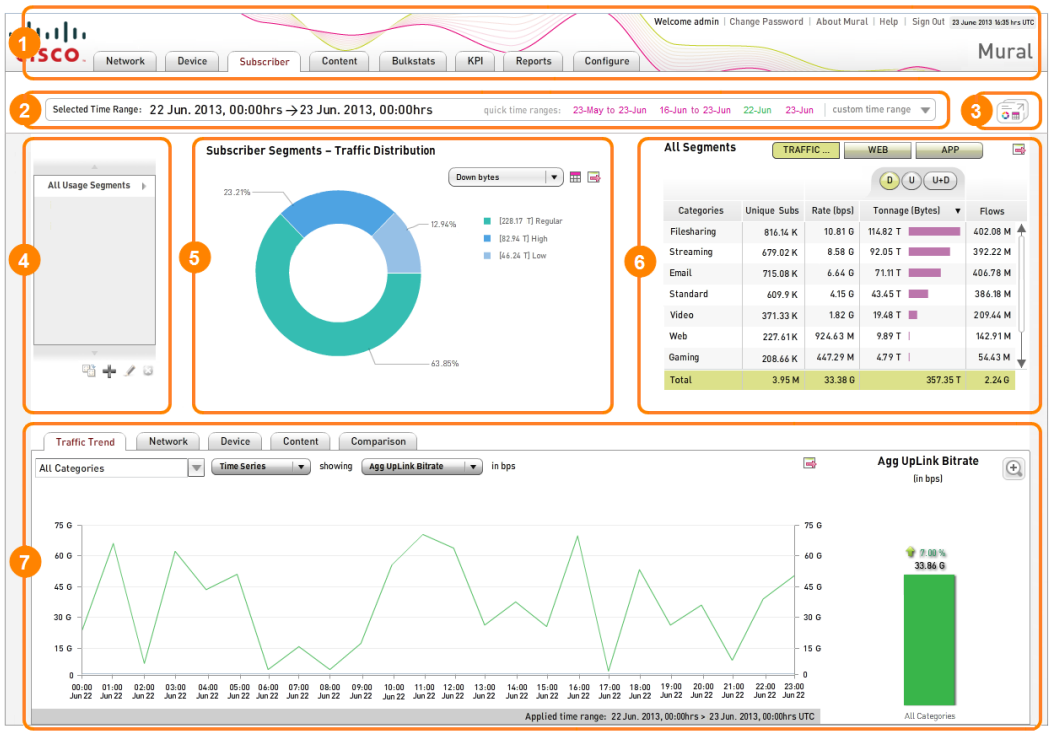
The **Subscriber** tab in Mobility Unified Reporting and Analytics (MURAL) reports the distribution of network traffic across subscribers, who are grouped into segments by level of usage. By tracking traffic patterns, you can determine how best to optimize content delivery to different groups of subscribers.

Use the **Subscriber** tab to answer questions like the following:

- Which subscriber segment is generating the most traffic?
- Are different types of devices more popular with different subscriber segments?
- Which categories of content are most popular with each subscriber segment?
- Where in my network are certain subscribers generating the most traffic?
- Which segment generates the most traffic to a particular domain?

Navigating the Subscriber Tab

The **Subscriber** tab is divided functionally into several panes, numbered **1** through **7** in the following figure.



The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Subscriber** to access the **Subscriber** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing the Main Tabs and Controlling the Session" on page 25.

2. Time range selector—Reports and sets the period of time for which data is reported on the tab. See "Setting the Time Range for Displayed Data" on page 29.

3. Palette icon—Opens the palette, which is a pop-up window where you can store and compare multiple images during the MURAL session. See "Comparing Images on the

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Palette" on page 121.

4. Filter panel—Provides the interface for defining and applying filters that limit the data in boxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the subscribers who generate the most traffic. When no filter is applied, the data includes all subscribers. See "Using Filters to Fine-tune the Reported Data" on page 37.

5. Traffic distribution—Indicates the proportion of total network traffic that was generated by different subscriber segments. The segments are made up of individual users of mobile devices who generated an average daily volume of traffic in the previous month that fell in the range of values that your system administrator defined for the **High**, **Regular** and **Low** classes during initial configuration of MURAL.

   When you first access the **Subscriber** tab, the data is presented in a doughnut chart, but you can also view it in table format. For more information, see "Analyzing Traffic Distribution" on page 54.

6. Content categories table—Categorizes traffic according to the icon selected above the table:

   - **TRAFFIC**—Traffic is categorized by transport protocol, such as **VOIP** (voice over IP) or **Web**, referring to Hypertext Transfer Protocol (HTTP)
   - **WEB**—Traffic is categorized by subject matter (type of content), such as **Sports** or **Entertainment**
   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   See "Analyzing Traffic by Category" on page 64.

7. Subtabs—Provide detailed information about one or more content categories or two mobile devices. The format and type of information depend on the subtab:

   - On the **Traffic Trend** subtab, traffic patterns over time are tracked in a time-series line chart for up to three of the categories in box **6**. See "Analyzing Traffic Trend Data" on page 73.
   - On the **Network**, **Device**, and **Content** subtabs, traffic distribution is reported

across the same kind of entity as on the top-level tab with the same name, along with summary statistics in a table. The information is reported for the selected row in box **6**, which represents either a single content category, or all categories in the case of the **Total** row. See "Analyzing Traffic Distribution" on page 54 and "Interpreting Usage Statistics" on page 97.

- On the **Comparison** subtab, traffic patterns over time are tracked in a time-series line chart for two of the segments in box **5**. See "Comparing Two Network Entities" on page 89.

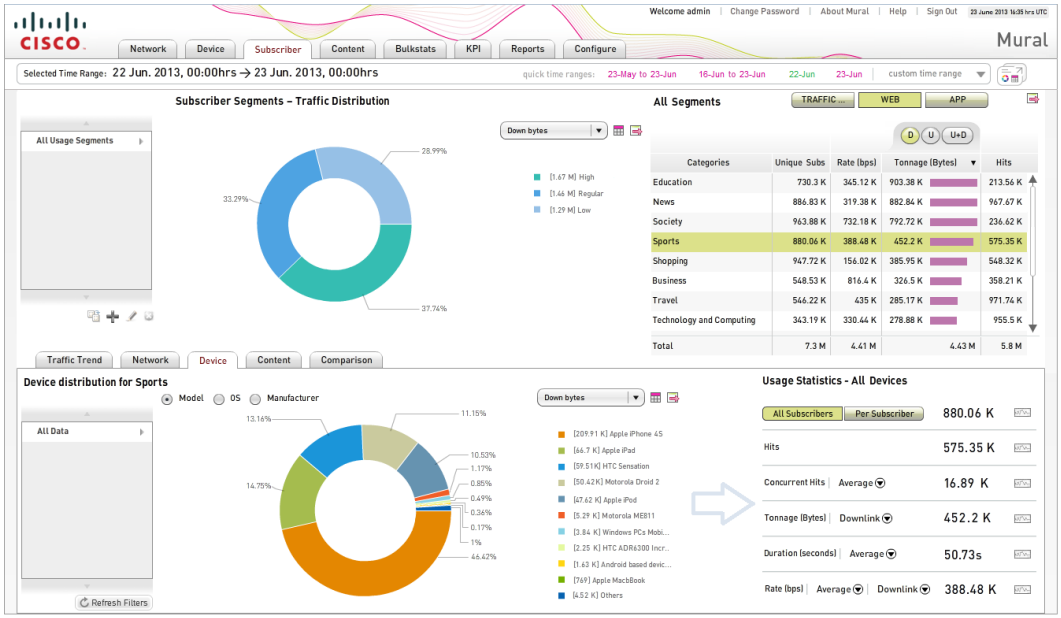
For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 111.

Use Case: Offering a New Video Service

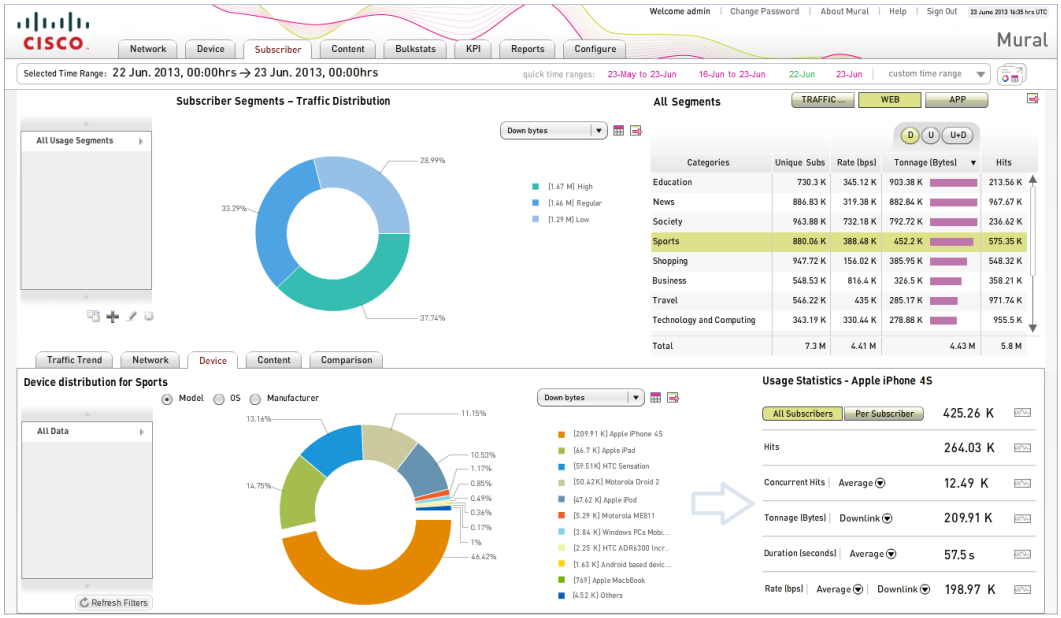
Your company is considering offering a new sports video download service for mobile users, and you've been tasked with determining whether current network capacity is sufficient to handle the increased traffic from video downloads. Using MURAL, you can quickly determine which subscriber segments are currently driving usage, what types of devices they are using, and the types of content they are accessing. Thus you can make intelligent projections about the additional capacity needed to accommodate the new service without decreasing network performance for users of other applications.

In the following figure, the doughnut chart in the upper left quadrant of the **Subscriber** tab reports traffic distribution across all subscriber segments. The table to its right highlights the current demand for sports content. Because the **Sports** row is selected, the **Device** subtab in the lower half of the tab reports the most popular devices among subscribers who accessed sports content.

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Switching to the **Device** subtab reveals that subscribers who accessed sports content using the iPhone 4S generated the most downlink traffic. When you click on the wedge for the iPhone 4S and pop it outward from the doughnut, the **Usage Statistics** table reports values only for subscribers using the iPhone 4S.



Analyzing Traffic Distribution Across Types of Content

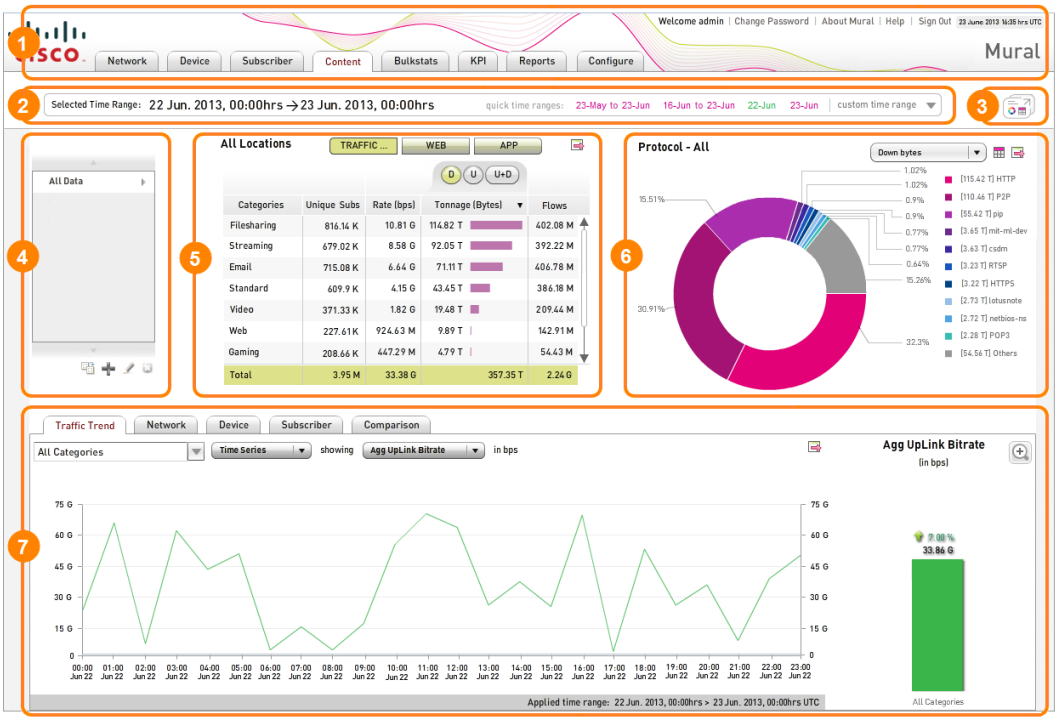
The **Content** tab in Mobility Unified Reporting and Analytics (MURAL) reports the distribution of network traffic across the types of content being accessed by your subscribers. By tracking traffic patterns for types of content over time, you can identify which web applications, web domains, and non-web content are most popular. This enables you to make informed decisions about new product and service introductions, marketing campaigns, resource allocation, and network provisioning across multiple geographies.

Use the **Content** tab to answer questions like the following:

- Which web categories are the most visited?
- Which mobile applications are the most popular?
- Which domains are the most popular within a given category?
- How are traffic patterns changing for a particular category of mobile application?
- Where in my network is a particular type of content generating the most usage?

Navigating the Content Tab

The **Content** tab is divided functionally into several panes, numbered **1** through **7** in the following figure.



The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Content** to access the **Content** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing the Main Tabs and Controlling the Session" on page 25.

2. Time range selector—Reports and sets the period of time for which data is reported on the tab. See "Setting the Time Range for Displayed Data" on page 29.

3. Palette icon—Opens the palette, which is a pop-up window where you can store and compare multiple images during the MURAL session. See "Comparing Images on the Palette" on page 121.

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4. Filter panel—Provides the interface for defining and applying filters that limit the data in boxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the content categories that match the filter criteria. When no filter is applied, the data includes all categories. See "Using Filters to Fine-tune the Reported Data" on page 37.

5. Content categories table—Categorizes traffic according to the icon selected above the table:

   - **TRAFFIC**—Traffic is categorized by transport protocol, such as **VOIP** (voice over IP) or **Web**, referring to Hypertext Transfer Protocol (HTTP)
   - **WEB**—Traffic is categorized by subject matter (type of content), such as **Sports** or **Entertainment**
   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   See "Analyzing Traffic by Category" on page 64.

6. Traffic distribution—For the highlighted row in box **5**, indicates the proportion of traffic for the category that was generated by subscribers accessing different content providers. When you first access the **Content** tab, the data is presented in a doughnut chart, but you can also view it in table format. For more information, see "Analyzing Traffic Distribution" on page 54.

7. Subtabs—Provide detailed information about either content categories or providers. The format and type of information depend on the subtab:

   - On the **Traffic Trend** subtab, traffic patterns over time are tracked in a time-series line chart for up to three of the categories in box **5**. See "Analyzing Traffic Trend Data" on page 73.
   - On the **Network**, **Device**, and **Subscriber** subtabs, traffic distribution is reported across the same kind of entity as on the top-level tab with the same name, along with summary statistics in a table. The information is reported for all content providers in box **6**, or for a single selected provider. See "Analyzing Traffic Distribution" on page 54 and "Interpreting Usage Statistics" on page 97.

- On the **Comparison** subtab, traffic patterns over time are tracked in a time-series line chart for two of the categories in box **5**. See "Comparing Two Network Entities" on page 89.

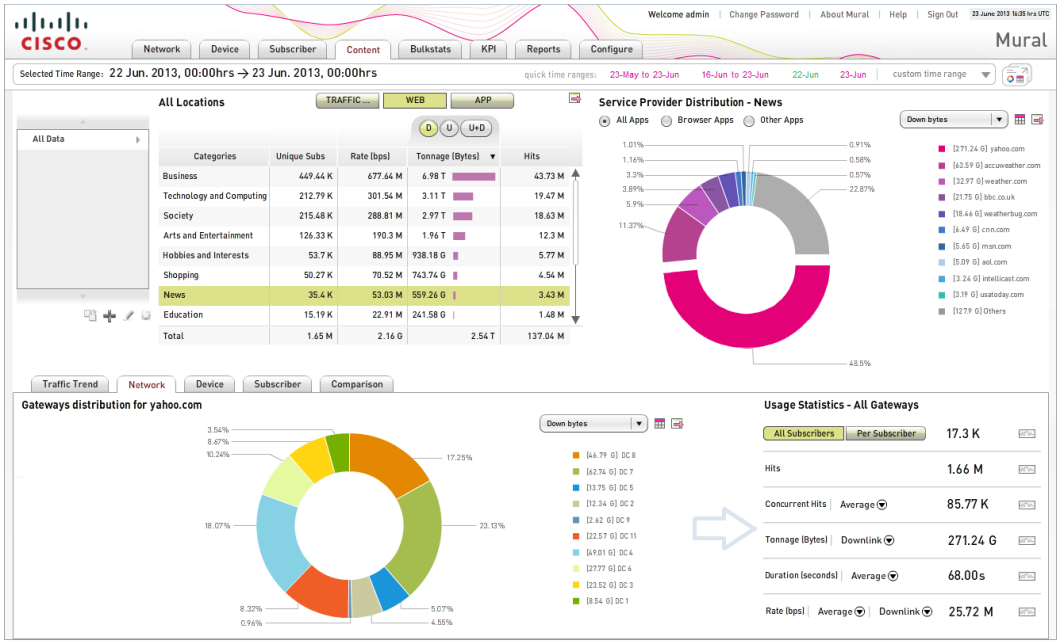
For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 111.

Use Case: Predicting Demand for Content

Your company is launching a new real-time news video service as part of an advertising campaign. Marketing wants to know where the campaign is making the biggest impact and which devices consumers are using to access it. The chief information officer (CIO) wants to know how the ad is affecting network volume, to ensure that all gateways can handle the increased traffic. The information technology (IT) director wants usage data by gateway to plan provisioning for the next promotional campaign. Using MURAL, you can answer all of these questions with near-real-time data.

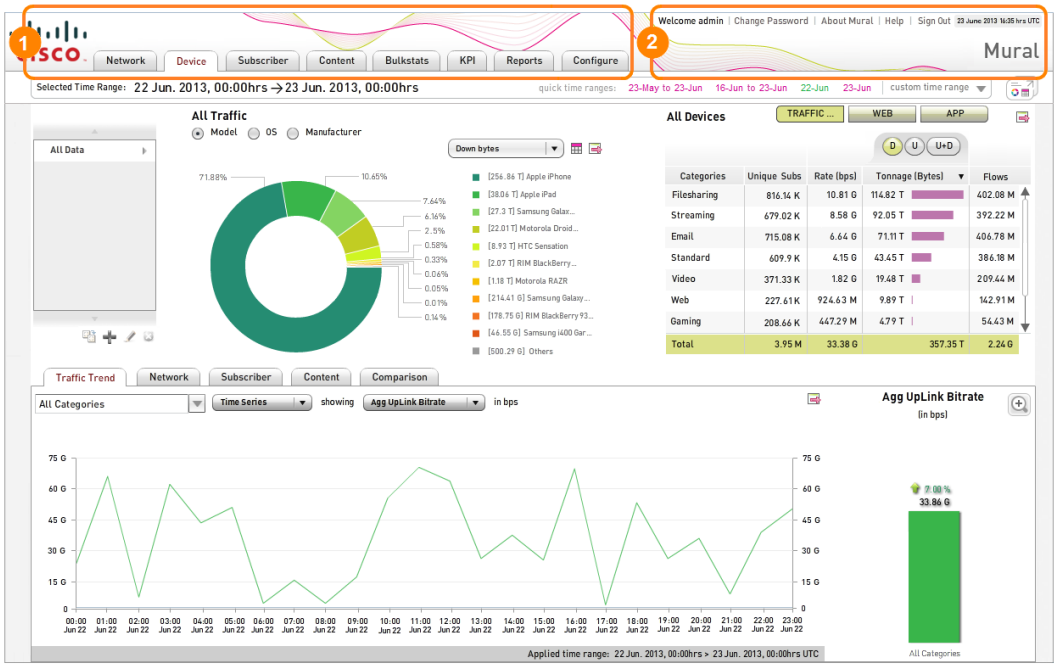
In the following figure, the table in the upper left quadrant of the **Content** tab highlights the current demand for news content. The doughnut chart to its right reports the proportion of news content provided by various websites. The wedge for **yahoo.com** is selected (popped outward from the doughnut), so the **Network** subtab reports the distribution of traffic for **yahoo.com** across the gateways in the network. The **Usage Statistics** table reports values for all gateways that handled traffic between mobile users and the **yahoo.com** website.

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Welcome admin | Change Password | About Mural | Help | Sign Out
Mural
Network
Device
Subscriber
Content
Bulkstats
KPI
Reports
Configure
Selected Time Range: 22 Jun. 2013, 00:00hrs → 23 Jun. 2013, 00:00hrs
quick time ranges: 23-May to 23-Jun 16-Jun to 23-Jun 22-Jun 23-Jun custom time range
All Locations
TRAFFIC ...
WEB
APP
All Data
Categories | Unique Subs | Rate (bps) | Tonnage (Bytes) | Hits
Business | 449.44 K | 677.64 M | 6.98 T | 43.73 M
Technology and Computing | 212.79 K | 301.54 M | 3.11 T | 19.47 M
Society | 215.48 K | 288.81 M | 2.97 T | 18.63 M
Arts and Entertainment | 126.33 K | 190.3 M | 1.96 T | 12.3 M
Hobbies and Interests | 53.7 K | 88.95 M | 938.18 G | 5.77 M
Shopping | 50.27 K | 70.52 M | 743.74 G | 4.54 M
News | 35.4 K | 53.03 M | 559.26 G | 3.43 M
Education | 15.19 K | 22.91 M | 241.58 G | 1.48 M
Total | 1.65 M | 2.16 G | 2.54 T | 137.04 M
Service Provider Distribution - News
All Apps
Browser Apps
Other Apps
Down bytes
Traffic Trend
Network
Device
Subscriber
Comparison
Gateways distribution for yahoo.com
Usage Statistics - All Gateways
All Subscribers
Per Subscriber
17.3 K
Hits
1.66 M
Concurrent Hits | Average
85.77 K
Tonnage (Bytes) | Downlink
271.24 G
Duration (seconds) | Average
68.00s
Rate (bps) | Average | Downlink
25.72 M

Accessing the Main Tabs and Controlling the Session

The title bar on tabs in Mobility Unified Reporting and Analytics (MURAL) is divided functionally into two panes, as depicted in the following sample **Device** tab.



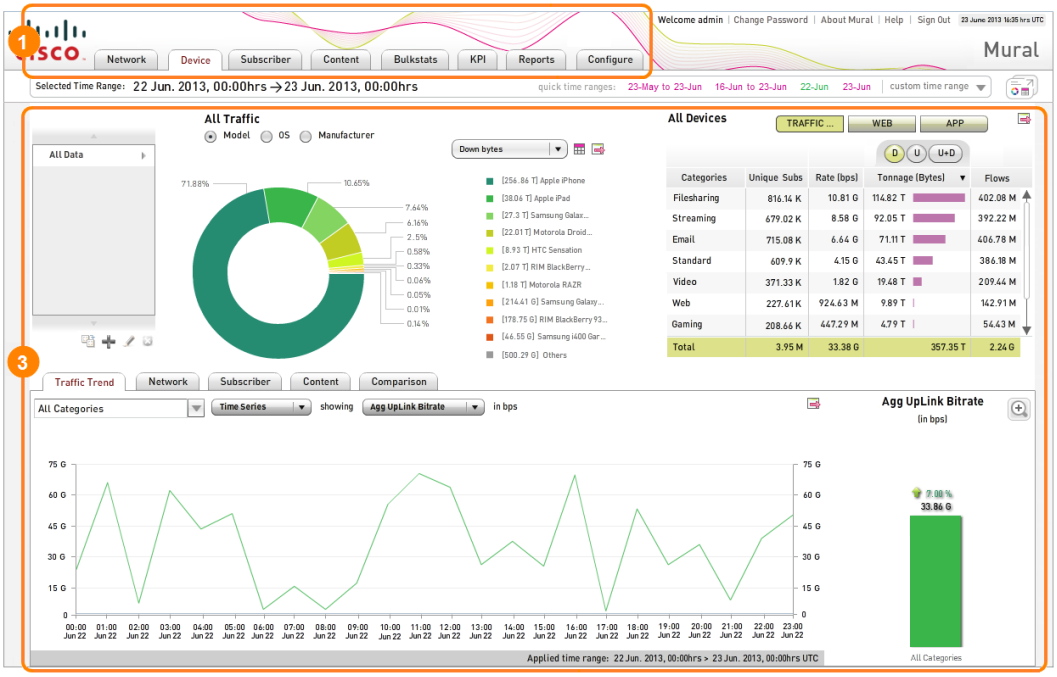
The elements in the numbered panes provide the following functionality:

1. Interface for accessing the specialized information on each tab. See "Accessing the MURAL Tabs" on the next page.

2. Fields that report status information about the current MURAL session and provide access to interfaces for changing your password, getting help, and closing the session. See "Controlling the MURAL Session" on page 27.

Accessing the MURAL Tabs

The pane enclosed in box **3** in the following figure displays the specialized information available on each tab in MURAL (here, traffic distribution for mobile devices on the **Device** tab). To access a tab, click its name in the left-hand portion of the title bar (enclosed in box **1** in the figure).



The following figure provides a closer view of the tab names in box **1**.



For details about the information featured on each tabs, see the indicated topics:

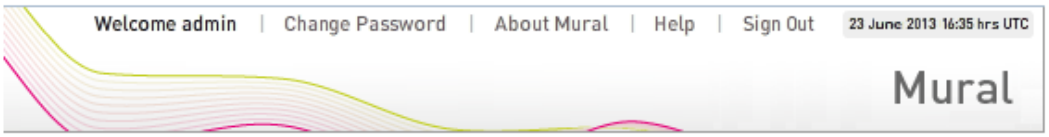
- **Network**—Analysis of traffic distribution across the gateways in your network; see "Analyzing Traffic Distribution Across Network Sites" on page 1
- **Device**—Analysis of traffic distribution across the specific models of device (such as smart phones and tablet computers) that subscribers used to access the network; see "Analyzing Traffic Distribution Across Mobile Devices" on page 7

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- **Subscriber**—Analysis of traffic distribution across subscriber segments; see "Analyzing Traffic Distribution Across Subscriber Segments" on page 13
- **Content**—Analysis of traffic distribution across types of content, classed by subject matter (such as sports or news), function (filesharing, VOIP), or application (browser, social networking); see "Analyzing Traffic Distribution Across Types of Content" on page 19
- **Bulkstats**—Summaries of performance statistics for the Cisco ASR 5000; see "Interpreting Performance Statistics for the ASR 5000" on page 127
- **KPI**—Summaries of key performance indicators (KPIs) for the Cisco ASR 5000; see "Interpreting Key Performance Indicators from the ASR 5000" on page 143
- **Reports**—Summaries of traffic analysis for different periods of time (days, weeks, months); see "Scheduling and Interpreting Statistical Reports" on page 165
- **Configure**—Administration of MURAL user accounts; see "Administering User Accounts" on page 195

Controlling the MURAL Session

The right-hand portion of the title bar (box **2** in the figure in the introduction) reports status information for the current MURAL session.



- **Welcome *username***—Names the user logged in to this MURAL session. In the figure, it is **admin**.
- **Change Password**—Opens the pop-up window for changing the password of the current user. See "Changing Your Account Password" on page 195.
- **About Mural**—Opens a pop-up window with information about this version of the MURAL application.

- **Help**—Opens a new tab in the browser to display help topics for MURAL.
- **Sign Out**—Ends the current MURAL session.

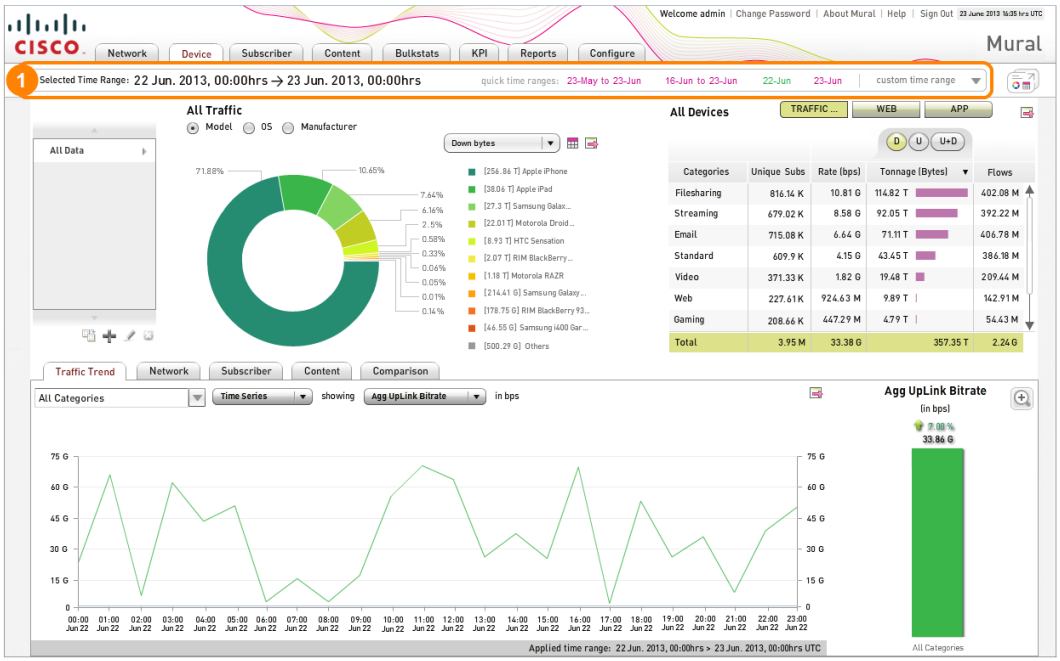
The field to the right of the **Sign Out** field reports the current date and time. The three-letter code specifies the time zone for the dates and times displayed and set on all tabs. Your system administrator sets the time zone during initial configuration of MURAL. In the figure, it is Coordinated Universal Time (UTC).

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Setting the Time Range for Displayed Data

The information displayed on the **Network**, **Device**, **Subscriber**, **Content**, **Bulkstats**, and **KPI** tabs in Mobility Unified Reporting and Analytics (MURAL) always corresponds to a specific time range. Determining whether the range is set properly, and resetting it as necessary, are the first steps any time you explore data on those tabs.

The time range is reported and set in the *time range selector*, which appears in box **1** in the following figure depicting the **Device** tab.



MURAL uses the 24-hour clock to represent times; for example, 00:00 hours is midnight and 18:00 hours is 6 PM.

The following figure depicts the time range selector from the **Network**, **Device**, **Subscriber**, and **Content** tabs with the left side stacked above the right to make the text larger and easier to read. The left side of the pane reports the current time range setting (in the figure, the 24 hours from midnight on 22 June to midnight on 23 June), and the right side provides the interface for resetting the time range.



The choices in the **quick time ranges** field on the **Bulkstats** and **KPI** tabs are different (as detailed in the following sections), but the operation of the time range selector is otherwise the same.

The following sections describe the two ways to set the time range:

- "Setting the Time Range to a Standard Duration" below
- "Setting the Time Range to a Custom Duration" on the facing page

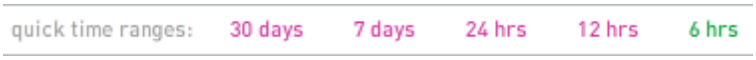
Note: The time range is independent on each tab, which provides maximum flexibility. When you switch between tabs, it is important to verify that the time range setting is the one you want.

Setting the Time Range to a Standard Duration

To set the time range quickly to a predefined duration, click it in the **quick time ranges** field. On the **Network**, **Device**, **Subscriber**, and **Content** tabs, the ranges correspond to the previous 30 days, the previous week, the previous day, and the current day. The term in green is the currently selected time range (in the following example, the current day, **23-Jun**).



In the following figure, **6 hrs** is the time range currently selected from among the choices on the **Bulkstats** and **KPI** tabs.



The start and end times for the selected range are reported in the **Selected Time Range** field to the left of the quick time ranges. Time ranges that include the current day end with the last hourly interval for which statistics have been calculated.

If none of the terms in the **quick time ranges** field are green, the current time range was set using the custom interface discussed in "Setting the Time Range to a Custom Duration" on the facing page.

If you select a quick time range that begins before the time when data was first collected, MURAL displays all available data (that is, data from the entire period between the first collec-

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tion time and the last hourly interval on the current day for which data is available). The precise start and end times appear in the **Selected Time Range** field of the time range selector.

Setting the Time Range to a Custom Duration

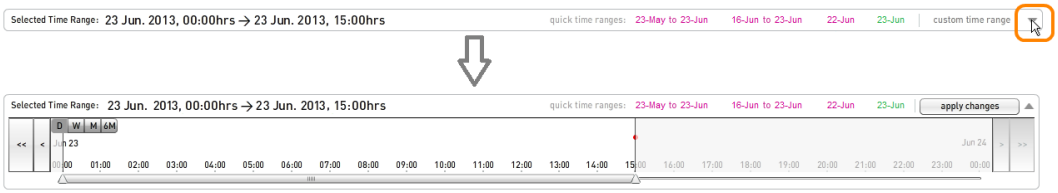
Quick time ranges are convenient, but are limited to standard start times, end times, and durations. Using the custom time range selector, you can set a range that starts at any hour of the day, ends before the current day, and includes as little as one hour.

The following sections explain how to interpret and use the custom time range selector:

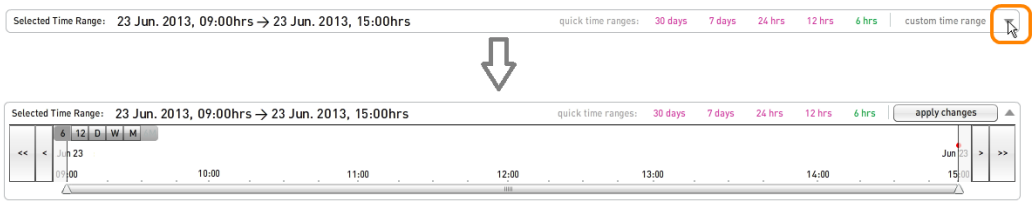
- "Accessing and Interpreting the Custom Time Range Selector" below
- "Setting a Custom Time Range" on page 33

Accessing and Interpreting the Custom Time Range Selector

To access the custom time range selector, click the triangle icon (▼) at the right end of the custom time range field. On the **Network**, **Device**, **Subscriber**, and **Content** tabs:

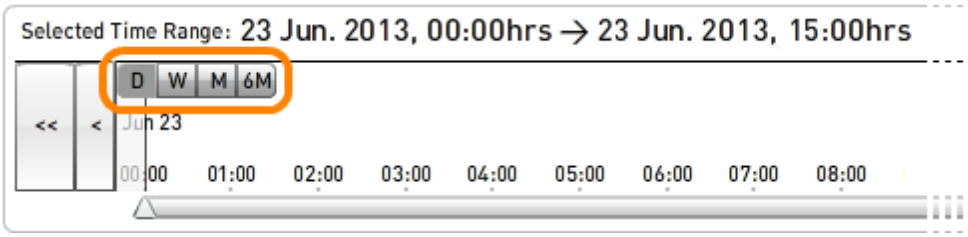


On the **Bulkstats** and **KPI** tabs:



The time range selector has four modes for depicting a span of time, represented by the buttons at the left end of the range selector: D for daily mode, W for weekly mode, M for monthly mode, or 6M for semiannual mode. On the **Bulkstats** and **KPI** tabs, there are two additional modes, 6-hour (6) and 12-hour (12). The button for the currently selected mode is solid gray. In the

following figure for the **Network**, **Device**, **Subscriber**, and **Content** tabs, daily mode is selected (D).

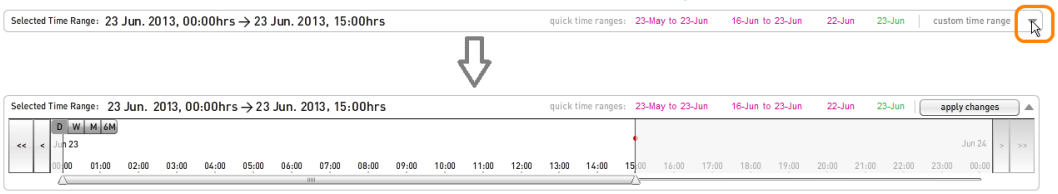


In the following figure for the **Bulkstats** and **KPI** tabs, 6-hour mode (6) is selected.



The time range in effect on the tab when you open the custom time range selector determines which mode is selected by default. If the time range in effect is a custom one, the selected mode is preserved from the previous time the custom selector was used. If the time range in effect is a quick one, the mode in the custom selector corresponds to the type of quick time range. For example, daily mode is selected (D) when the current quick time range is the date of the previous or current day (**22-Jun** and **23-Jun** in the preceding figure) or **24 hrs** on the **Bulkstats** and **KPI** tabs. Similarly, weekly mode is selected (W) when the current quick time range corresponds to the previous week (**16-Jun to 23-Jun** in the preceding figure) or is **7 days** on the **Bulkstats** and **KPI** tabs, and monthly mode is selected (M) when the current quick time range corresponds to the previous month (**23-May to 23-Jun** in the preceding figure) or is **30 days** on the **Bulkstats** and **KPI** tabs.

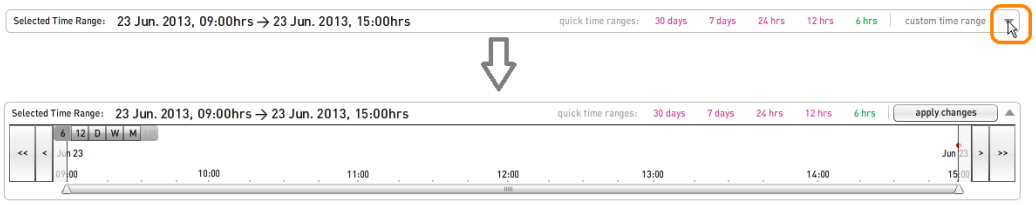
In the following figure, the quick time range corresponding to the current day (**23-Jun**) is selected when the custom selector is opened, so daily mode is selected.



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The selected mode determines the span of time that is represented by the full width of the time range selector bar, within which you set the smaller time range for which data is displayed on the tab. For daily mode the span is 24 hours, which in the figure starts at 00:00 hours on 23 June. The unshaded window in the bar represents the current selected time range (the period for which data is displayed on the tab), here 00:00 hours to 15:00 hours. The red dot at 15:00 hours marks the end of the final hourly interval for which statistics have been calculated; a similar dot marks the start of first interval for which data was collected (not shown in the figure). For most quick time ranges other than the date corresponding to the current day, when you open the custom selector bar the unshaded window (selected time range) covers the full width of the bar.

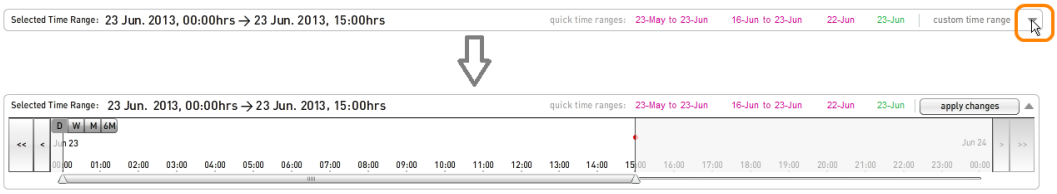
In the following figure for the **Bulkstats** and **KPI** tabs, the quick time range **6 hrs** is set when the custom selector opens, so both the unshaded window and the width of the selector bar cover the 6-hour span between 18:00 hours on 22 June and midnight on 23 June.



Setting a Custom Time Range

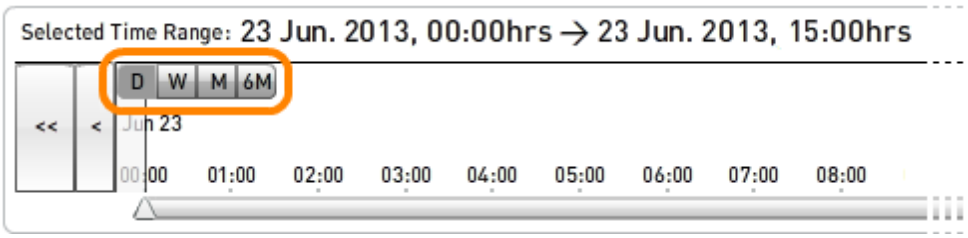
To set the time range to a custom value:

1. If the time range selector bar is not expanded, click the triangle icon (▼) in the **custom time range** field.

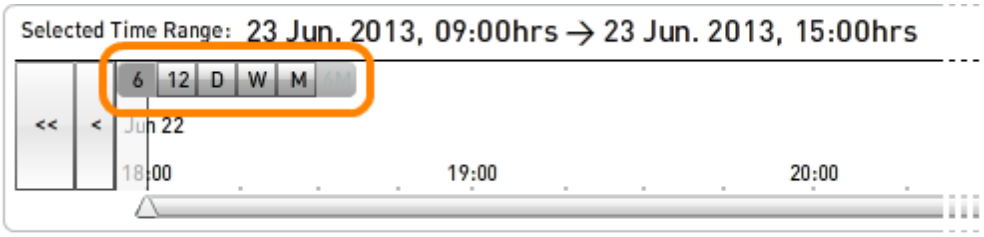


2. At the left end of the expanded time range selector bar, click the button for the mode appropriate for the time range and increment you want to set.

   On the **Network**, **Device**, **Subscriber**, and **Content** tabs:



   On the **Bulkstats** and **KPI** tabs:



   The characteristics of each mode are defined in the indicated columns of the following table:

   - **Span displayed**—The span of time within which you can set the time range
   - **Numbered increments**—The increments labeled with numbers in the time range selector
   - **Settable range**—The minimum and maximum time range you can set
   - **Minimum increment**—The smallest increment by which you can increase or decrease the setting

	Mode	Span displayed	Numbered increments	Settable range	Minimum increment
6	6-hour	6 hours	1 hour	15 minutes – 6 hours	15 minutes
12	12-hour	12 hours	1 hour	15 minutes – 6 hours	15 minutes

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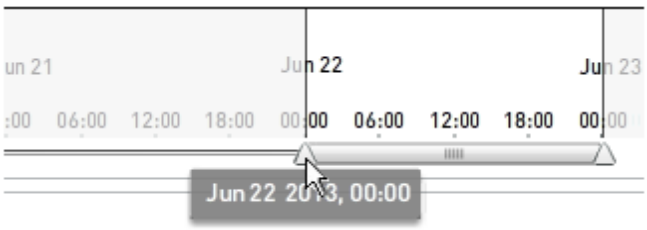
	Mode	Span displayed	Numbered increments	Settable range	Minimum increment
D	Daily on the **Network**, **Device**, **Sub-scriber**, and **Content** tabs	24 hours	1 hour	1 – 24 hours	1 hour
D	Daily on the **Bulkstats** and **KPI** tabs	24 hours	1 hour	15 minutes – 24 hours	15 minutes
W	Weekly	7 days	6 hours	1 hour – 7 days	1 hour
M	Monthly	30 days	1 day	1 – 30 days	1 day
6M	Semiannual	6 months	10 days	1 day – 6 months	1 day

3. Determine whether the desired start time and end time for the time range appears in the range selector. If not, shift the time span in the desired direction by clicking on the appropriate box with single or double arrows at the end of the selector bar. The following table specifies the amount by which the time span shifts in each mode.

Mode	< and >	<< and >>
6-hour (6)	1 hour	6 hours
12-hour (12)	1 hour	12 hours
Daily (D)	1 hour	1 day
Weekly (W)	1 day	7 days
Monthly (M)	7 days	31 days
Semiannual (6M)	31 days	180 days

4. Set the desired start and end times for the time range. The following figure depicts a setting of 24 hours in weekly mode, but the mechanism is the same for all modes.

    - To set the start time, mouse over the triangle that appears below the current start time. A dark gray box appears below the triangle and reports the precise current setting. Press and hold the left mouse button as you slide the triangle to the desired time. The time in the box updates as you pass over each settable increment.



(Note that if the desired new start time is after the current end time, you must set the end time first.)

- To set the end time, mouse over the triangle that appears below the current end time, then use the same instructions as for the start time.
- To move the time range without changing its duration, mouse over the thin bar between the start and end triangles. A dark gray box appears below the bar and reports the start and end times. Press and hold the left mouse button as you slide the bar right or left.

5. To refresh the tab to display data for the new time range, click the **apply changes** button at the upper right corner of the time range selector. The time range selector bar closes.

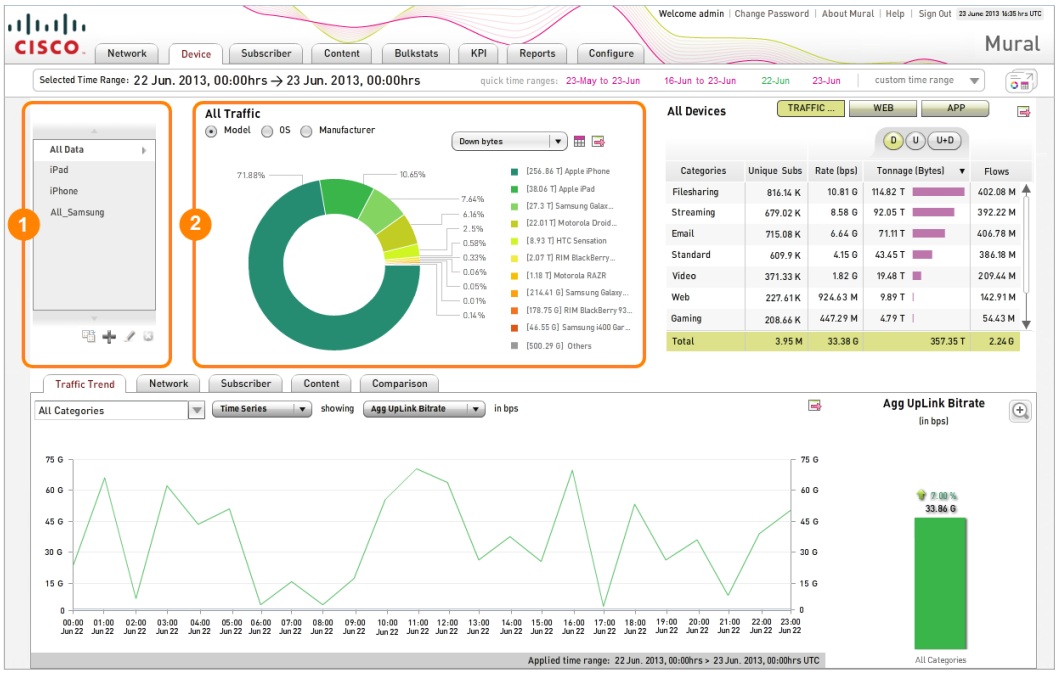


To close the time range selector bar without applying your changes, click the triangle icon (▲) to the right of the **apply changes** button.

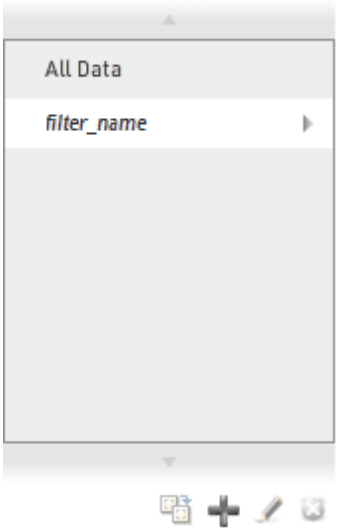
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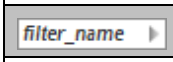
Using Filters to Fine-tune the Reported Data

By default, the data on the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL) represents all traffic during the selected time range. By applying a filter, you can restrict the source of data to only entities that match criteria you choose. In the following figure for the **Device** tab, the interface for creating and applying filters is in box **1** and the traffic distribution data on which it operates is in box **2**.



The filters interface consists of the elements shown in the following figure and described in the table.



Element	Function
	Scrolls the list, exposing the previous filter at the top of the list or the next filter at the bottom of the list.
	Indicates the currently selected filter.
	Clones the selected filter. See "Cloning or Editing an Existing Filter" on page 49.
	Creates a new filter. See "Creating a New Filter" on page 48.
	Edits the selected filter. See "Cloning or Editing an Existing Filter" on page 49.
	Removes the selected filter. See "Applying and Removing Filters" on the facing page.

For instructions on adding, editing, and removing filters, see the following sections:

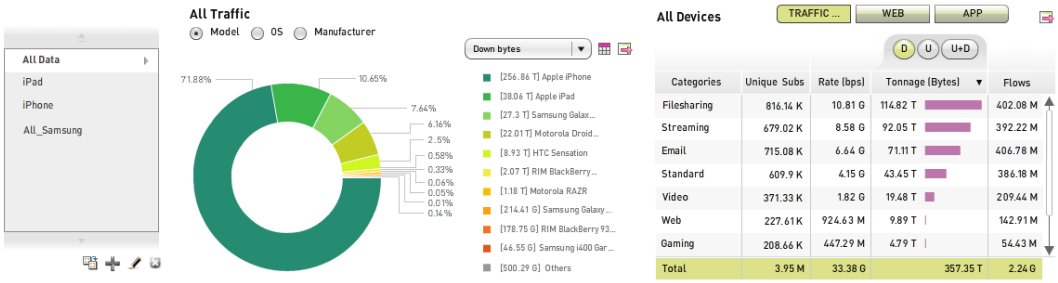
- "Applying and Removing Filters" on the facing page
- "Selecting Criteria for a Filter" on page 40
- "Selecting Filter Criteria from a Drop-Down Menu" on page 47
- "Creating a New Filter" on page 48
- "Cloning or Editing an Existing Filter" on page 49

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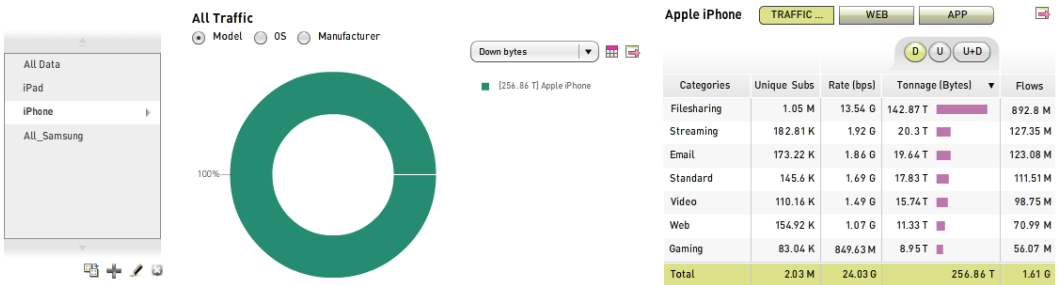
- "Displaying Filter Terms" on page 50
- "Using the Filters on Subtabs" on page 51

Applying and Removing Filters

In the following example from the **Device** tab, there are three filters defined (**iPad**, **iPhone**, and **All_Samsung**). The currently selected "filter" is the default **All Data**, which MURAL provides to indicate that no filter is applied. (The default is called **All Data** on the **Network** and **Content** tabs also; on the **Subscriber** tab it is **All Usage Segments**.) Because there is no filter, the doughnut chart includes a wedge for each of the ten devices that account for the most traffic, plus an eleventh wedge that aggregates the remaining devices.



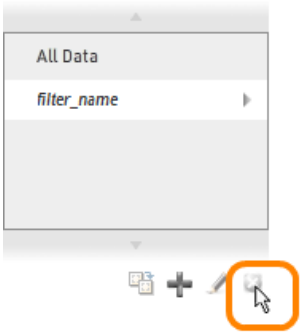
To apply a filter, click its name in the filter list. The background color for its row changes from gray to white and an arrow appears at the right end of the row. In the following figure, the **iPhone** filter is applied. As a consequence, the entire doughnut chart corresponds to the one device. The title of the categories table changes to **Apple iPhone** and the table now lists the categories accessed by iPhone users.



To clear a filter and display all data again, click **All Data** in the filter list.

To remove a filter from the list, perform the following steps.

1. In the filter list, click on the name of the filter you want to remove.
2. Click the remove icon ( ).



Selecting Criteria for a Filter

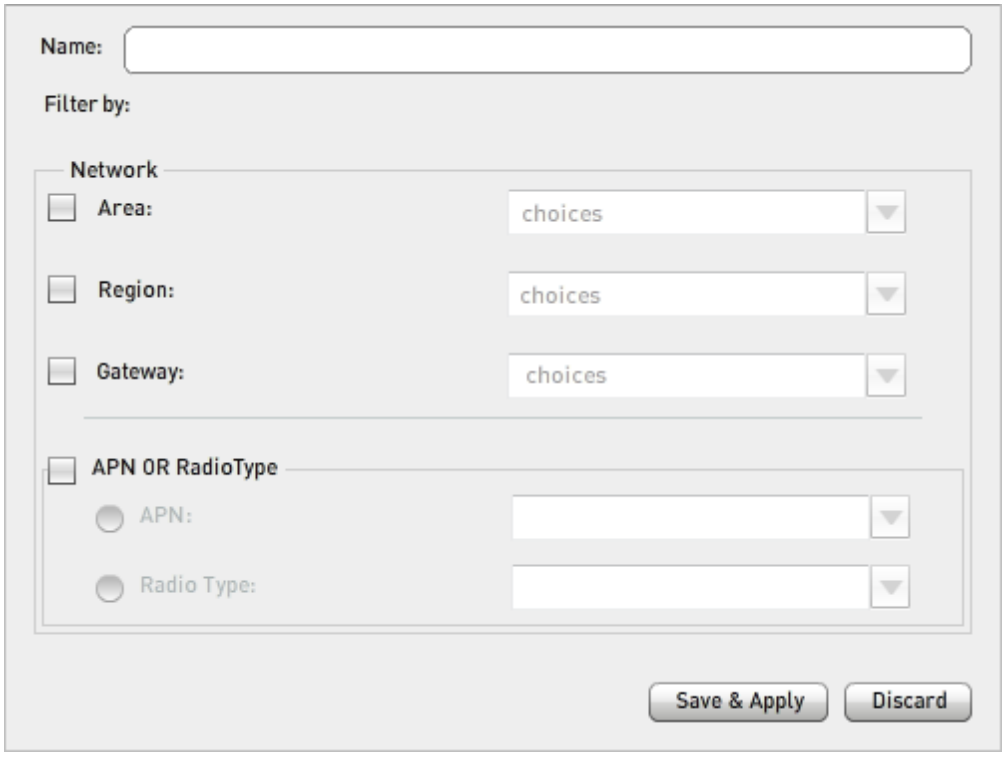
The procedures for creating, editing, or cloning a filter are described in "Creating a New Filter" on page 48 and "Cloning or Editing an Existing Filter" on page 49. The following sections describe the categories of criteria you can include in a filter on the various tabs.

- "Selecting Filter Criteria on the Network Tab" on the facing page
- "Selecting Filter Criteria on the Device Tab" on page 43
- "Selecting Filter Criteria on the Subscriber Tab" on page 45
- "Selecting Filter Criteria on the Content Tab" on page 46

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Selecting Filter Criteria on the Network Tab

On the **Network** tab, you can select criteria from the categories shown in the following figure.



- **Name**—Type in the box a name that, ideally, indicates the kind of entities that match the filter. The name can include uppercase and lowercase letters, numerals, spaces, periods, and underscores (_).
- **Network**—Click the check box for one, two, or all categories (**Area**, **Region**, and **Gateway**). Your system administrator defined the criteria in them during initial MURAL configuration. In the usual configuration, they correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices in the **Area** category might be regions like **Northeast** and **South**, the choices for **Region** the states in which network equipment is located, and the choices for **Gateway** cities or points of presence (PoPs).

  The criteria you select in either or both of the **Area** and **Region** categories determine which criteria are available in the categories below it. For example, if you select the

single criterion **California** in the **Region** category, then the available criteria in the **Gateway** category are limited to locations defined to belong to the California region.

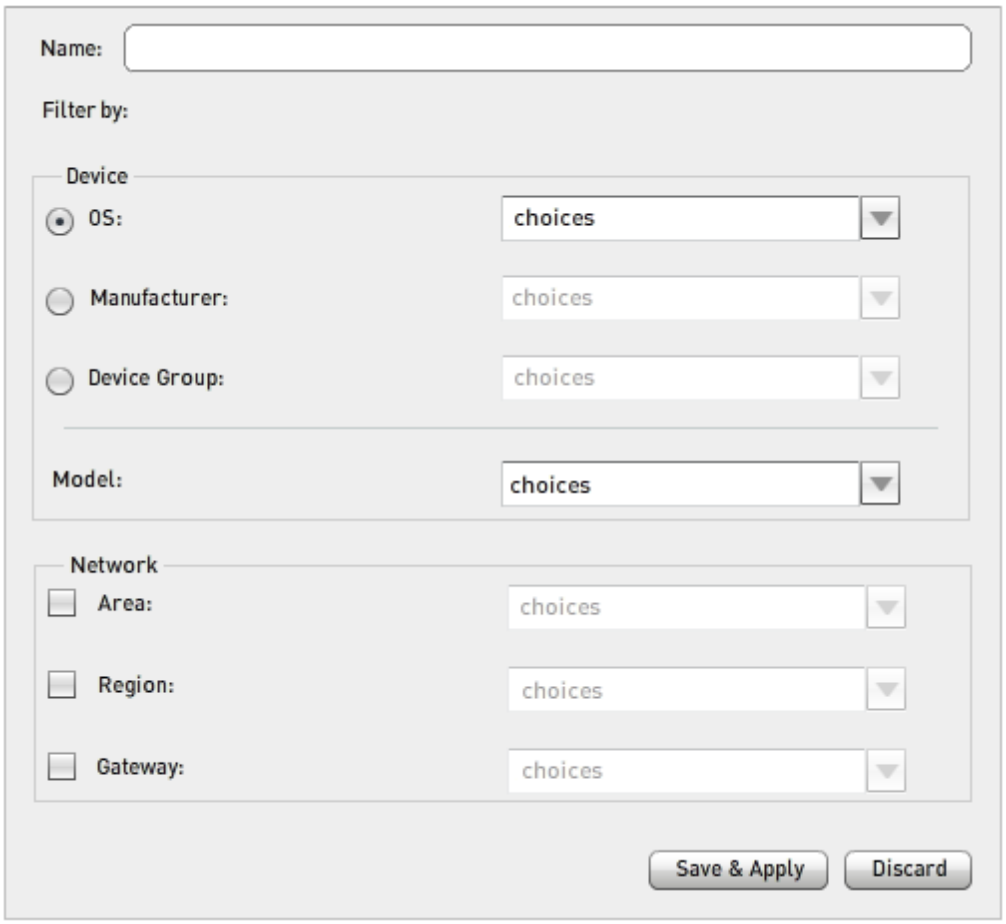
For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" on page 47.

- **APN or RadioType**—Click the **APN** or **Radio Type** radio button to select criteria from that category. The lists of criteria are configured by your system administrator during initial MURAL configuration:
    - **APN**—Access point names
    - **Radio Type**—Mobile technologies such as GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access)

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Selecting Filter Criteria on the Device Tab

On the **Device** tab, you can select criteria from the categories shown in the following figure.



- **Name**—Type in the box a name that, ideally, indicates the kind of entities that match the filter. The name can include uppercase and lowercase letters, numerals, spaces, periods, and underscores (_).
- **Device**—Mobile devices categorized in one of the following ways (click the radio button preceding a category to select it):
    - **OS**—Operating systems (the default)
    - **Manufacturer**—Companies that manufacture (or brands of) mobile devices or OSs

- **Device group**—Classes of mobile devices, such as **Smartphone** and **Tablet**

Optionally, you can further refine the criteria to include only specified device models from the chosen category. Click the open-menu icon () at the right end of the **Model** field to display the drop-down menu of available models, which depend on your selections in the chosen category. For instructions on selecting criteria from a drop-down menu, see "Selecting Filter Criteria from a Drop-Down Menu" on page 47.

- **Network**—Click the check box for one, two, or all categories (**Area**, **Region**, and **Gateway**). Your system administrator defined the criteria in them during initial MURAL configuration. In the usual configuration, they correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices in the **Area** category might be regions like **Northeast** and **South**, the choices for **Region** the states in which network equipment is located, and the choices for **Gateway** cities or points of presence (PoPs).

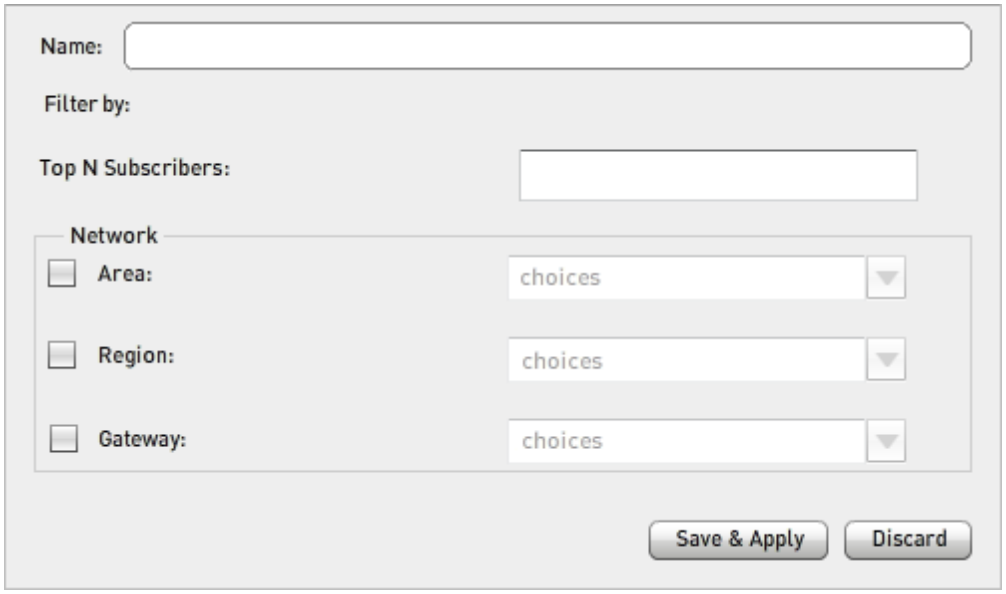
  The criteria you select in either or both of the **Area** and **Region** categories determine which criteria are available in the categories below it. For example, if you select the single criterion **California** in the **Region** category, then the available criteria in the **Gateway** category are limited to locations defined to belong to the California region.

  For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" on page 47.

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Selecting Filter Criteria on the Subscriber Tab

On the **Subscriber** tab, you can select criteria from the categories shown in the following figure.



- **Name**—Type in the box a name that, ideally, indicates the kind of entities that match the filter. The name can include uppercase and lowercase letters, numerals, spaces, periods, and underscores (_).
- **Top N Subscribers**—Type in the box the number (1 through **N**) of the most active subscribers to include in the report. To compile the list of most active subscribers, MURAL tracks subscribers over a period of several weeks and ranks their activity level with an algorithm that considers both the volume of traffic and the number of hits and flows each one generates. The subscribers in the list are not necessarily active at the time the filter is applied.
- **Network**—Click the check box for one, two, or all categories (**Area**, **Region**, and **Gateway**). Your system administrator defined the criteria in them during initial MURAL configuration. In the usual configuration, they correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices in the **Area** category might be regions like **Northeast** and **South**, the choices for **Region** the states in which network equipment is located, and the choices for **Gateway**

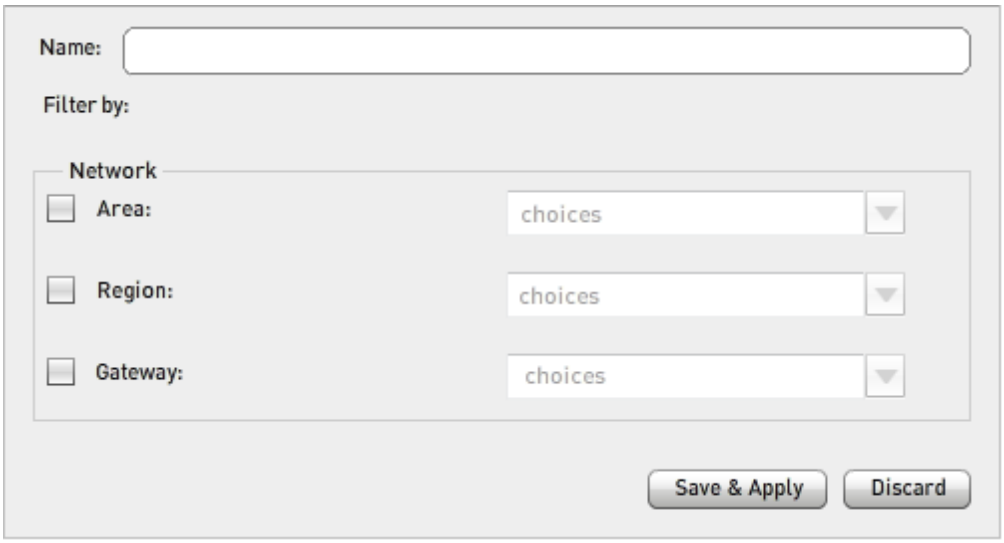
cities or points of presence (PoPs).

The criteria you select in either or both of the **Area** and **Region** categories determine which criteria are available in the categories below it. For example, if you select the single criterion **California** in the **Region** category, then the available criteria in the **Gateway** category are limited to locations defined to belong to the California region.

For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" on the facing page.

Selecting Filter Criteria on the Content Tab

On the **Content** tab, you can select criteria from the categories shown in the following figure.



- **Name**—Type in the box a name that, ideally, indicates the kind of entities that match the filter. The name can include uppercase and lowercase letters, numerals, spaces, periods, and underscores (_).
- **Network**—Click the check box for one, two, or all categories (**Area**, **Region**, and **Gateway**). Your system administrator defined the criteria in them during initial MURAL configuration. In the usual configuration, they correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices in the **Area** category might be regions like **Northeast** and **South**, the choices for

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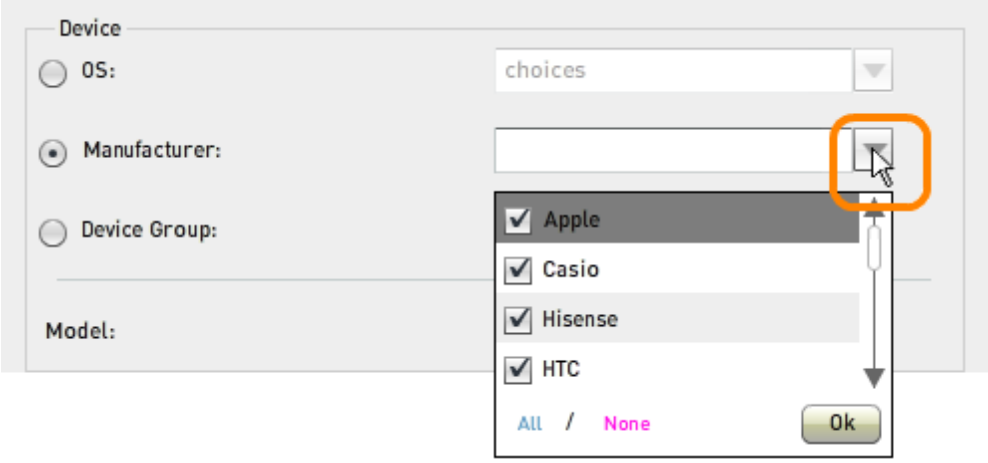
Region the states in which network equipment is located, and the choices for **Gateway** cities or points of presence (PoPs).

The criteria you select in either or both of the **Area** and **Region** categories determine which criteria are available in the categories below it. For example, if you select the single criterion **California** in the **Region** category, then the available criteria in the **Gateway** category are limited to locations defined to belong to the California region.

For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" below.

Selecting Filter Criteria from a Drop-Down Menu

To indicate the category from which you are choosing criteria, click the check box or radio button that precedes the category name. Then click the open-menu icon ( ) to expose the list of criteria. The following figure shows an example for device filters.



When the menu drops down, all values are checked, which selects them for inclusion in the filter.

- To exclude a value from the filter, click its check box to remove the check.
- To remove the check from all boxes, click None. (If there are a large number of values and you want to include only a few of them in the filter, it is most efficient to deselect all of them this way and then check your selections.)
- To include all values in the filter, click All.

- To add the selected values to the filter and close the drop-down menu, click the **Ok** button. The selected values appear as a comma-separated list in the white box.

  Note: The **Ok** button is nonoperational if no values are checked.

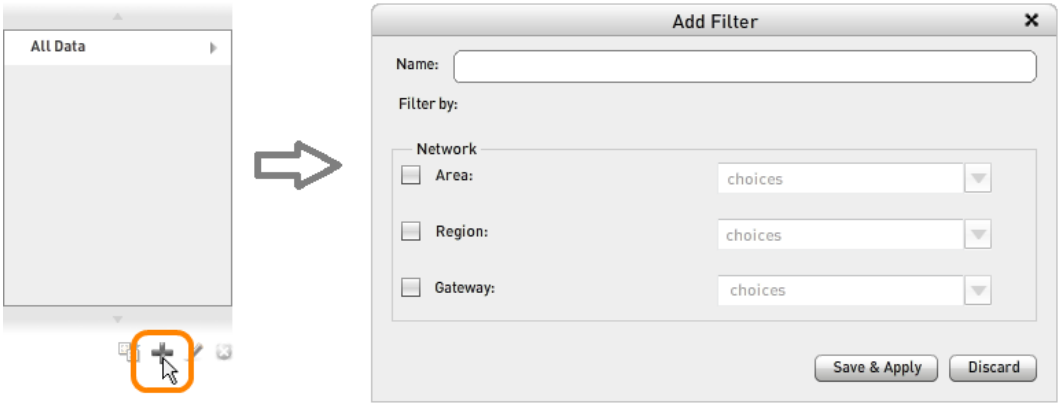
If you decide that you do not want to apply the criteria you have selected on a drop-down menu:

- For categories preceded by a check box, click the check box to remove the check. Your criteria selections are discarded and the category is not included in the filter.
- For categories in the **Device** box of the filter interface for the **Device** tab, click All and then the **Ok** button. This returns the category to the default state, with all criteria selected.

Creating a New Filter

To create a new filter, perform the following steps:

1. Click the add icon (➕) below the filter list to open the **Add Filter** pop-up window. The following figure shows the window as opened on the **Content** tab.



2. Specify the filter name and select criteria as described in "Selecting Criteria for a Filter" on page 40.
3. Click the **Save & Apply** button to save the filter to the filters list and apply it to the currently displayed data. To close the window without saving the filter, click the **Discard** button or the close-window icon (✖) in the title bar.

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Cloning or Editing an Existing Filter

Cloning an existing filter refers to creating a copy of it and saving it with a different name, presumably after modifying it. The source filter for the clone is not changed. The only difference in the procedures for cloning and editing a filter are the label on the pop-up window (**Save as Filter** or **Edit Filter**) and the predefined value in the **Name** field.

1. In the filter list, click the name of the filter you want to clone or edit.
2. Click the clone icon ( ) to clone the filter or the edit icon ( ) to edit it.

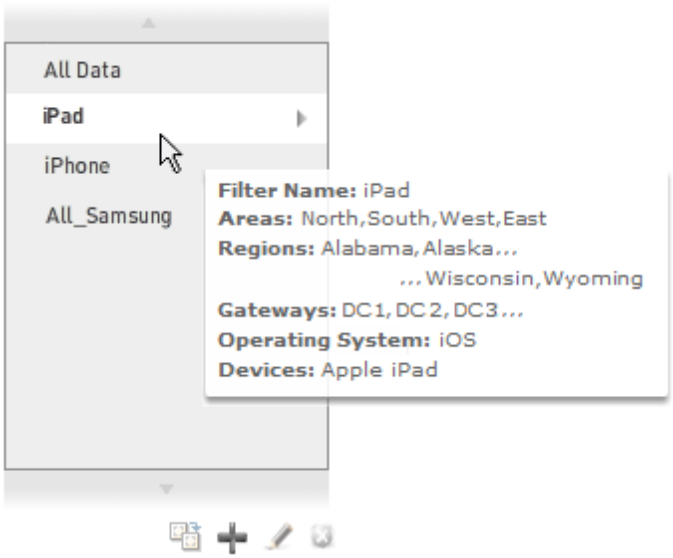


3. Make the desired changes to the filter name or criteria, as described in "Selecting Criteria for a Filter" on page 40.
4. Click the **Save & Apply** button to save the filter to the filters list and apply it to the currently displayed data. To close the window without saving the filter, click the **Discard** button or the close-window icon (✖) in the title bar.

Displaying Filter Terms

You can review the terms in a filter in two ways:

- Open the filter editing window as described in "Cloning or Editing an Existing Filter" on the previous page. To close the filter window, click either the **Discard** button or the close-window icon (✖) in the title bar.
- Mouse over the filter name. A pop-up box reports the terms in the filter, as shown in the following figure for the **iPad** filter on the **Device** tab. If a category of criteria was not chosen during filter creation, the pop-up box lists all criteria from the category. In the example, during filter creation the **OS** category was chosen, the **iOS** criterion selected from it, and the **Apple iPad** criterion was selected in the **Model** field. Because no criteria were selected from the **Area**, **Region**, or **Gateway** categories, all criteria in the category are listed in the pop-up box (but the lists of regions and gateways are shortened here for the sake of brevity).



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Using the Filters on Subtabs

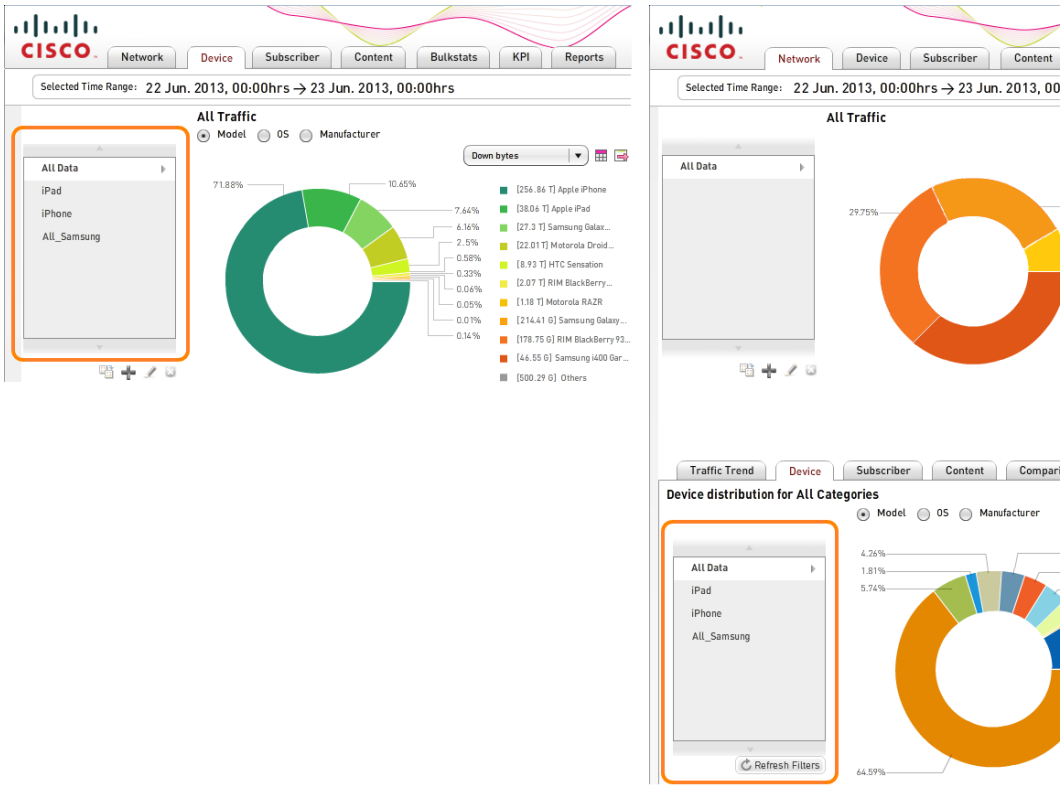
The filters on the **Network**, **Device**, **Subscriber**, and **Content** subtabs are derived from elements on the top-level tab of the same name, as described in the following sections:

- "Using Filters on the Network, Device, and Subscriber Subtabs" below
- "Using Filters on the Content Subtab" on the next page

Using Filters on the Network, Device, and Subscriber Subtabs

On the **Network**, **Device**, and **Subscriber** subtabs, the available filters are duplicates of the filters defined on the top-level tab with the same name.

The orange boxes in the following sample figure highlight how filters defined on the **Device** tab are duplicated on the **Device** subtab of the **Network** tab.



You cannot edit the filter list on a subtab directly; it is always derived from the filter list on the corresponding top-level tab. Therefore, the icons for cloning, adding, editing, and removing filters are not available on subtabs.

Also, changes to the filter list on the top-level tab do not propagate automatically to the subtab. To propagate them, click the **Refresh Filters** button under the filter list on the subtab. The list of filters (and their criteria) is updated to match the top-level tab, and the default filter (**All Data** or **All Usage Segments**) is selected.

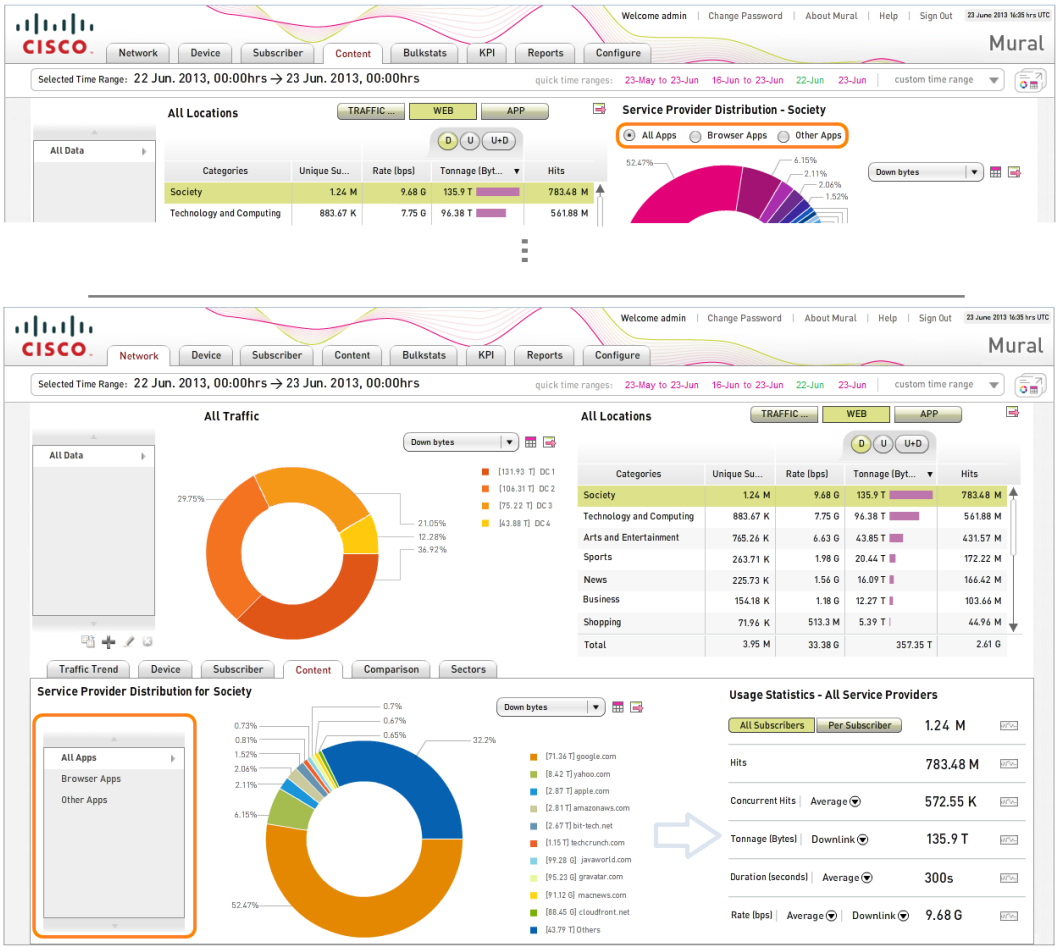
Using Filters on the Content Subtab

The filters available on the **Content** subtab depend on which traffic type is selected for the categories table on the top-level tab.

- When the **WEB** traffic type is selected, the three filters on the **Content** subtab correspond to the radio buttons on the doughnut chart of distribution data on the top-level **Content** tab, as highlighted by the orange boxes in the following figure.

  Because the filter list is not derived from the list on the top-level **Content** tab and cannot be changed, neither the icons for cloning, adding, editing, and removing filters nor the **Refresh Filters** button appear on the **Content** subtab.

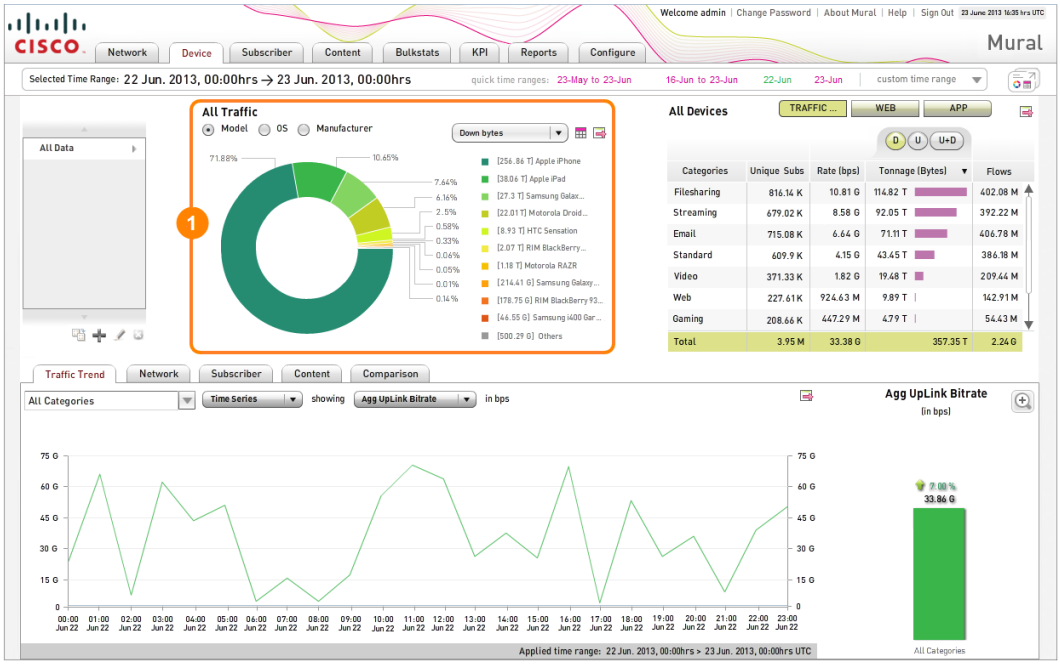
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- When the **TRAFFIC** or **APP** traffic type is selected for the categories table on the top-level tab, no filters are available on the **Content** subtab.

Analyzing Traffic Distribution

The main pane on the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL) summarizes the distribution of traffic for the type of network entity featured on the tab, and provides tools for "drilling down" to more fine-grained analysis of individual entities. The traffic distribution data is displayed in the part of the pane enclosed in box **1** in the following figure from the **Device** tab. When you first access a tab during the MURAL session, the distribution data appears as a doughnut chart.



For information about the related filter interface, which appears to the left of box **1**, see "Using Filters to Fine-tune the Reported Data" on page 37.

For information about the categories table, which appears to the right of box **1**, see "Analyzing Traffic by Category" on page 64.

This topic describes the following tasks:

- "Navigating the Traffic Distribution Display" on the facing page
- "Interpreting Doughnut Charts" on page 57
- "Interpreting Distribution Tables" on page 60

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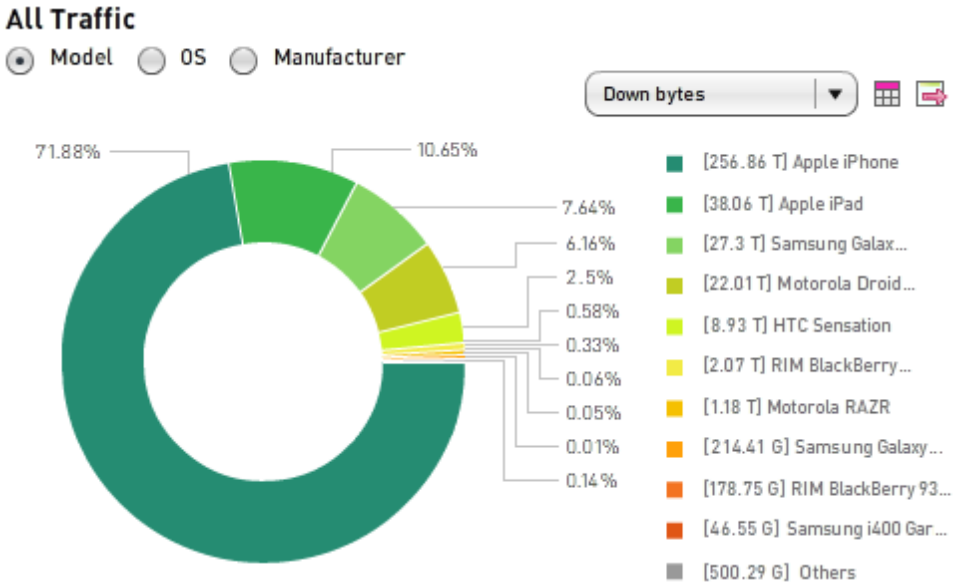
Navigating the Traffic Distribution Display

The tabs report the distribution of traffic across the most active members of the network class featured on the tab:

- **Network**—Locations that house network equipment, referred to as *gateways*. During initial MURAL configuration, your system administrator defined the gateway names and the hosts that belong to each one.
- **Device**—Mobile devices such as phones and tablet computers, categorized by specific model (click the **Model** radio button), operating system (the **OS** radio button), or brand (the **Manufacturer** radio button).
- **Subscriber**—Users of mobile devices who generated traffic. When no filter is applied, users are grouped into three classes based on the average daily amounts of traffic they generated in the previous month: **High**, **Regular** and **Low**. Your system administrator defined the range of amounts for each class during initial MURAL configuration.

  When a **Top N Subscribers** filter is applied, the chart reports per-user data for up to 10 of the most active users. For more about creating a filter, see "Using Filters to Fine-tune the Reported Data" on page 37.
- **Content**—Network protocols (when the **TRAFFIC** traffic type is chosen for the adjacent categories table), content provider websites (when **WEB** is chosen), or applications (when **APP** is chosen). For information about the categories table, see "Analyzing Traffic by Category" on page 64.

When you first access a tab during the MURAL session, distribution data appears as a doughnut chart as in this example from the **Device** tab.



The following table describes the elements in the doughnut chart display area.

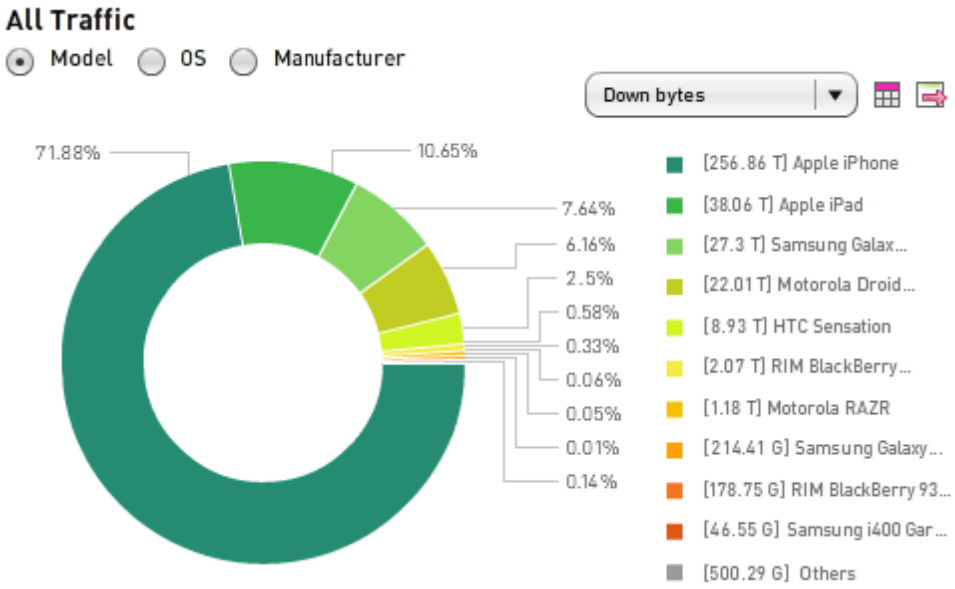
Element	Description
All Traffic	Indicates that traffic of all protocol types is included in the chart.
Model OS Manufacturer	(**Device** tab and subtab only) Indicates and sets whether the chart represents the distribution of traffic across specific models of mobile device, operating systems, or manufacturers (brands).
All Apps Browser Apps ... Other Apps	(Top-level **Content** tab, when the **WEB** traffic type is selected for the adjacent categories table) Indicates and sets whether the reported traffic was data accessed via a browser on a mobile device (**Browser Apps**), data accessed via another type of mobile application (**Other Apps**), or both (**All Apps**).
Down bytes	Indicates and sets the statistic reported in the doughnut chart. See "Selecting the Statistic Reported in a Doughnut Chart" on page 59.
	Changes display format from doughnut chart to table. See "Interpreting Distribution Tables" on page 60.

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Element	Description
	Copies the data represented in the display area to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.

Interpreting Doughnut Charts

The size of each wedge in a doughnut chart indicates the proportion of traffic accounted for by each of the entities that were responsible for the most traffic. There can be up to eleven wedges: one for each of the top ten entities plus one for the aggregation of all remaining entities. In the following doughnut chart from the **Device** tab, the entities are models of mobile device. On the **Network** tab they are locations, on **Subscriber** tab individual or groups of subscribers, and on the **Content** tab content provider websites. Each wedge in the chart is marked with the percentage of traffic that it accounts for.



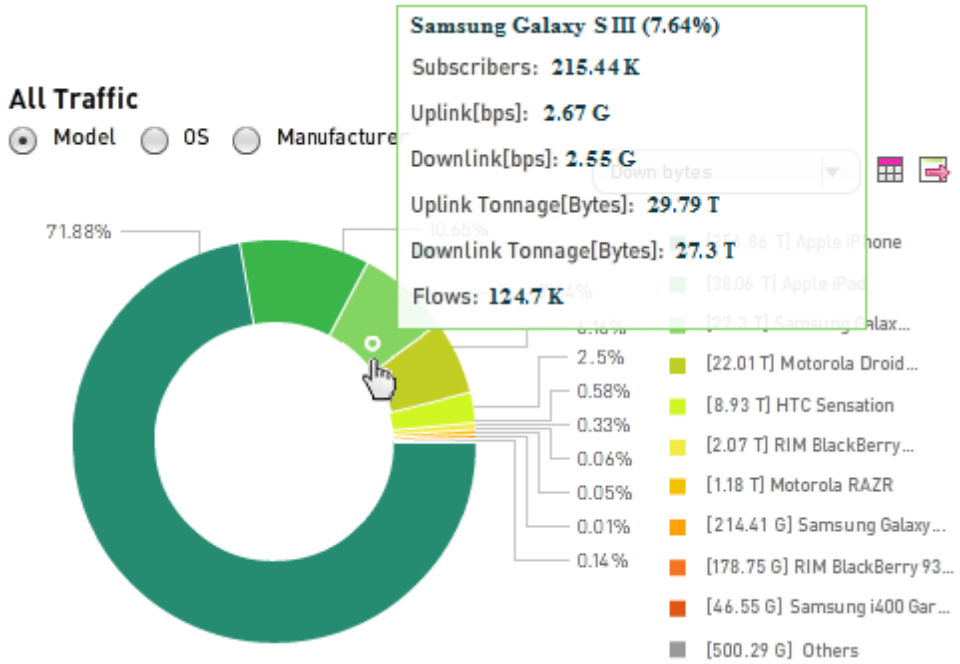
The legend to the right of the chart lists the entities, marking them with the color of the corresponding wedge in the chart. They are listed in order from largest to smallest value (matching the decreasing size of the wedges). A quantified measurement of the traffic precedes the entity name. The letter following the digits indicates the multiple, the meaning of which depends on the type of statistic (traffic rate, traffic volume, or count).

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

By default, the chart reports the total number of bytes that traversed the downlink (from the network to mobile users) during the selected time range, but you can choose from five other statistics, as described in "Selecting the Statistic Reported in a Doughnut Chart" on the facing page.

Displaying All Statistics for One Entity

By mousing over a wedge, you can display for the corresponding single entity the value of all of the statistics on the drop-down menu (which is **Down bytes** by default). In the following figure, the title in the pop-up box indicates that users of Samsung Galaxy S III mobile phones account for 7.64% of the total bytes on the downlink during the selected time range. For information about the meaning of the other values in the box, see "Selecting the Statistic Reported in a Doughnut Chart" on the facing page.



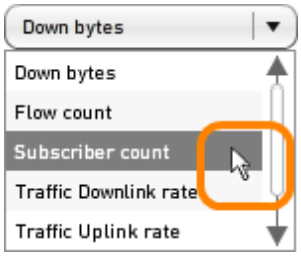
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Selecting the Statistic Reported in a Doughnut Chart

When you first access a tab during the MURAL session, the doughnut chart ranks entities in terms of the number of bytes that traveled from the network toward the entities depicted in the chart during the selected time range (referred to as **Down bytes** on the drop-down menu bar).

(When you switch display format from table to doughnut chart, the doughnut chart reports the statistic by which the table is currently sorted.)

To change the statistic reported in the doughnut chart, click on the drop-down menu bar, then click the desired statistic. In the following figure, the statistic is being changed to **Subscriber count**.



The text in the menu bar changes to indicate the new statistic. The statistics are defined as follows.

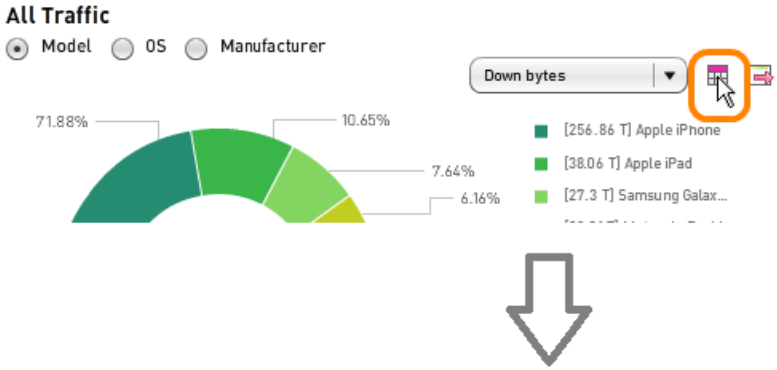
- **Down bytes**—Number of bytes that traveled from the network toward mobile users.
- **Flow count**—Total number of distinct flows in both directions, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol.
- **Subscriber count**—Number of unique subscribers who generated network traffic during the selected time range.
- **Traffic Downlink rate**—Average number of bits per second (bps) that traveled from the network toward mobile users. It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.
- **Traffic Uplink rate**—Average number of bits per second (bps) that traveled from mobile

users toward the network. It is calculated in the same way as the downlink rate.

- **Up bytes**—Number of bytes that traveled from mobile users toward the network.

Interpreting Distribution Tables

When you first access a tab during the MURAL session, traffic distribution data appears in a doughnut chart. To display the information in a table, click the table icon () in the upper right corner of the display area. One advantage of the table format is that all measurements are visible at once. Also, data is reported for all entities, even those with values so small that they do not appear in the doughnut chart.



All Traffic

Model OS Manufacturer

Device	Unique Subs	Uplink (bps)	Downlink (bps)	Uplink Tonnage...	Downlink Tonnage... ▼	Flows
Apple iPhone	2.03 M	25.27 G	24.03 G	247.28 T	256.86 T	1.61 G
Apple iPad	307.25 K	3.39 G	3.55 G	42.3 T	38.06 T	238.56 M
Samsung Galaxy S III	215.47 K	2.62 G	2.49 G	26.95 T	27.3 T	171.12 M
Motorola Droid 2	173.71 K	1.93 G	2.06 G	24.51 T	22.01 T	137.98 M
HTC Sensation	70.83 K	865.12 M	834.52 M	8.62 T	8.93 T	56.34 M
RIM BlackBerry 9650 ...	16.36 K	177.84 M	193.61 M	2.4 T	2.07 T	12.99 M
Motorola RAZR	9.31 K	121.49 M	110.15 M	1.37 T	1.18 T	7.38 M

Showing 1 - 22 of 22 page 1 of 1

Total	2.82 M	35.02 G	33.38 G	362.5 T	357.35 T	2.24 G

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The following table describes the elements in the table (not all elements appear on every tab).

Element	Description
All Traffic	Indicates that traffic of all protocol types is included in the chart.
Model OS Manufacturer	(**Device** tab and subtab only) Indicates and sets whether the table reports the distribution of traffic across specific models of mobile device, operating systems, or manufacturers (brands). The header for the first column of the table also changes to indicate the category (**Device**, **Operating System**, or **Manufacturer**).
All Apps Browser Apps ... Other Apps	(Top-level **Content** tab, when **WEB** category is selected on the adjacent table) Indicates and sets whether the reported traffic was data accessed via a browser on a mobile device (**Browser Apps**), data accessed via another type of mobile application (**Other Apps**), or both (**All Apps**).
	Changes display format from table to doughnut chart. See "Interpreting Doughnut Charts" on page 57.
	Copies the data represented in the display area to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.
	Appears in a column header to indicate that the column is being used to sort the rows in the table. For information about sorting on the basis of different columns, see "Changing the Sort Order in the Distribution Table" on page 63.
Showing 1 - 50 of 303	Indicates the set of rows presented in the currently displayed page of the table. There are 50 rows on each page (and up to 50 on the last one).
page 1 of 7	Indicates the currently displayed page (set of 50 rows) and the total number of pages. Click on the black left arrow (←) to display the previous 50 rows or the black right arrow (→) to display the next 50. A grayed-out arrow indicates that no previous or subsequent page is available.

Note that the **Total** row reports the sum of values from all rows on every page, not just those on the current page.

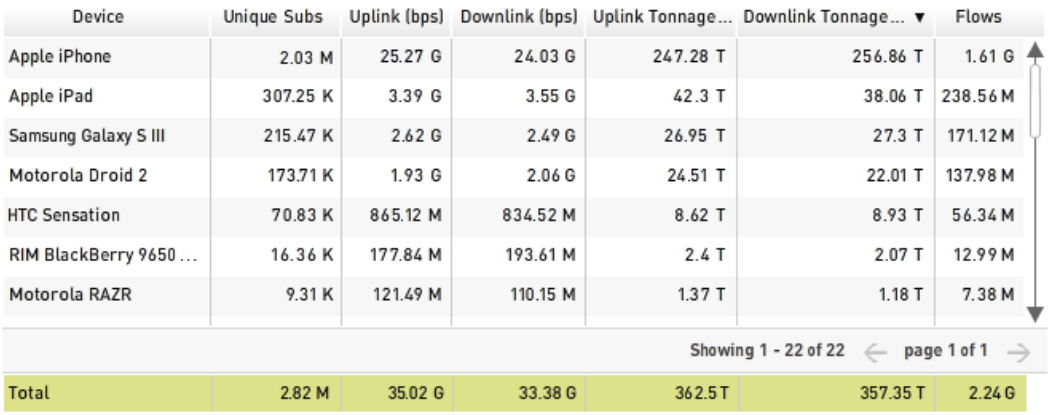
The following information is reported in the columns with the specified headers:

- ***Entity type***—Category (within the type of network entity named in the header) for which data is reported. The value in the header depends on the tab. In the preceding figure from the **Device** tab it is **Device**. It is **Gateway** on the **Network** tab, **Segment** on the **Subscriber** tab, and so on.
- **Unique Subs**—Number of distinct subscribers who accessed data from the category in the first column.
- **Uplink (bps)**—Average number of bits per second (bps) that traveled from mobile users toward the network. It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.
- **Downlink (bps)**—Average number of bits per second (bps) that traveled from the network toward mobile users. It is calculated in the same way as the uplink rate.
- **Uplink Tonnage (Bytes)**—Number of bytes that traveled from mobile users toward the network.
- **Downlink Tonnage (Bytes)**—Number of bytes that traveled from the network toward mobile users.
- **Flows**—Total number of distinct flows in both directions, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol.
- **Hits**—(**Content** tab only, when the **WEB** or **APP** traffic type is chosen for the adjacent categories table) Number of requests for a file sent to web servers. For information about the categories table, see "Analyzing Traffic by Category" on page 64.

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Changing the Sort Order in the Distribution Table

When you change display format from doughnut chart to table, the rows are sorted according to the statistic currently reported in the doughnut chart, from largest to smallest. As shown in the following figure, this is indicated by the decreasing-order sort icon (▼) in the column's header bar (in this case, the **Downlink Tonnage (Bytes)** column).



Device	Unique Subs	Uplink (bps)	Downlink (bps)	Uplink Tonnage...	Downlink Tonnage... ▼	Flows
Apple iPhone	2.03 M	25.27 G	24.03 G	247.28 T	256.86 T	1.61 G
Apple iPad	307.25 K	3.39 G	3.55 G	42.3 T	38.06 T	238.56 M
Samsung Galaxy S III	215.47 K	2.62 G	2.49 G	26.95 T	27.3 T	171.12 M
Motorola Droid 2	173.71 K	1.93 G	2.06 G	24.51 T	22.01 T	137.98 M
HTC Sensation	70.83 K	865.12 M	834.52 M	8.62 T	8.93 T	56.34 M
RIM BlackBerry 9650 ...	16.36 K	177.84 M	193.61 M	2.4 T	2.07 T	12.99 M
Motorola RAZR	9.31 K	121.49 M	110.15 M	1.37 T	1.18 T	7.38 M

Showing 1 - 22 of 22 ← page 1 of 1 →

Total	2.82 M	35.02 G	33.38 G	362.5 T	357.35 T	2.24 G

You can sort based on the values in any of the columns. To change columns, click in the column's header bar. The sort icon (▲ or ▼) moves to the new column and the rows are resorted. The increasing-order sort icon (▲) indicates the sort order is smallest to largest (alphabetical in the first column), and the decreasing-order sort icon (▼) largest to smallest (reverse alphabetical in the first column).

The basis for sorting is independent on the **Network**, **Device**, **Subscriber**, and **Content** tabs—for example, you can sort by uplink traffic rate on the **Network** tab and at the same time sort by number of hits on the **Device** tab. MURAL maintains the sorting basis on a tab for the duration of a session.

Analyzing Traffic by Category

The table in the main pane of the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL) reports statistics about the traffic in your network during the selected time range, categorized according to the icon selected above the table:

- **TRAFFIC**—Categories of protocol type, such as **VOIP** (voice over IP) or **Web**, referring to Hypertext Transfer Protocol (HTTP)
- **WEB**—Categories of type of content as defined by the Interactive Advertising Bureau, such as **Sports** or **Entertainment**
- **APP**—Categories of application type used to request and deliver the content, such as **Browser** or **Social Networking**

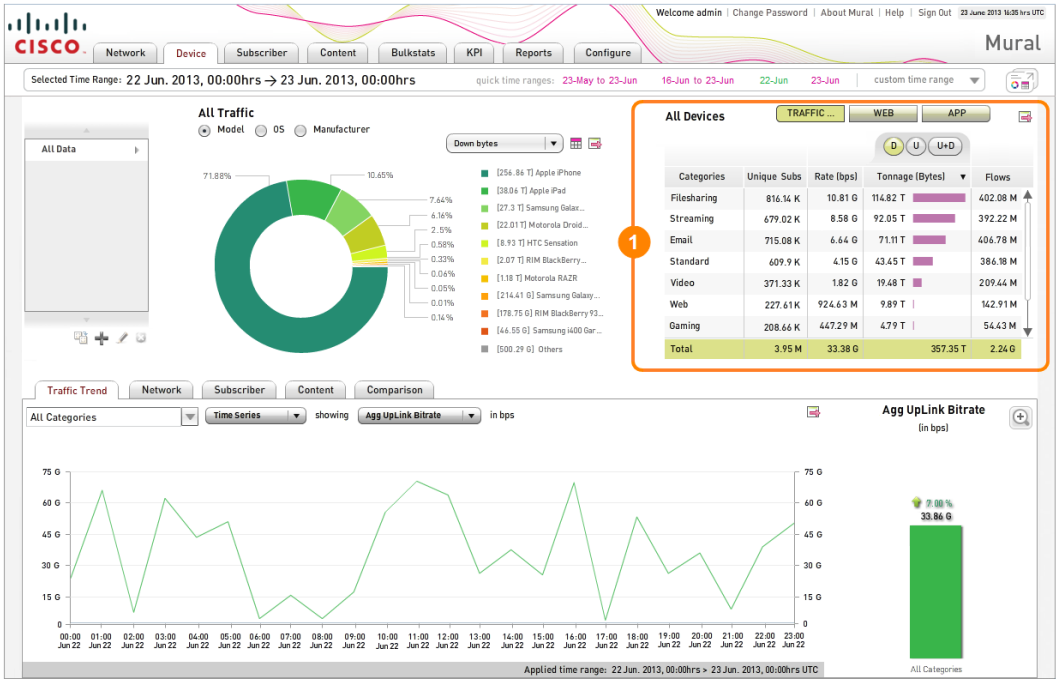
This topic describes the following tasks:

- "Interpreting the Content Categories Table" on the facing page
- "Categorizing Traffic by Type" on page 68
- "Changing the Sort Order in the Categories Table" on page 70

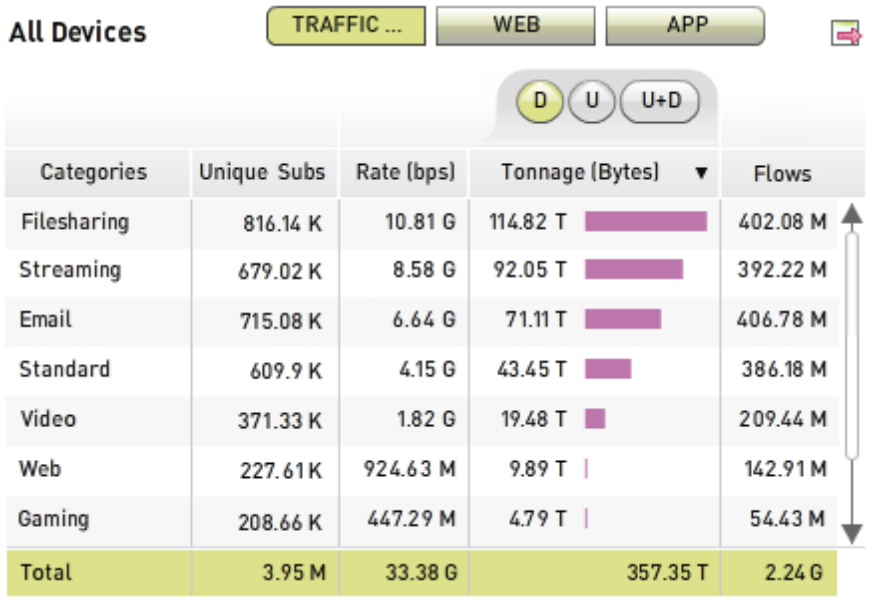
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Interpreting the Content Categories Table

In the following figure for the **Device** tab, the table is enclosed in box **1**. It is in the same position on the **Network** and **Subscriber** tabs; on the **Content** tab, the positions of the table and the adjacent doughnut chart are reversed.



The following figure shows what the table looks like when you first access a tab during a MURAL session. The **TRAFFIC** traffic type is selected, as indicated by the solid gold color of that icon, and the table displays values for the associated traffic categories, which are named in the **Categories** column. The categories are sorted in order of decreasing traffic volume (indicated by the sort icon [▼] in the **Tonnage (Bytes)** column header) on the downlink (indicated by the gold **D** icon above the table). The **Total** row at the bottom of the table is selected, as indicated by the gold color.

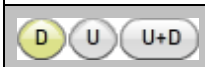
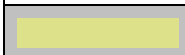


Categories	Unique Subs	Rate (bps)	Tonnage (Bytes) ▼	Flows
Filesharing	816.14 K	10.81 G	114.82 T	402.08 M
Streaming	679.02 K	8.58 G	92.05 T	392.22 M
Email	715.08 K	6.64 G	71.11 T	406.78 M
Standard	609.9 K	4.15 G	43.45 T	386.18 M
Video	371.33 K	1.82 G	19.48 T	209.44 M
Web	227.61 K	924.63 M	9.89 T	142.91 M
Gaming	208.66 K	447.29 M	4.79 T	54.43 M
Total	3.95 M	33.38 G	357.35 T	2.24 G

The following table describes the elements in the table display area.

Element	Description
Entity_type	Names the entity from the adjacent doughnut chart or table for which data appear in this table (in the preceding figure, it is **All Devices**). For more information about the interaction between the adjacent chart or table and the categories table, see "Performing In-Depth Data Analysis" on page 111.
TRAFFIC WEB APP	Indicates and sets the traffic-type categories used in the table (the categories are named in the **Categories** column). The solid gold icon indicates the currently selected traffic type. For information about the traffic-type categories, see "Categorizing Traffic by Type" on page 68.

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Element	Description
	Copies the data in the table to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.
	Indicates and sets the direction for which traffic is reported in the **Rate (bps)** and **Tonnage (Bytes)** columns: • **D**—Downlink (from the network toward mobile users) • **U**—Uplink (from mobile users toward the network) • **U+D**—Both directions The gold icon indicates the current traffic direction.
	Appears in a column header to indicate that it is being used to sort the rows in the table. For information about sorting on the basis of different columns, see "Changing the Sort Order in the Categories Table" on page 70.
	Indicates that the category (row) is selected, as a result of which the information on the **Network**, **Device**, **Subscriber**, and **Content** subtabs is specific to the category. To select a different category, click anywhere in its row. For more information about the relationship between the selected row and the subtab, see "Performing In-Depth Data Analysis" on page 111.

The information reported in the columns of the table is as follows:

- **Categories**—Category name.
- **Unique Subs**—Number of distinct mobile users who accessed content from a category.
- **Rate (bps)**—Average number of bits per second (bps) that traveled in the direction indicated by the directional icons (**D**, **U**, and **U+D**). The rate is calculated by dividing the number in the **Tonnage (Bytes)** column by the number of seconds in the selected time range and multiplying by eight to convert bytes to bits.
- **Tonnage (Bytes)**—Number of bytes that traveled in the direction indicated by the directional icons (**D**, **U**, and **U+D**).
- **Flows**—Total number of distinct flows in both directions, where a flow is defined as a

group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol. This value is reported when the **TRAFFIC** traffic type is selected.

- **Hits**—Number of requests for a file sent to a web server. This value is reported when the **WEB** or **APP** traffic type is selected.

For numerical values, the letter following the digits indicates the multiple, the meaning of which depends on the type of statistic (traffic rate, traffic volume, or count).

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

Categorizing Traffic by Type

When you first access a tab during a MURAL session, the **TRAFFIC** icon above the table is clear gold (rather than grayed out), indicating that the data is categorized by network protocol type. You can choose from among three sets of categories.

Categorizing Traffic by Protocol Type

To categorize traffic by protocol type, click the **TRAFFIC** icon above the table. In this mode, MURAL assigns traffic to categories according to the protocol type of the packets that constitute the traffic. The categories include the following.

Filesharing	Streaming
Gaming	Unclassified
IM	VOIP
Standard	Web (HTTP)

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Categorizing Traffic by Type of Content

To categorize traffic by type of content, click the **WEB** icon above the table. In this mode, MURAL assigns traffic to categories according to the URL of the website that is providing content, based on categorization guidelines from the Interactive Advertising Bureau. MURAL continually categorizes new URLs to keep the categories up to date. The categories include the following.

Adult Content	Hobbies and Interests	Religion and Spirituality
Arts and Entertainment	Home and Garden	Science
Automobile	Illegal Content	Shopping
Business	Law, Government, Politics	Society
Careers	Malicious Content	Sports
Education	News	Style and Fashion
Family and Parenting	Personal Finance	Technology and Computing
Food and Drink	Pets	Travel
Health and Fitness	Real Estate	Uncategorized

Categorizing Traffic by Application Type

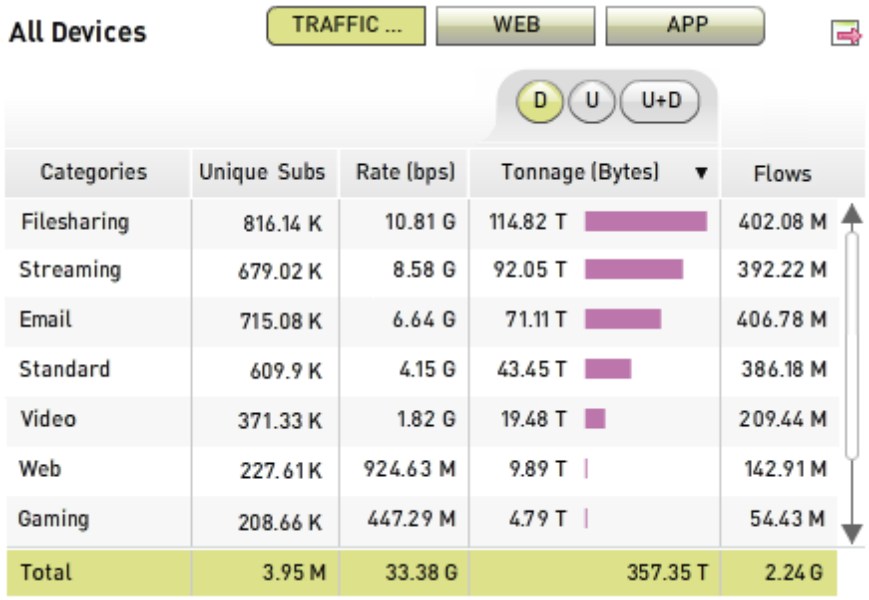
To categorize traffic by the type of application used to request and download data, click the **APP** icon above the table. In this mode, MURAL assigns traffic to categories according to the type of application used to request content from the network. The categories include the following.

Browser	Social Networking
Business	Weather
Productivity	mobileappcategorynotfound
Standard	

Traffic that cannot be assigned to another category is assigned to **mobileappcategorynotfound**.

Changing the Sort Order in the Categories Table

When you access the **Network**, **Device**, **Subscriber**, or **Content** tab for the first time during a MURAL session, the rows are sorted according to the value in the **Tonnage (Bytes)** column, largest to smallest. As shown in the following figure, this is indicated by the decreasing-order sort icon (▼) in the column's header bar and by the purple bars, which graphically convey the relative size of the values in the column.



Categories	Unique Subs	Rate (bps)	Tonnage (Bytes) ▼	Flows
Filesharing	816.14 K	10.81 G	114.82 T	402.08 M
Streaming	679.02 K	8.58 G	92.05 T	392.22 M
Email	715.08 K	6.64 G	71.11 T	406.78 M
Standard	609.9 K	4.15 G	43.45 T	386.18 M
Video	371.33 K	1.82 G	19.48 T	209.44 M
Web	227.61 K	924.63 M	9.89 T	142.91 M
Gaming	208.66 K	447.29 M	4.79 T	54.43 M
Total	3.95 M	33.38 G	357.35 T	2.24 G

You can sort based on the values in any of the five columns. To change columns, click in the column's header bar. The sort icon (▼ or ▲) and purple bars move to the new column and the rows are resorted. The increasing-order sort icon (▲) indicates the sort order is smallest to largest (alphabetical in the **Categories** column), and the decreasing-order sort icon (▼) largest to smallest (reverse alphabetical in the **Categories** column).

To reverse the sort order in the column that is currently controlling it, click in the header bar again. The sort icon reverses direction to indicate the new order.

Note: If you have selected a row in the table other the **Total** row, changing the sort order deselects it and the **Total** row becomes selected again.

Note: Categories such as **mobileappcategorynotfound**, which are for items that have not yet been categorized, always appear in the last row of the table, regardless of the sort order.

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The basis for sorting is independent on the **Network**, **Device**, **Subscriber**, and **Content** tabs—for example, you can sort by uplink traffic rate on the **Network** tab and at the same time sort by number of hits on the **Device** tab. MURAL maintains the sorting basis on a tab for the duration of a session.

Analyzing Traffic Trend Data

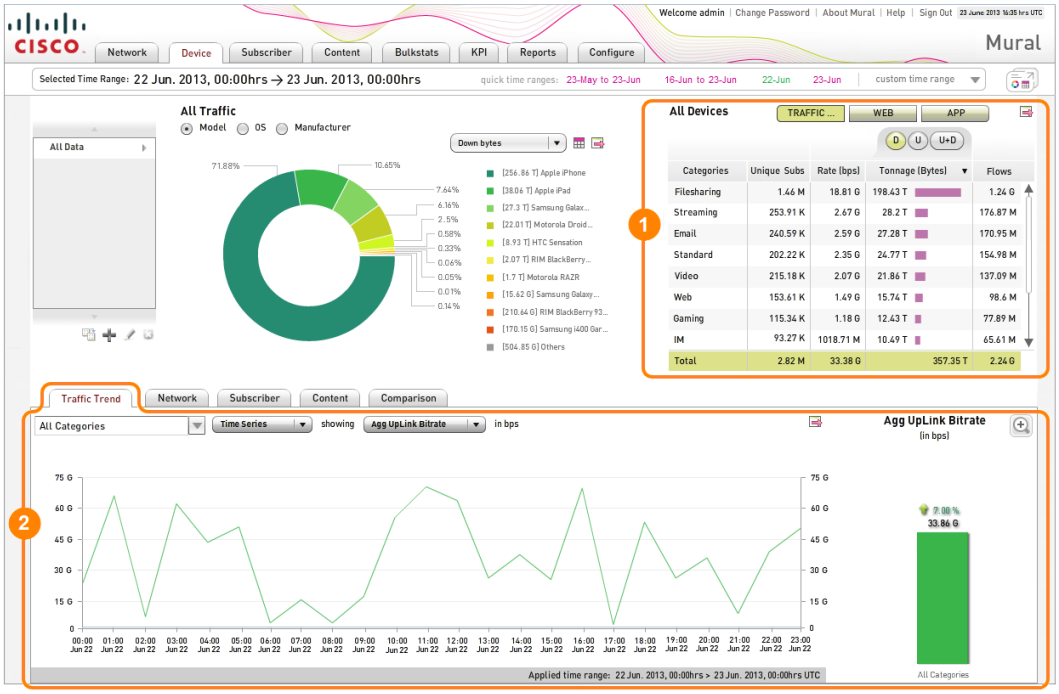
On the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL), the **Traffic Trend** subtab tracks traffic patterns over time for individual rows from the traffic-type table on the top-level tab. You can also compare up to three categories at once.

This topic describes the following tasks:

- "Interpreting the Traffic Trend Subtab" on the next page
- "Displaying Traffic Trend Data in Line or Bar Charts" on page 76
- "Displaying the Exact Value for an Hourly Interval" on page 82
- "Setting the Statistic Reported in a Traffic Trend Chart" on page 83
- "Interpreting the Summary Bar Chart" on page 84
- "Displaying Data from Multiple Categories" on page 85
- "Comparing Two Charts" on page 86

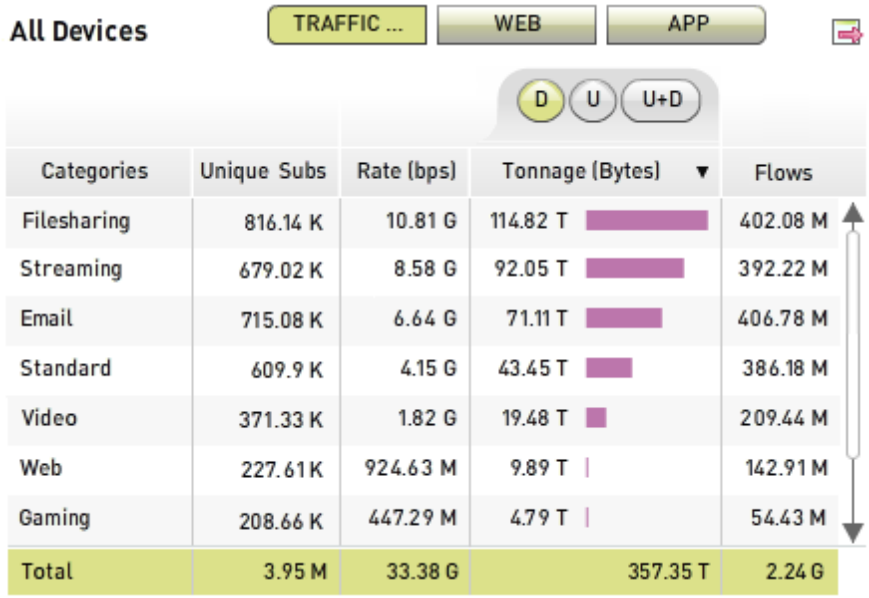
Interpreting the Traffic Trend Subtab

The following figure from the **Device** tab shows the table in box **1** and the **Traffic Trend** subtab open in box **2**. This is the table's position on the **Network** and **Subscriber** tabs as well; on the **Content** tab, the positions of the table and the adjacent doughnut chart are reversed.



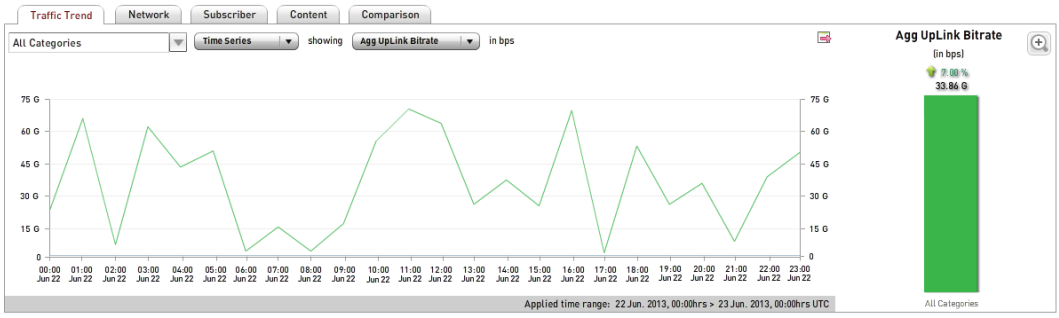
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As shown in the following figure, when you first access a tab during a MURAL session, the **Total** row at the bottom of the table is selected, as indicated by the gold color.



Categories	Unique Subs	Rate (bps)	Tonnage (Bytes)	Flows
Filesharing	816.14 K	10.81 G	114.82 T	402.08 M
Streaming	679.02 K	8.58 G	92.05 T	392.22 M
Email	715.08 K	6.64 G	71.11 T	406.78 M
Standard	609.9 K	4.15 G	43.45 T	386.18 M
Video	371.33 K	1.82 G	19.48 T	209.44 M
Web	227.61 K	924.63 M	9.89 T	142.91 M
Gaming	208.66 K	447.29 M	4.79 T	54.43 M
Total	3.95 M	33.38 G	357.35 T	2.24 G

The **Traffic Trend** subtab reports data at hourly increments for the selected category (**Total**), as indicated by the value **All Categories** in the box above the table. When you first access a top-level tab during a MURAL session, a time-series line chart tracks average traffic rate on the uplink, as indicated by the values **Time Series** and **Agg UpLink Bitrate** on the drop-down menus. The bar chart to the right of the line chart reports the same statistic for the entire selected time range; for more information, see "Interpreting the Summary Bar Chart" on page 84.



The following table describes the elements on the **Traffic Trend** subtab.

Element	Description
Category_name	Names the categories (up to three) for which data is presented on the subtab. See "Displaying Data from Multiple Categories" on page 85.

Element	Description
	Indicates and sets the type of chart displayed. See "Displaying Traffic Trend Data in Line or Bar Charts" below.
	Indicates and sets the statistic reported in the chart. See "Setting the Statistic Reported in a Traffic Trend Chart" on page 83.
	Copies the data in the table to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.
	Expands the **Traffic Trend** subtab to twice the default height and displays two charts, or returns the subtab to default size with one chart. See "Comparing Two Charts" on page 86.

The vertical axis at either end of the chart indicates the units. The letter following the numerical value indicates the multiple, the meaning of which depends on the type of statistic (traffic rate, traffic volume, or count).

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

Displaying Traffic Trend Data in Line or Bar Charts

When you first access a top-level tab during a MURAL session, traffic trend information is presented in a time-series line chart. Click on the **Time Series** drop-down menu button to choose from among three formats.



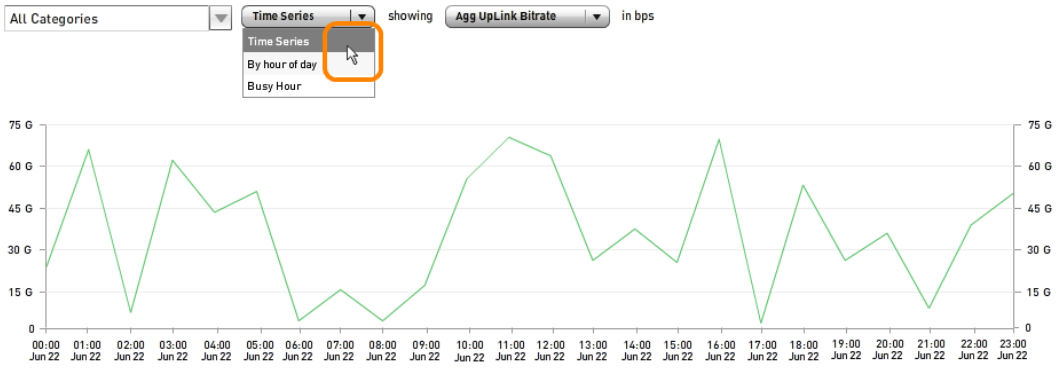
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The formats are described in the following sections:

- "Interpreting Time-Series Line Charts" below
- "Interpreting Hourly Bar Charts" on the next page
- "Interpreting Busy-Hour Bar Charts" on page 80

Interpreting Time-Series Line Charts

When you select **Time Series** from the drop-down menu, a time-series line chart connects data points which each represent a defined collection period. In the following figure, the chart presents hourly time points for a one-day period.



For data to appear in the line chart, you must set the time range to a minimum of 2 hours.

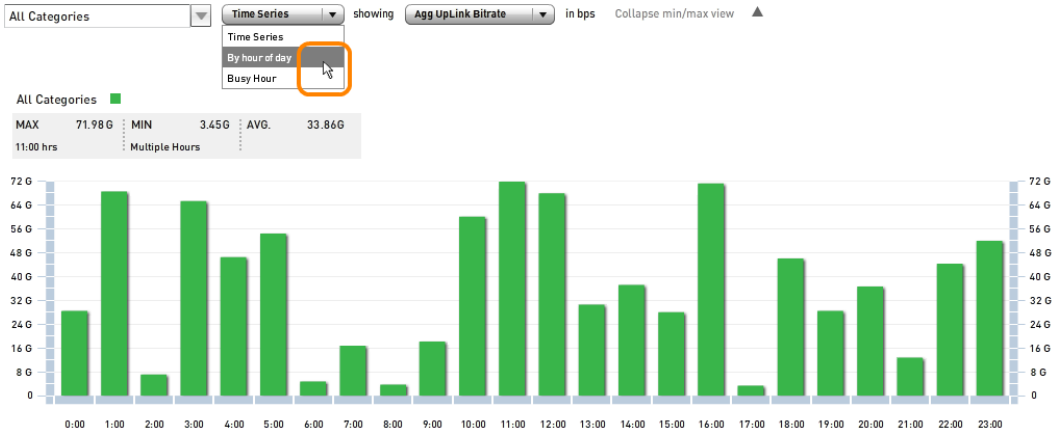
The length of the collection period for each time point depends on the method used to set the time range for the top-level tab:

- One hour—For custom time ranges set using daily (D) or weekly (W) mode, and for the quick time ranges that correspond to the current day, the previous day, or the previous seven days.
- One day—For custom time ranges set in monthly (M) or semiannual (6M) mode, and for the quick time range that corresponds to the previous 30 days.

For details about the time range selector, see "Setting the Time Range for Displayed Data" on page 29.

Interpreting Hourly Bar Charts

When you select **By hour of day** from the drop-down menu, the chart includes a bar for each of the 24 hourly collection periods from 00:00 hours through 23:00 hours.



For data to appear in the chart, you must set a time range that covers at least one full calendar day (the 24 hours from 00:00 hours one day to 00:00 hours the next day). This implies that data is not displayed for the following time ranges:

- The quick time range corresponding to the current day
- A custom time range in daily (D) mode that does not begin at 00:00 hours and end at 00:00 the next day
- A custom time range in weekly (W) mode that does not cover at least one full calendar day (as defined previously); for example, the 24-hour period from 18:00 hours one day to 18:00 hours the next day is not valid

The maximum time range for which data can appear in the chart is seven calendar days, which implies that data is not displayed for the quick time range corresponding to the previous 30 days, or for custom time ranges of more than 7 days set in monthly (M) or semiannual (6M) mode.

For details about the time range selector, see "Setting the Time Range for Displayed Data" on page 29.

When the time range covers a single calendar day, each bar reports the value for the one-hour collection period indicated by the label below it. When the time range includes two or more calendar days, each bar reports the average of the values for that hourly period each day. For

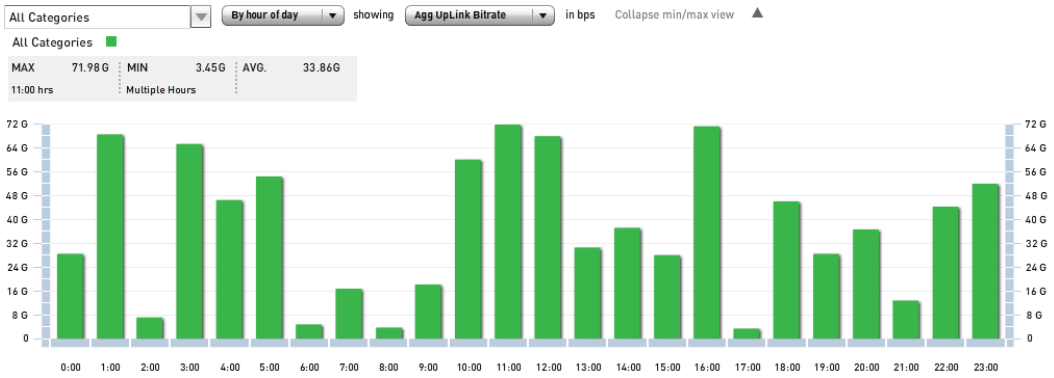
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example, suppose that for a three-day time range download traffic volume during the 11:00-hours collection period was 8 terabytes (TB) on the first day, 3 TB on the second, and 7 TB on the third. The value for the 11:00-hours bar in the chart is 6 TB ((8+3+7)/3 = 6).

In weekly (W) mode, it is possible to set a custom time range that includes part of the day before the first full calendar day, part of the day after the last calendar day, or both. The partial days are not included in the display, and the **Applied time range** field below the chart reports the included complete days. For example, if you set the time range from 03:00 hours on 20 June until 20:00 hours on 23 June, the chart includes data for two complete days only (00:00 hours on 21 June to 00:00 hours on 23 June).

A legend appears above the chart to report the collection periods with the largest (**MAX**) and smallest (**MIN**) values, plus the average (**AVG**) for the time range. Note that for applied time ranges of two days or more, the **MAX** and **MIN** values are for the bars displayed in the chart (which represent averages), not from the individual collection periods used to calculate the averages.

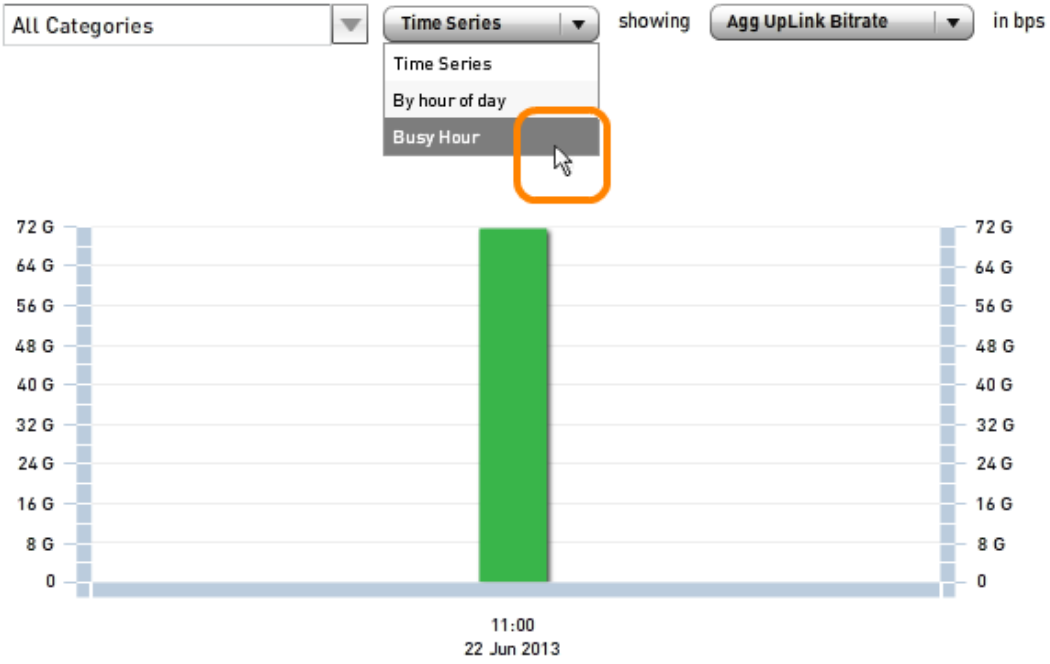
In the following example, the smallest value—3.45 gigabits per second—occurred at both 08:00 and 17:00 hours, so the legend for the **MIN** value reads **Multiple hours**.



To collapse the legend, click the triangle icon (▲) labeled Collapse min/max view. To expose the legend when it is hidden, click the triangle icon (▼) labeled Expand to show min/max.

Interpreting Busy-Hour Bar Charts

When you select **Busy hour** from the drop-down menu, the chart includes a bar for each of the full calendar days in the applied time range, indicating the hourly collection period with the largest value during that day. (A calendar day is defined as the 24 hours from 00:00 hours one day to 00:00 hours the next day.) The following chart indicates that the 11:00-hours collection period had the largest value on 22 June.



For data to appear in the chart, you must set a time range that covers at least one full calendar day. This implies that data is not displayed for the following time ranges:

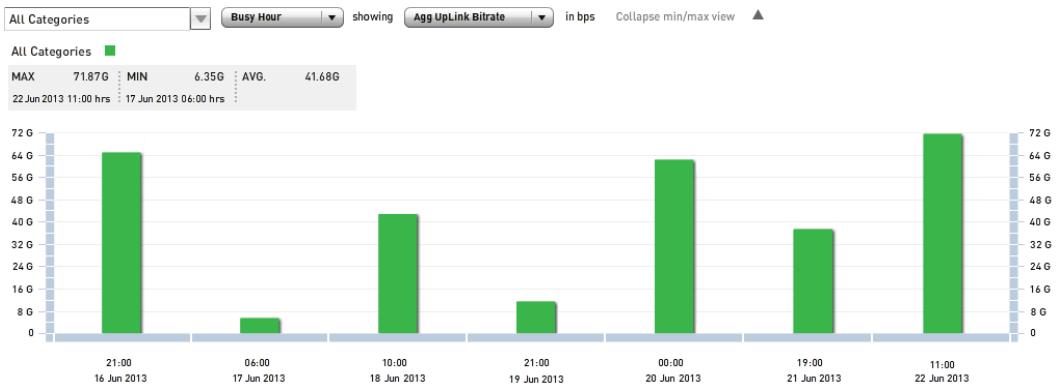
- The quick time range corresponding to the current day
- A custom time range in daily (D) mode that does not begin at 00:00 hours and end at 00:00 the next day
- A custom time range in weekly (W) mode that does not cover at least one full calendar day (as defined previously); for example, the 24-hour period from 18:00 hours one day to 18:00 hours the next day is not valid

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The maximum time range for which data can appear in the chart is seven calendar days, which implies that data is not displayed for the quick time range corresponding to the previous 30 days, or for custom time ranges of more than 7 days set in monthly (M) or semiannual (6M) mode.

For details about the time range selector, see "Setting the Time Range for Displayed Data" on page 29.

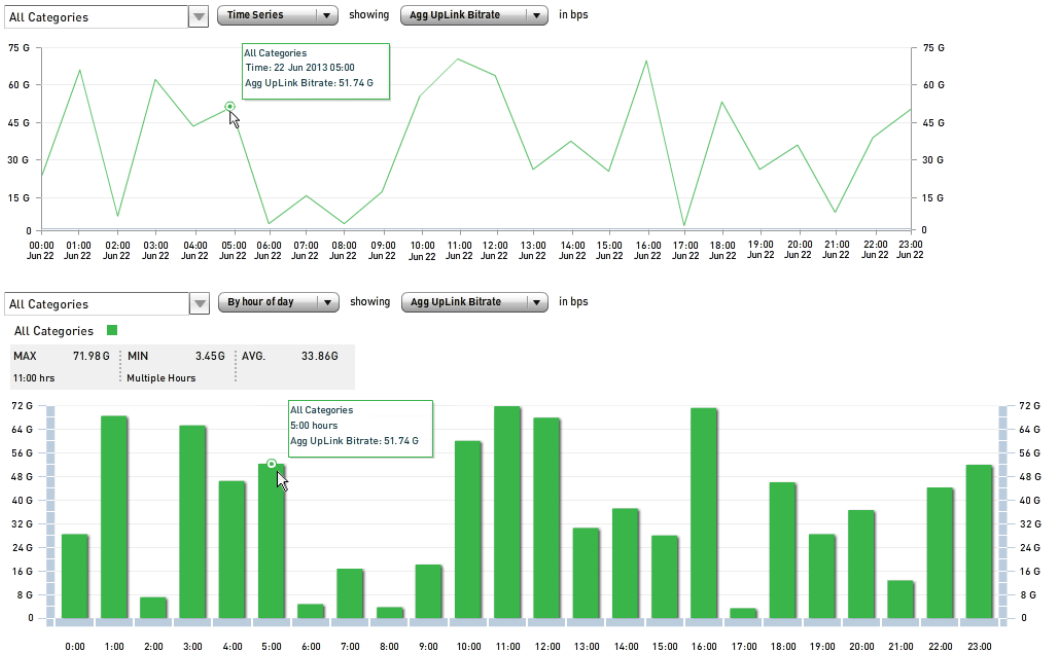
When the time range includes two or more calendar days, there is a bar for each day. The following example covers the maximum possible time range, seven days. A legend appears above the chart to report the collection periods with the largest (**MAX**) and smallest (**MIN**) values, plus the average (**AVG**) for the time range. Note that the **MIN** and **AVG** values are for the bars displayed in the chart (which represent averages), not from the individual collection periods used to calculate the averages. If the **MAX** or **MIN** value applies to more than one day, the legend reports **Multiple Days** instead of a specific day and time.



To collapse the legend, click the triangle icon (▲) labeled Collapse min/max view. To expose the legend when it is hidden, click the triangle icon (▼) labeled Expand to show min/max.

Displaying the Exact Value for an Hourly Interval

To view the exact value for a data point in a line chart or bar in a bar chart, mouse over it. A window pops up to report the category, time, and value. The following figure shows the result for 05:00 hours on the **Time Series** and **By hour of day** charts; the pop-up box on the **Busy Hour** chart looks the same as on the **By hour of day** chart.



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Setting the Statistic Reported in a Traffic Trend Chart

When you first access the **Network**, **Device**, **Subscriber**, or **Content** tab, the statistic reported on the **Traffic Trend** subtab is bits per second (bps) on the uplink, as indicated by the **Agg UpLink Bitrate** drop-down menu button. To display a different statistic on any of the three graph types, click on the button and then on the desired statistic.



The text in the menu bar and in the field to its right change to indicate the new units. The units are defined as follows for each hourly increment. The three flow-related statistics are reported when the **TRAFFIC** type is chosen for the categories table in the upper half of the top-level tab, and the three hit-related statistics are reported when **WEB** or **APP** is chosen.

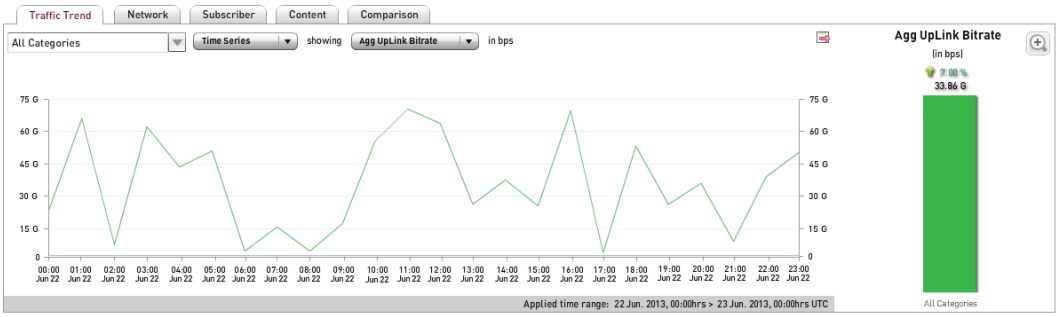
- **Agg DownLink Bitrate**—Average number of bits per second (bps) that traveled from the network toward mobile users. It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.
- **Agg UpLink Bitrate**—Average number of bits per second (bps) that traveled from mobile users toward the network. It is calculated in the same way as the downlink rate.
- **Aggregate Subscriber Count**—Number of active subscribers.
- **Avg Concurrent Flows**—Average number of flows active at the same time, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol.
- **Avg Concurrent Hits**—Average number of requests for a file that occurred at the same time.

- **Avg Flows Duration**—Average duration in seconds of flows.
- **Avg Hits Duration**—Average duration in seconds of file requests sent to web servers. Duration is measured from the time the file request is sent until a response is received
- **DownLink Tonnage**—Number of bytes that traveled from the network toward mobile users.
- **Flows**—Number of active flows.
- **Hits**—Number of requests for a file sent to web servers.
- **Total Tonnage**—Number of bytes that traveled in both directions (sum of **DownLink Tonnage** and **UpLink Tonnage**).
- **UpLink Tonnage**—Number of bytes that traveled from mobile users toward the network.

Interpreting the Summary Bar Chart

The bar chart at the right side of the **Traffic Trend** tab provides a summary of the hourly information in the chart to its left. The statistic reported by the bar chart is the same as in the main chart and is reported in the label field above the bar chart. The value appears in the black print just above the bar.

In the following figure, the bar reports an average traffic rate of nearly 34 Gbps on the uplink (**Agg UpLink Bitrate**).



The percentage value above the measurement indicates the percentage change in its value compared to the period of the same duration as the current time range that immediately preceded the current time range. A value in green preceded by the upward arrow indicates an increase, and a value in red a decrease. The time range is reported as the **Applied Time Range** in the gray bar

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below the main chart. In the figure, the value of 34 Gbps on 22 June represents an increase of 7% over 21 June.

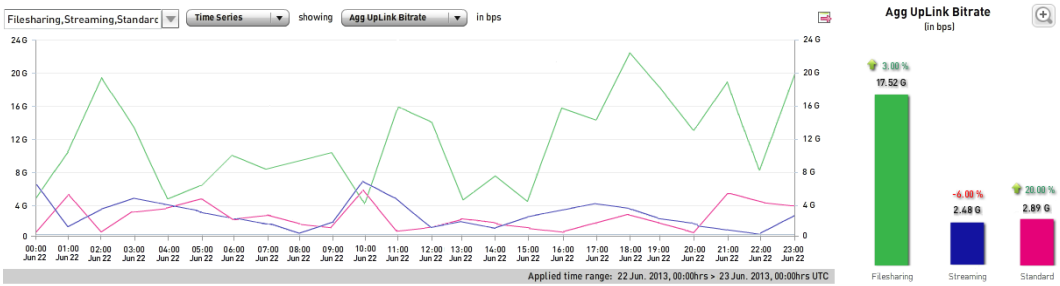
For statistics that are themselves averages, the bar reports the average of the hourly values in the main chart (this applies to bit rates and statistics with **Avg** in their names). For statistics that are sums, the bar reports the sum of the hourly values in the main chart (this applies to traffic volume [tonnage], flows, hits, and subscriber counts).

Displaying Data from Multiple Categories

You can simultaneously display data for up to three categories. When you first access a top-level tab during the MURAL session, the **Total** row is selected in the categories table and **All Categories** appears in the drop-down menu box above the line chart in the **Traffic Trend** subtab. Click the row of the table for the category you want to display or compare in the line chart. Then click the icon () at the right end of the drop-down menu box and click the check boxes of up to two additional categories. In the following example, the check box for the category selected in the table (**Filesharing**) is already checked and thus grayed out; the two additional checked categories are **Streaming** and **Standard**. Click the **Ok** button to close the menu.



The following figure shows the resulting time series line graph for the three categories. You can compare categories in all three chart formats described in "Displaying Traffic Trend Data in Line or Bar Charts" on page 76.



The meaning and available operations on a chart with multiple categories are the same as on a single-category chart.

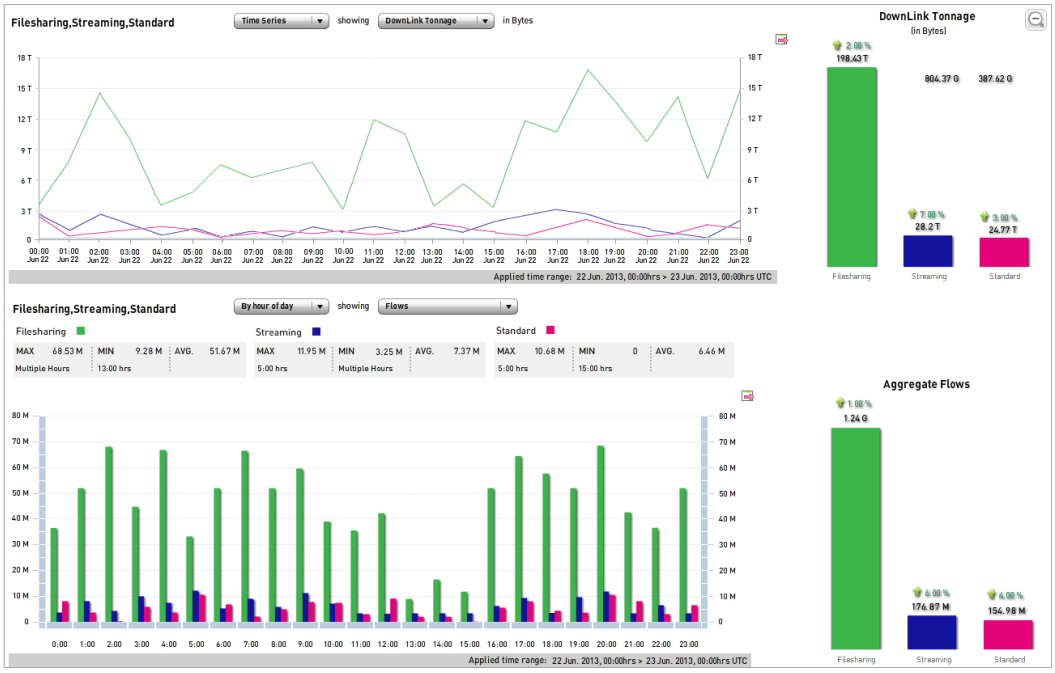
Comparing Two Charts

You can expand the **Traffic Trend** subtab to display two charts at the same time. Click the expand-pane icon (⊕) in the upper right corner of the subtab.



After the subtab expands, you can choose different chart types and units of measure for the two charts. In the following figure, the upper part of the pane is a time series of traffic volume on the downlink, and the lower part a bar chart of the number of flows each hour.

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To collapse the subtab back to its normal size, click the collapse-pane icon ( ).

Comparing Two Network Entities

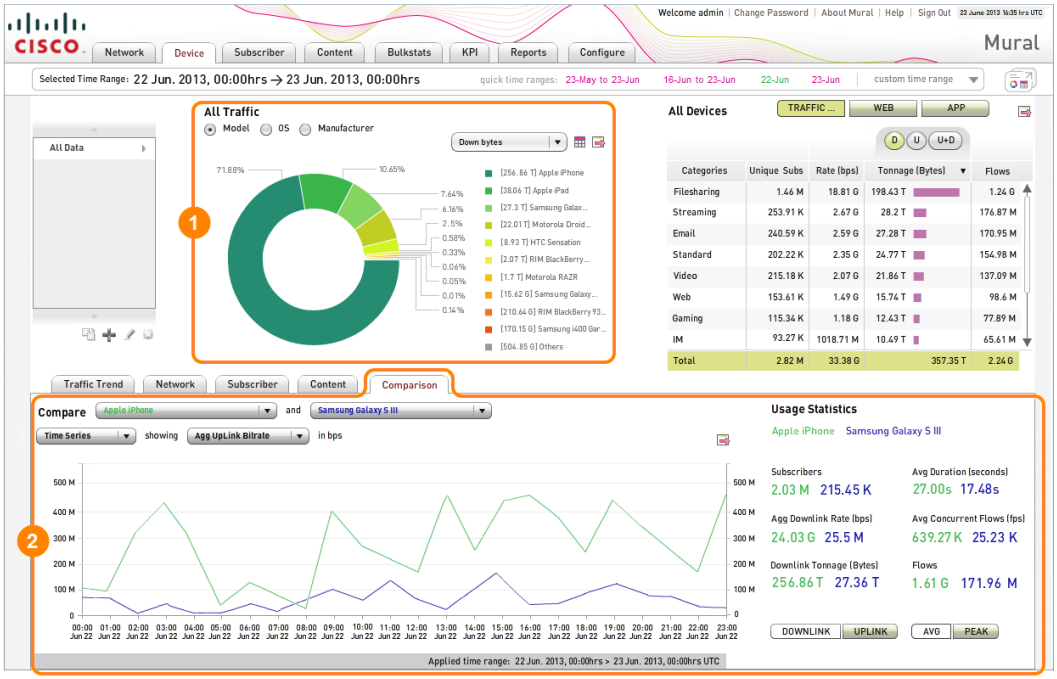
On the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL), the **Comparison** subtab enables you to view simultaneously statistics for two entities selected from the upper half of the top-level tab.

This topic describes the following tasks:

- "Interpreting the Comparison Subtab" on the next page
- "Displaying Traffic Trend Data as a Line or Bar Chart" on page 92
- "Displaying the Precise Value for an Hourly Interval" on page 93
- "Setting the Statistic Reported in Comparison Charts" on page 94
- "Interpreting Usage Statistics" on page 96

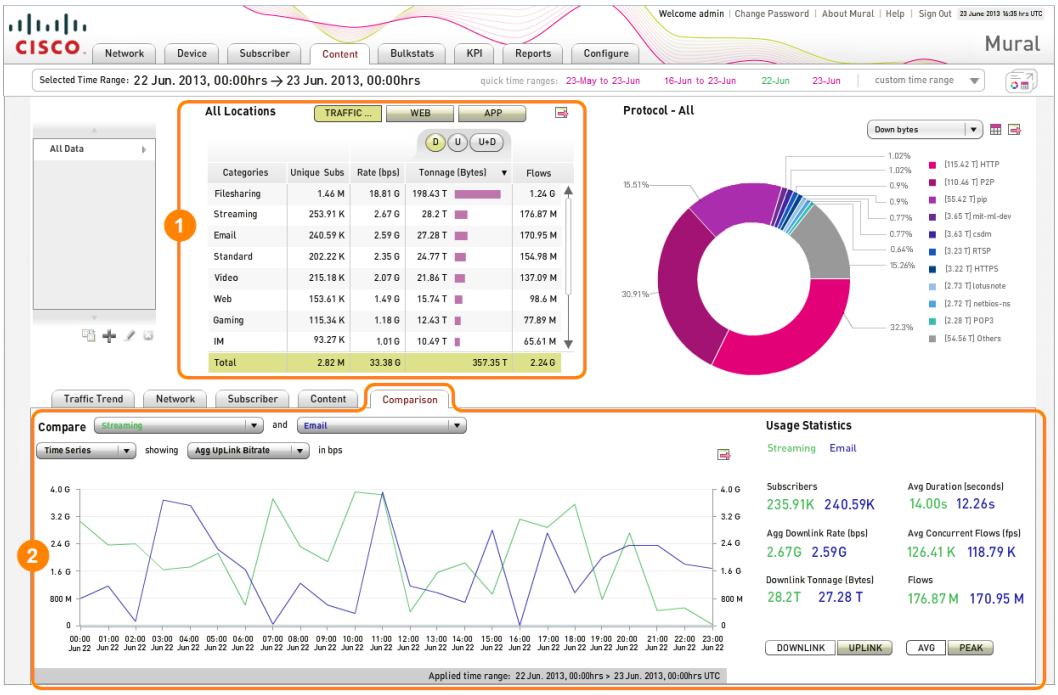
Interpreting the Comparison Subtab

On the **Network**, **Device**, and **Subscriber** tabs, you select two entities from the doughnut chart of distribution data (box **1** in the following sample **Device** tab) to compare on the **Comparison** subtab (box **2**).



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On the **Content** tab, you select two categories from the table in box **1** to compare on the **Comparison** subtab (box **2**).



When you first access the **Comparison** subtab on a top-level tab during the MURAL session, the time-series line chart reports the average traffic rate on the uplink at hourly increments for two entities. The **Usage Statistics** table to the right of the line chart provides totals and averages over the selected time range for the statistics available for tracking at hourly intervals in the chart; see "Interpreting Usage Statistics" on page 96.

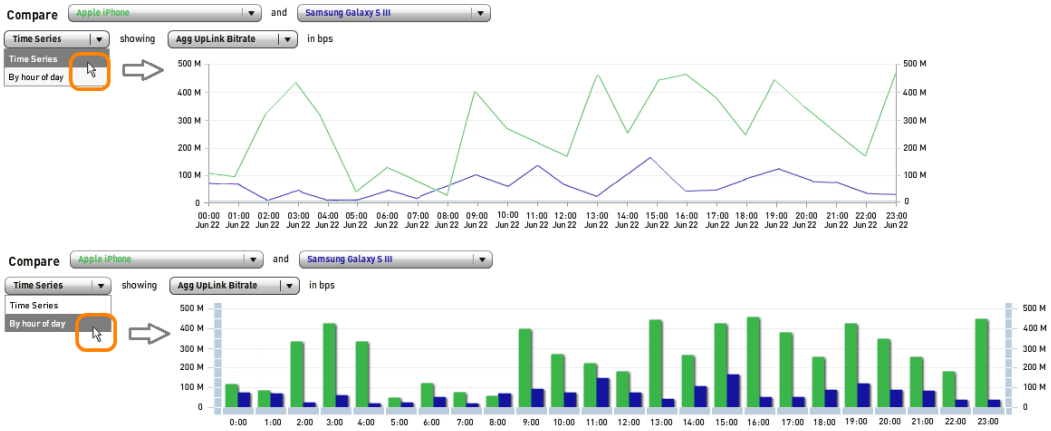
The following table describes the elements on the **Comparison** subtab.

Element	Description
Compare Entity_1 ... and Entity_2	Names the two entities in the doughnut chart for which data is presented on the subtab. Click on each button to open the drop-down list of entities, then click on an entity to select it.
Time Series	Indicates and sets the type of chart displayed. See "Displaying Traffic Trend Data as a Line or Bar Chart" on the next page.
Agg UpLink Bitrate	Indicates and sets the type of statistic tracked in the chart. See "Setting the Statistic Reported in Comparison Charts" on page 94.
	Copies the data in the table to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.

Displaying Traffic Trend Data as a Line or Bar Chart

When you first access the **Comparison** subtab on each top-level tab during the MURAL session, the data is presented in a time-series line chart. The data points connected by the line represent one-hour collection periods. Use the **Time Series** drop-down menu to choose between two formats:

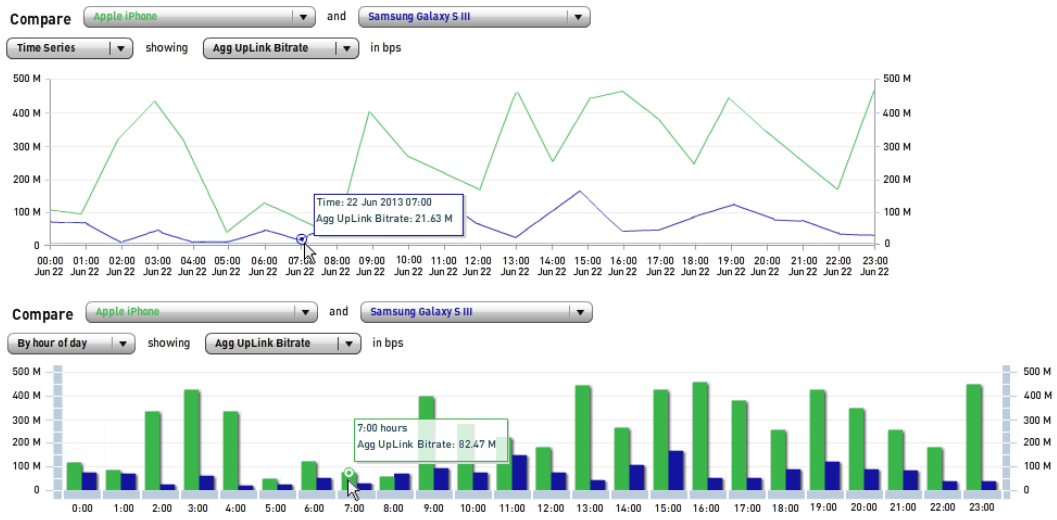
- **Time Series**—Time-series line chart
- **By hour of day**—Bar chart with one bar per hour



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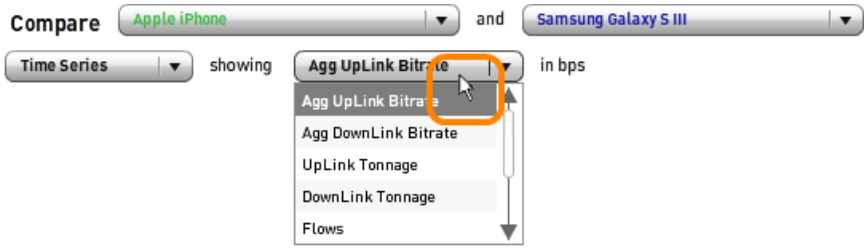
Displaying the Precise Value for an Hourly Interval

To view the exact value for a data point in a line chart or bar in a bar chart, mouse over it. A window pops up to report the category, time, and measured value (you can view the exact value for one of the two entities at a time). The following figure shows the result for 07:00 hours on the two types of chart.



Setting the Statistic Reported in Comparison Charts

When you first access the **Comparison** subtab on a top-level tab during the MURAL session, the statistic is bits per second (bps) on the uplink, as indicated by the **Agg UpLink Bitrate** drop-down menu button. To display a different statistic, click on the button to open the menu, and then click on the desired unit.



The text on the menu button and in the field to its right change to indicate the new units. The units are defined as follows for each hourly increment. Statistics related to flows are available on the **Network**, **Device**, and **Subscriber** tabs, and on the **Content** tab when the **TRAFFIC** traffic type is selected for the categories table. Statistics related to hits are available on the **Content** tab when the **WEB** or **APP** traffic type is selected.

- **Agg DownLink Bitrate**—Average number of bits per second (bps) that traveled from the network toward mobile users. It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.
- **Agg UpLink Bitrate**—Average number of bits per second (bps) that traveled from mobile users toward the network. It is calculated in the same way as the downlink rate.
- **Aggregate Subscriber Count**—Number of active subscribers.
- **Avg Concurrent Flows**—Average number of flows active at the same time, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol.
- **Avg Concurrent Hits**—Average number of file requests made to web servers at the

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same time.

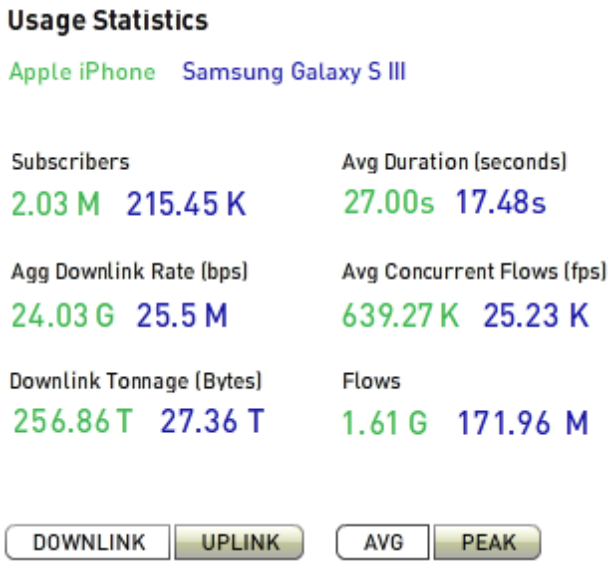
- **Avg Flows Duration**—Average duration in seconds of flows.
- **Avg Hits Duration**—Average duration in seconds of file requests.
- **DownLink Tonnage**—Number of bytes that traveled from the network toward mobile users.
- **Flows**—Number of active flows.
- **Hits**—Number of requests for a file sent to web servers.
- **Peak Flow Duration**—Longest duration in seconds of a flow.
- **Peak Hits Duration**—Longest duration in seconds of a hit.
- **UpLink Tonnage**—Number of bytes that traveled from mobile users toward the network.

On the time scales at either end of the chart, the letter following the digits indicates the multiple. The **Rate Statistics** column in the following table applies to **Agg DownLink Bitrate** and **Agg UpLink Bitrate**, the **Tonnage Statistics** column to **DownLink Tonnage** and **UpLink Tonnage**, and the **Count Statistics** column to the other units of measure.

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

Interpreting Usage Statistics

The **Usage Statistics** table on the right side of the **Comparison** subtab reports sum totals across the entire selected time range for the statistics that are available from the drop-down menu on the adjacent line or bar chart. For information about the features and types of statistics in the table, see "Interpreting Statistics on the Comparison Subtab" on page 102.



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Interpreting Usage Statistics

On the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL), several of the subtabs that appear in the lower half of the display area feature a **Usage Statistics** table that summarizes multiple statistics.

This topic describes the following tasks:

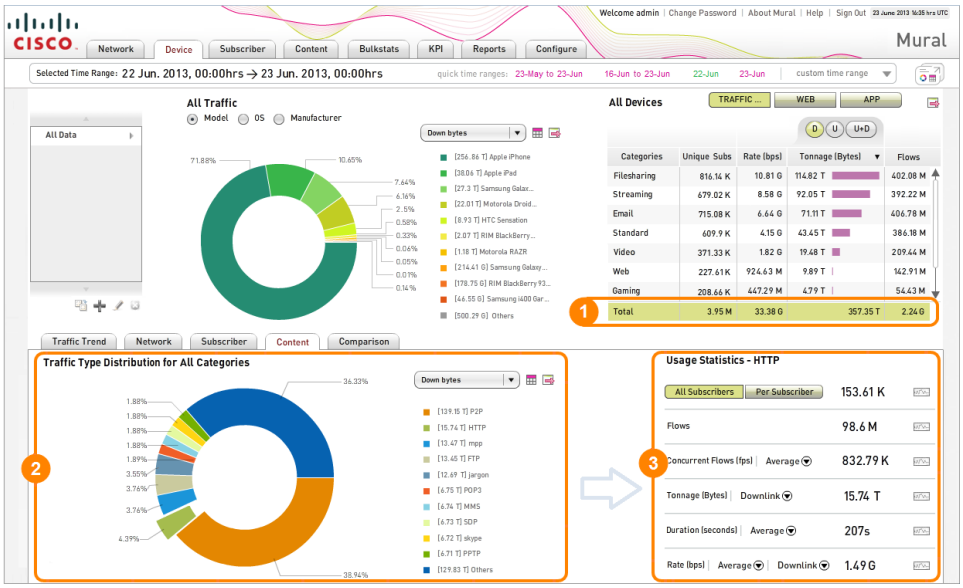
- "Interpreting the Usage Statistics Table" below
- "Interpreting Statistics on the Content, Device, Network, and Subscriber Subtabs" on page 100
- "Interpreting Statistics on the Comparison Subtab" on page 102
- "Generating Traffic Trend Charts from the Usage Statistics Table" on page 105

Interpreting the Usage Statistics Table

The function of the table depends on the kind of data reported on the subtab:

- On the **Network**, **Device**, **Subscriber**, and **Content** subtabs, the left pane (enclosed in box **2** in the following figure) reports traffic distribution data in a doughnut chart or table for the category that is currently selected in the categories table (box **1**). The **Usage Statistics** table (box **3**) reports multiple statistics either summed across of all the entities in box **2**, or for just the entity currently selected there. See "Interpreting Statistics on the Content, Device, Network, and Subscriber Subtabs" on page 100.

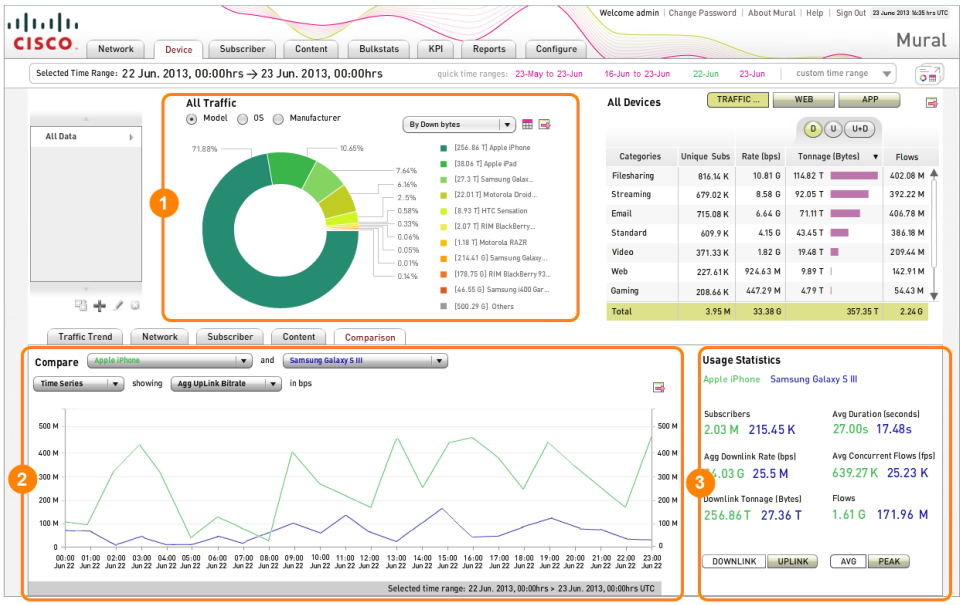
In the following sample **Device** tab and **Content** subtab, the **Usage Statistics** table reports statistics for Hypertext Transfer Protocol (HTTP) traffic, because it is the protocol type selected in box **2** (its wedge is "popped out" from the doughnut chart).



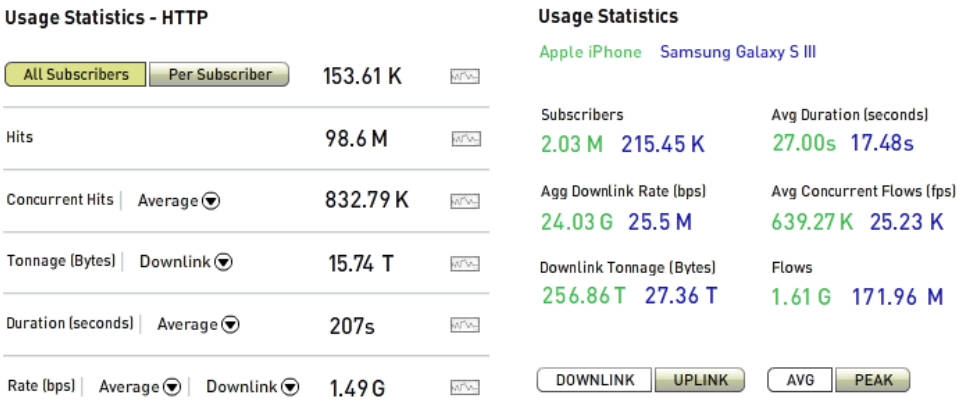
- On the **Comparison** subtab, the left pane (enclosed in box **2** in the following figure) displays statistics collected at hourly increments for two entities from box **1**. The **Usage Statistics** table in box **3** reports statistics summed or averaged across the entire selected time range, depending on the type of statistic (in other words, for count statistics box **3** reports the sum of the hourly values presented in box **2**, and for averages it reports the average of the hourly values). See "Interpreting Statistics on the Comparison Subtab" on page 102.

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In the following sample **Device** tab and **Comparison** subtab, the **Usage Statistics** table reports statistics for the two mobile phones in the line chart in box **2** (the Apple iPhone in green and the Samsung Galaxy S III in blue).



In general, the **Usage Statistics** table presents the same types of statistics that you can select on the drop-down menu of statistic types in box **2**. On the left side of the following figure is a sample **Usage Statistics** table for the **Network**, **Device**, **Subscriber**, and **Content** subtabs, and on the right a sample **Usage Statistics** table for the **Comparison** subtab.



The following table summarizes how the buttons and drop-down menus in the **Usage Statistics** table change the type or format of a statistic in the row.

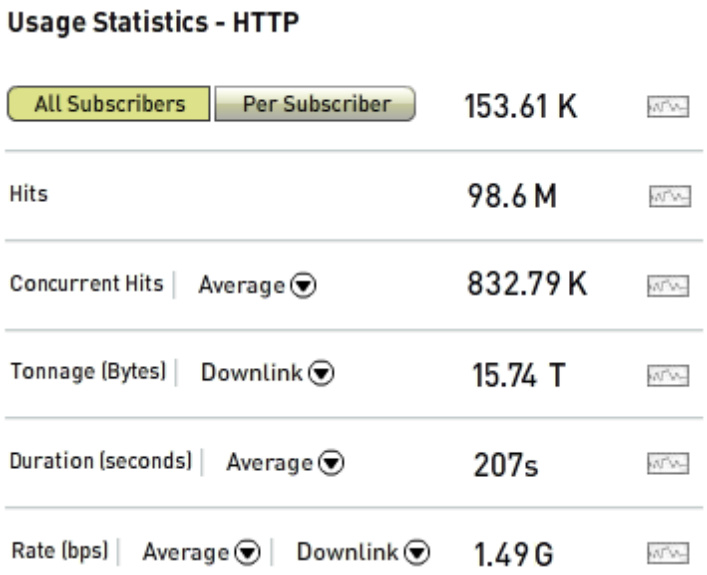
Button or Menu	Function
All Subscribers Per Subscriber	Indicates that the statistics in the subsequent rows of the table are reported as a total across all subscribers, or divided by the number of subscribers (which is reported just to the right of the button).
Average Peak AVG PEAK	Indicates that the statistic in the row is an average over the selected time range, or is the largest (peak) value that occurred. To toggle between average and peak values on the **Network**, **Device**, **Subscriber**, and **Content** subtabs, click the open-menu icon (⊙) and select the other type. To select either average or peak values on the **Comparison** subtab, click the appropriate button.
Downlink Uplink DOWNLINK UPLINK	Indicates that the statistic in the row is for traffic on the downlink (traveling from the network to mobile users), or the uplink (traveling from mobile users to the network). To toggle between downlink and uplink on the **Network**, **Device**, **Subscriber**, and **Content** subtabs, click the open-menu icon (⊙) and select the other type. To select either downlink or uplink values on the **Comparison** subtab, click the appropriate button.
	Changes the contents of the subtab to a time-series line chart that reports values at hourly intervals for the statistic in the row. To close the chart and return to the previous view of the tab, click the page-back icon () in the upper left corner.

Interpreting Statistics on the Content, Device, Network, and Subscriber Subtabs

On the **Content**, **Device**, **Network**, and **Subscriber** subtabs, the number of active subscribers is reported in the first row. The statistics in the subsequent rows of the table are defined as follows.

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Flow-related statistics are reported when the **TRAFFIC** traffic type is selected for the categories table in the upper half of the top-level tab, and hit-related statistics are reported when either of **WEB** or **APP** is selected, as in the following figure.



- **Concurrent Flows (fps)**—Number of flows active at the same time, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol. Click the adjacent icon (⏷) to display either the average or peak (largest) value.
- **Concurrent Hits**—Number of requests for a file that occurred at the same time. Click the adjacent icon (⏷) to display either the average or peak (largest) value.
- **Duration**—Duration in seconds for the type of event reported in the second and third rows of the table (either flows or hits). Click the adjacent icon (⏷) to display either the average or peak (largest) value.
- **Flows**—Number of active flows.
- **Hits**—Number of file requests.
- **Rate**—Number of bits per second (bps) of traffic flowing on the network. Click the directly adjacent icon (⏷) to display either the average or peak (largest) value, and the icon (⏷) to its right to display either downlink traffic (flowing from the network toward mobile users) or uplink traffic (flowing from mobile users toward the network).

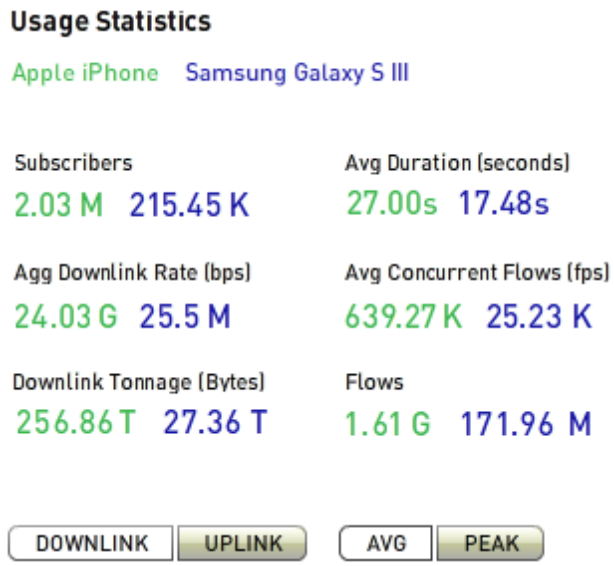
- **Tonnage**—Volume of traffic that traversed the network, in bytes. Click the icon (⊙) to display either downlink traffic (flowing from the network toward mobile users) or uplink traffic (flowing from mobile users toward the network).

The letter following the numerical value for a statistic indicates the multiple, the meaning of which depends on the type of statistic (traffic rate, traffic volume, or count).

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

Interpreting Statistics on the Comparison Subtab

On the **Comparison** subtab, the statistics are defined as follows. Hit-related statistics are reported when either the **WEB** or **APP** traffic type is selected for the categories table on the top-level **Content** tab. Flow-related statistics are always reported on the **Comparison** subtab of the top-level **Network**, **Device**, and **Subscriber** tabs, and of the top-level **Content** tab when the **TRAFFIC** traffic type is selected.



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- **Agg Downlink Rate**—Average number of bits per second (bps) that traveled from the network toward mobile users.It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.
- **Agg Uplink Rate**—Average number of bits per second (bps) that traveled from mobile users toward the network. It is calculated in the same way as the downlink rate.
- **Avg Concurrent Flows (fps)**—Average number of flows active at the same time, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol.
- **Avg Concurrent Hits**—Average number of requests for a file that occurred at the same time.
- **Avg Duration**—Average duration in seconds for the type of event reported in the two fields below this field (either flows or hits).
- **Downlink Tonnage**—Number of bytes that traveled from the network toward mobile users.
- **Flows**—Number of active flows.
- **Hits**—Number of requests for a file sent to web servers.
- **Peak Agg Downlink Rate**—Largest number of bits per second (bps) that traveled from the network toward mobile users.
- **Peak Agg Uplink Rate**—Largest number of bits per second (bps) that traveled from the network toward mobile users.
- **Peak Concurrent Flows**—Largest number of flows active at the same time.
- **Peak Concurrent Hits**—Largest number of file requests to web servers that occurred at the same time.
- **Peak Duration**—Longest duration in seconds for the type of event reported in the two fields below this field (either flows or hits).
- **Subscribers**—Number of active subscribers.
- **Uplink Tonnage**—Number of bytes that traveled from mobile users toward the network.

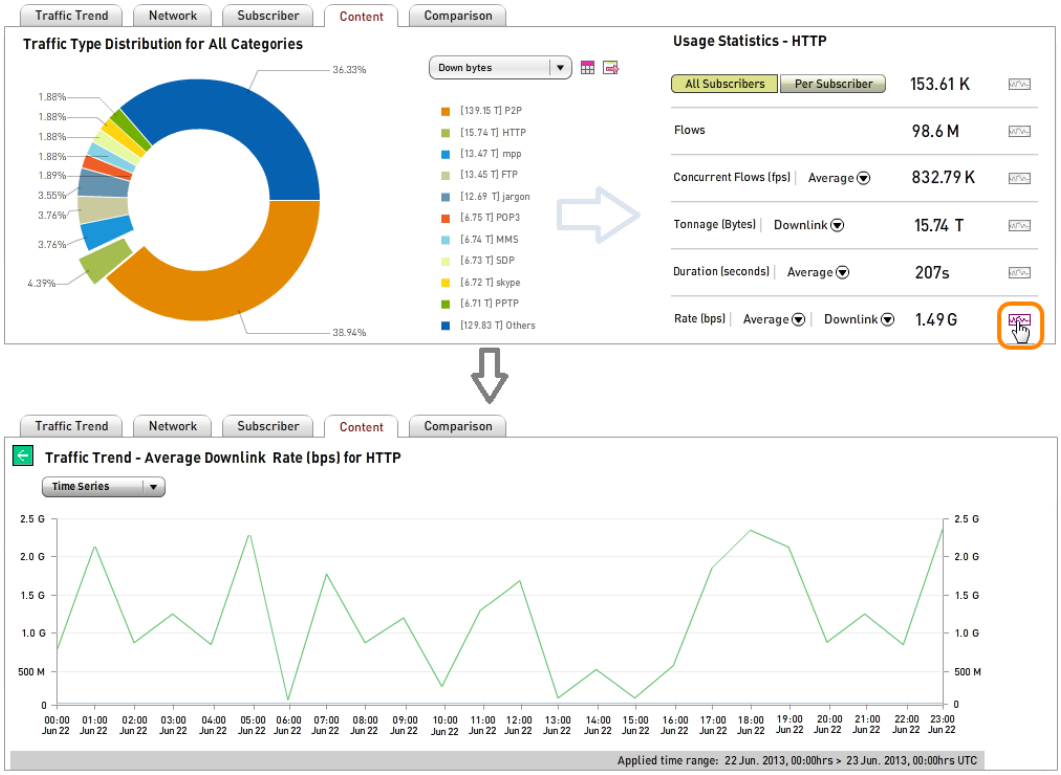
The letter following the numerical value for a statistic indicates the multiple, the meaning of which depends on the type of statistic (traffic rate, traffic volume, or count).

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

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Generating Traffic Trend Charts from the Usage Statistics Table

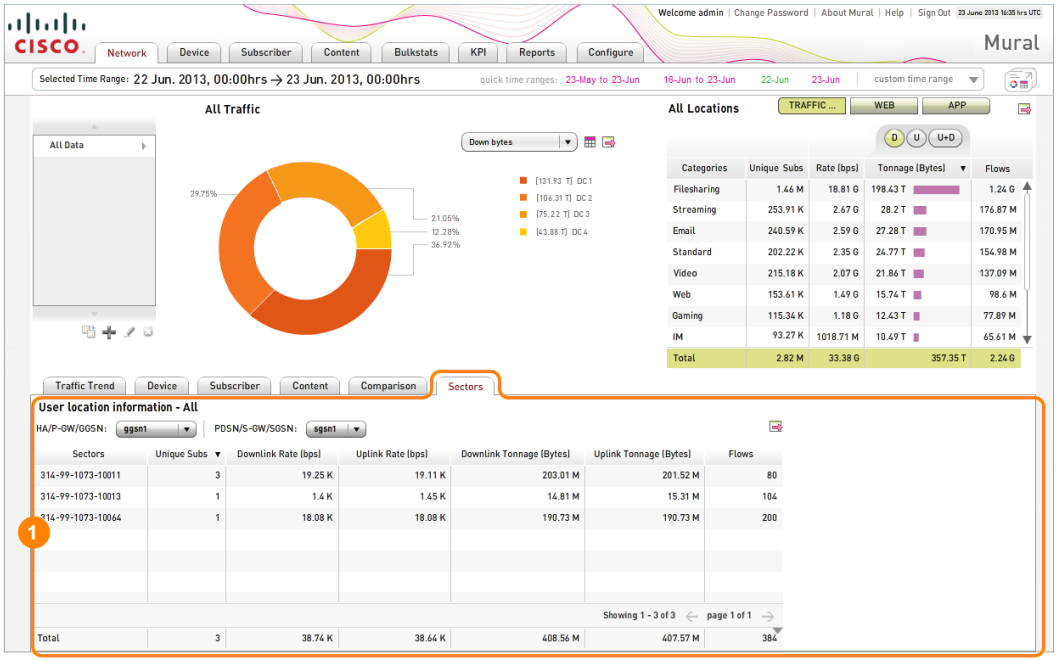
A time-series icon ( ) appears at the right end of each row in the **Usage Statistics** table. Click on the icon to generate an hourly traffic trend chart for the data in the row, like the ones on the **Traffic Trend** subtab. In the following example, the **Usage Statistics** table on the **Content** subtab displays statistics for **HTTP** as the selected protocol (its wedge is "popped out" in the doughnut chart). When you click the time-series icon in the **Rate** row, a traffic-trend line chart opens in the **Content** subtab, reporting the average traffic rate on the downlink for **HTTP**.



To close the chart and return to the previous view of the subtab, click the page-back icon ( ) in the upper left corner. For information about traffic-trend charts, see "Analyzing Traffic Trend Data" on page 73.

Analyzing Traffic in Mobile Network Sectors

The **Sectors** subtab reports traffic statistics for sectors. A *sector* is a subdivision of a mobile network cell that is served by a specific pair of nodes, which have two different defined functions in the network architecture. The subtab is available only on the **Network** tab and appears in box **1** in the following figure.



To specify the set of sectors to display, click the drop-down menus above the table and select a node from each of them. The list of sectors is determined only by the two nodes; selecting an individual wedge in the doughnut chart or row in the categories table in the upper half of the tab has no effect on the subtab.

User location information - All

HA/P-GW/GGSN: ggsn1 | PDSN/S-GW/SGSN: sgsn1

Sectors	Unique Subs	Downlink Rate (bps)	Uplink Rate (bps)	Downlink Tonnage (Bytes)	Uplink Tonnage (Bytes)	Flows
314-99-1073-10011	3	19.25 K	19.11 K	203.01 M	201.52 M	80
314-99-1073-10013	1	1.4 K	1.45 K	14.81 M	15.31 M	104
314-99-1073-10064	1	18.08 K	18.08 K	190.73 M	190.73 M	200
					Showing 1 - 3 of 3	page 1 of 1
Total	3	38.74 K	38.64 K	408.56 M	407.57 M	384

The following table describes the elements on the subtab.

Element	Description
HA/P-GW/GGSN: node	Names and sets the selected node that has the following function in the architecture used in the network: • **HA**—Home agent in cdma2000 (Code Division Multiple Access) • **P-GW**—Packet data network (PDN) gateway in System Architecture Evolution (SAE) • **GGSN**—Gateway GPRS support node in General Packet Radio Service (GPRS)
PDSN/S-GW/SGSN: node	Names and sets the selected node that has the following function in the architecture used in the network: • **PDSN**—Packet data serving node in cdma2000 • **S-GW**—Serving gateway in SAE • **SGSN**—Serving GPRS support node in GPRS
	Copies the data represented in the display area to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.
	Appears in a column header to indicate that the column is being used to sort the rows in the table. For information about sorting on the basis of different columns, see "Changing the Sort Order in the Sectors Table" on page 110.
Showing 1 - 50 of 303	Indicates the set of rows presented in the currently displayed page of the table. There are 50 rows on each page (and up to 50 on the last one).
page 1 of 7	Indicates the currently displayed page (set of 50 rows) and the total number of pages. Click on the black left arrow (←) to display the previous 50 rows or the black right arrow (→) to display the next 50. A grayed-out arrow indicates that no previous or subsequent page is available.

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The columns of the table report the following information:

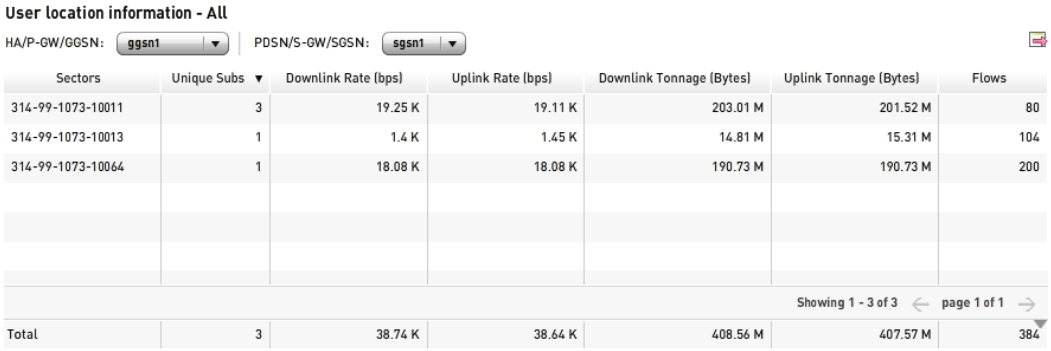
- **Sectors**—Sector identifier, comprised of the mobile country code (MCC), mobile network code (MNC), location area code (LAC) and cell identifier (CI).
- **Unique Subs**—Number of distinct mobile users for which the sector transmitted data.
- **Downlink Rate (bps)**—Average number of bits per second (bps) that traveled from the network toward mobile users. It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.
- **Uplink Rate (bps)**—Average number of bits per second (bps) that traveled from mobile users toward the network. It is calculated in the same way as the downlink rate.
- **Downlink Tonnage (Bytes)**—Number of bytes that traveled from the network toward mobile users.
- **Uplink Tonnage (Bytes)**—Number of bytes that traveled from mobile users toward the network.
- **Flows**—Total number of distinct flows in both directions, where a flow is defined as a group of packets that have the same source and destination IP addresses, source and destination port numbers, and transport protocol.

For numerical values, the letter following the digits indicates the multiple, the meaning of which depends on the type of unit of measure (traffic rate, traffic volume, or count).

	Rate Statistics	Volume Statistics	Count Statistics
K	kilobits per second (Kbps)	kilobytes	thousands (10^3)
M	megabits per second (Mbps)	megabytes	millions (10^6)
G	gigabits per second (Gbps)	gigabytes	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	quadrillions (10^{15})

Changing the Sort Order in the Sectors Table

When you access the **Sectors** subtab for the first time during a MURAL session, the rows are sorted according to the value in the **Unique Subs** column, largest to smallest. As shown in the following figure, this is indicated by the decreasing-order sort icon (▼) in the column's header bar.

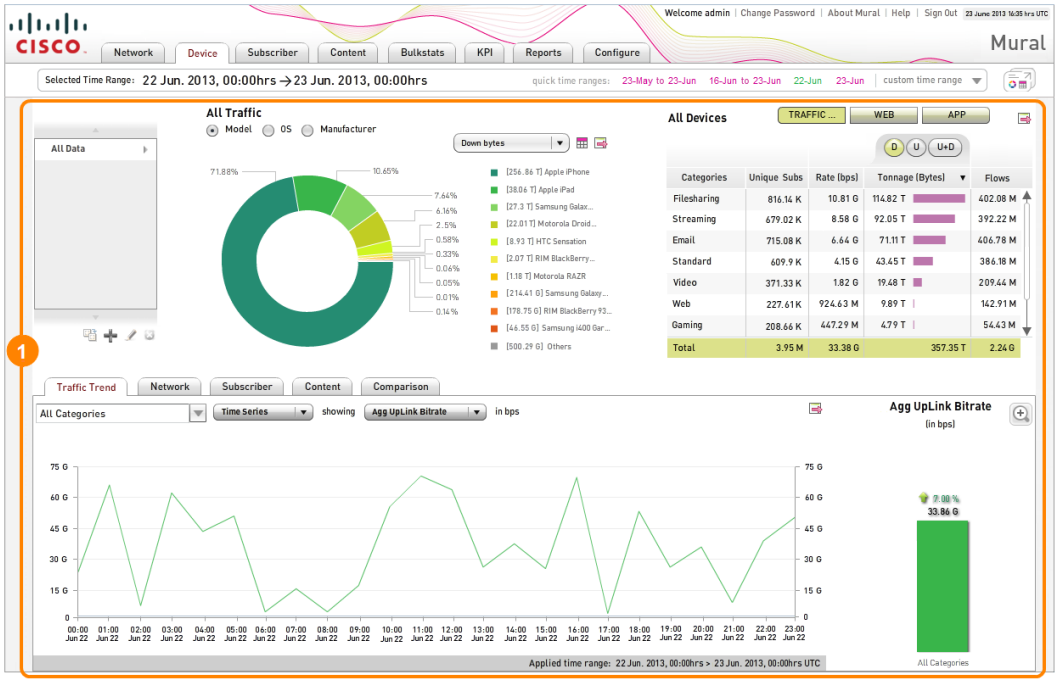


You can sort based on the values in any of the columns. To change columns, click in the column's header bar. The sort icon (▲ or ▼) moves to the new column and the rows are resorted. The increasing-order sort icon (▲) indicates the sort order is smallest to largest, and the decreasing-order sort icon (▼) largest to smallest.

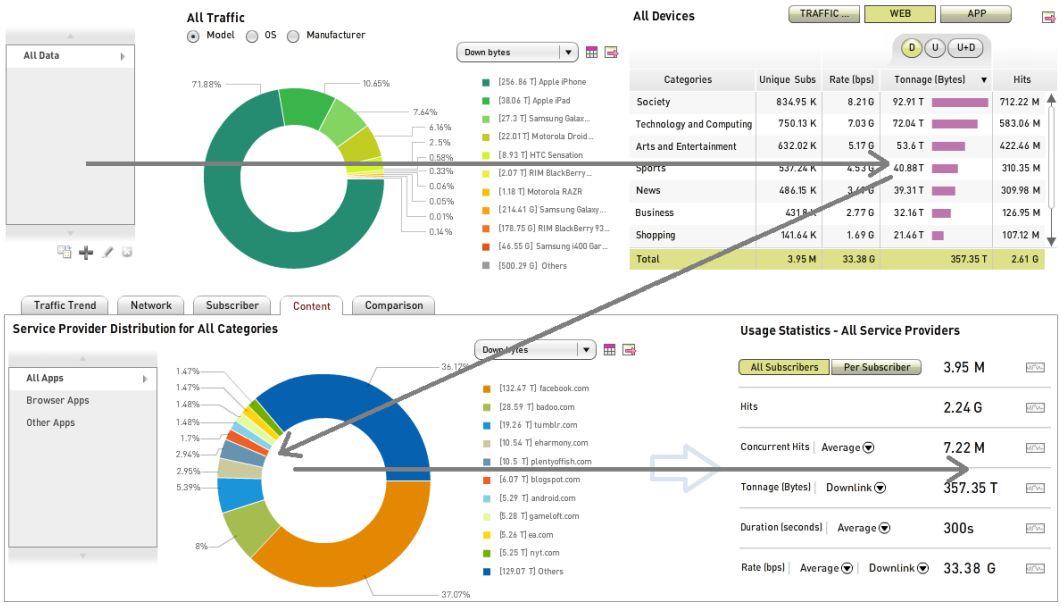
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Performing In-Depth Data Analysis

The main pane on the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL) provides a summary view of distribution data for the category of network entity featured on the tab, along with tools for "drilling down" to more fine-grained analysis of individual entities with respect to the categories on the other tabs. The pane is in box **1** in the following figure.

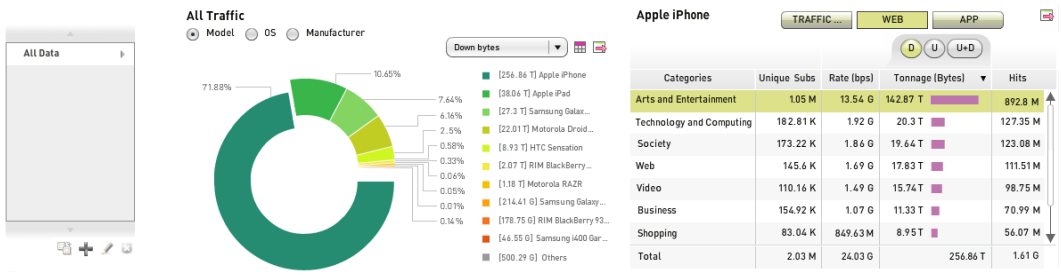


The "flow" from high-level summary data to detailed data in the MURAL main pane creates a Z shape, starting at the filter interface in the upper left corner, proceeding through the charts and tables to its right, then moving down to the charts and graphs on the subtabs in the lower left corner, and ending with the detailed usage statistics on the right side of most subtabs. In the following figure, the **WEB** traffic type has been selected for the categories table and the **Content** subtab opened in the lower half of the tab.



By means of an example, this topic describes how to obtain detailed information about a very specific portion of the traffic on your network.

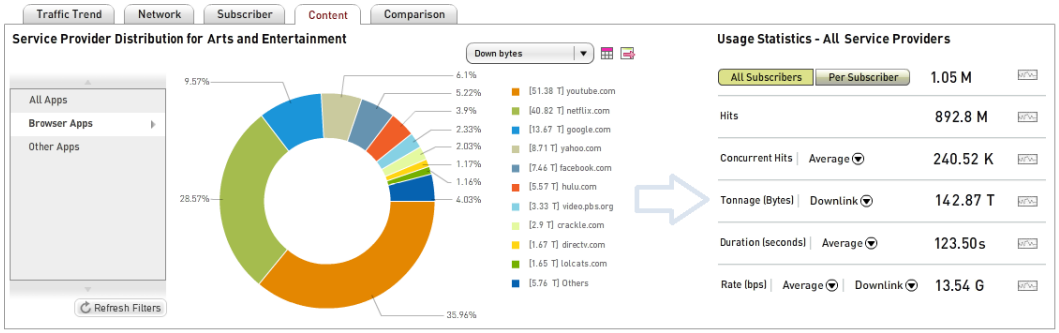
To view data in the categories table for just one of the devices in the doughnut chart, click the wedge for it. The following figure shows the result when the wedge for the Apple iPhone is clicked: the wedge "pops out" from the doughnut, and the title and set of categories in the table changes. By default, the **Total** row is selected, but in the following figure a single category has been clicked and selected—**Arts and Entertainment**, which is the category with the largest number of bytes on the downlink.



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(To switch back to viewing data for all entities in the doughnut chart, click the popped-out wedge.)

The **Content** subtab changes to reflect the change to the categories table above it: it shows data only for the iPhone users accessing data from the **Arts and Entertainment** category. The **Browser Apps** filter is applied, so the tab displays only data that subscribers accessed with a browser. The chart shows the relative proportion of traffic volume on the downlink for the top ten content-provider websites, with an eleventh wedge representing the aggregate of all the others. The **Usage Statistics** table reports multiple statistics aggregated from all websites.



For more information about filters, see "Using Filters to Fine-tune the Reported Data" on page 37.

For more information about doughnut charts and tables of distribution data, see "Analyzing Traffic Distribution" on page 54.

For more information about the **Usage Statistics** table, see "Interpreting Usage Statistics" on page 97.

Exporting Data to a File or the Palette

On the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL), you can save the data presented in most charts and tables to a file, either as text or as images. The charts and tables that you can save have the export icon ( ) in the upper right corner of their display pane.

You can also use the export icon to copy images to the *palette*, which is a pop-up window to which you can store multiple images for visual comparison during the MURAL session.

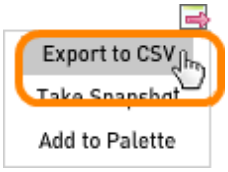
This topic describes the following tasks:

- "Exporting Data to a File as Text" below
- "Exporting an Image to a File" on page 117
- "Exporting an Image to the Palette" on page 119

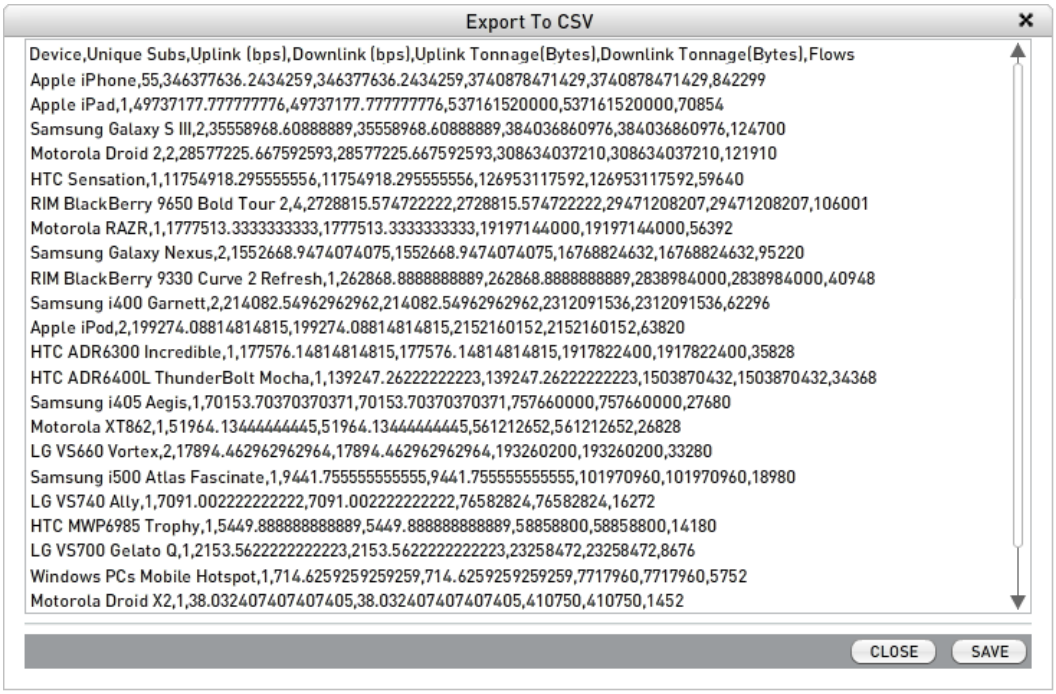
Exporting Data to a File as Text

To export the data in a chart or table as text in comma-separated format (CSV):

1. Click the export icon ( ) in the upper right corner of the display area.
2. Click **Export to CSV** on the menu that pops up.



A new window pops up to display the CSV-formatted text. The example is from the traffic distribution pane on the **Devices** tab.



There are three points to note:

- The values in the first row act as column headers, specifying the type of value in the corresponding position in the following rows (device name in the first field, number of subscribers in the second field, and so on).
- The data includes all entities used to generate the chart or table, not just the ones that are currently visible on the tab. In the current example, the **Export to CSV** window lists more than 20 devices and the complete list is visible by scrolling down. The corresponding doughnut charts shows only eleven wedges (one for each of the top ten devices, plus an eleventh one that aggregates the remaining devices).
- The time range is not recorded in the file. If you want to note it, one possibility is to include it in the filename you choose in the next step.

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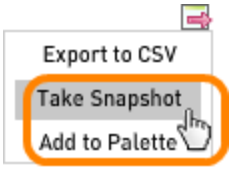
3. To save the data in the window to a file, click the **SAVE** button. In the file system window that pops up, choose the directory location and change the default name (**export.csv**) if desired.

   To close the window without writing the data to a file, click the **CLOSE** button or the close-window icon (✖) on the title bar.

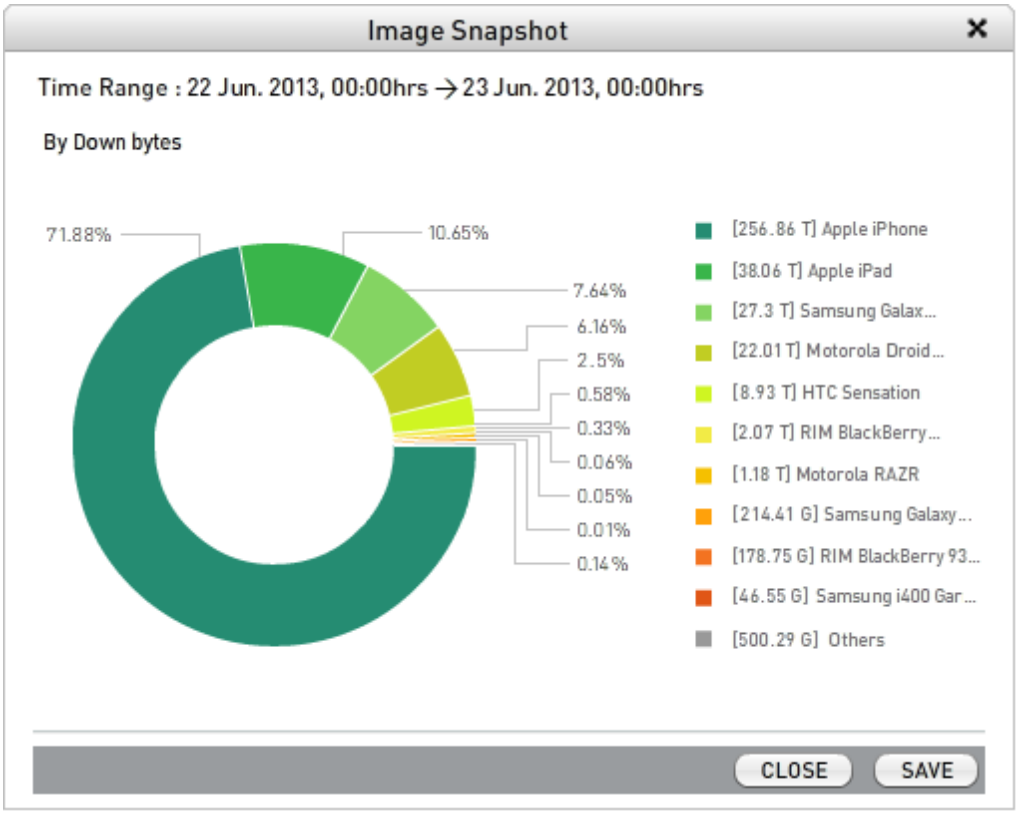
Exporting an Image to a File

To export the image of a chart or table to a file in JPEG format:

1. Click the export icon ( ) in the upper right corner of the display area.
2. Click **Take Snapshot** on the menu that pops up.



A new window pops up and displays the captured image, as in this example of a traffic distribution doughnut chart. The image includes the chart or table from the display area, but not icons (such as the export data icon itself). The time range is added above the chart, along with the current settings of any drop-down menus and selector boxes in the display.



Note: If you save a table as an image, the image includes only the rows that are visible on the tab. If you want to capture all of the data used to generate the table, follow the procedure in "Exporting Data to a File as Text" on page 115.

3. To save the image to a file, click the **SAVE** button. In the file system window that pops up, choose the directory location and change the default name (**snapshot.jpg**) if desired.

   To close the window without writing the data to a file, click the **CLOSE** button or the close-window icon (✖) on the title bar.

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Exporting an Image to the Palette

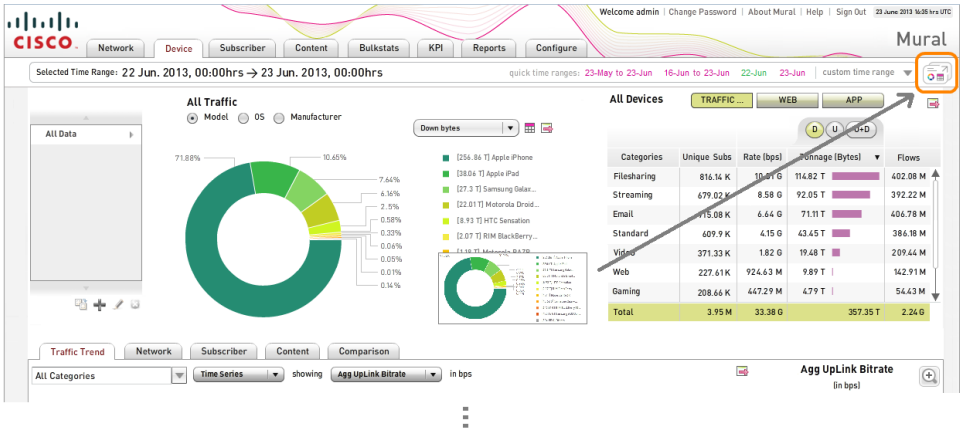
The palette is a pop-up window to which you can save multiple images for visual comparison during the MURAL session. For information about using the palette window, see "Comparing Images on the Palette" on page 121.

To export the image of a chart or table to the palette:

1. Click the export icon () in the upper right corner of the display area.
2. Click **Add to Palette** on the menu that pops up.



A small version of the image appears and floats quickly across the screen to the palette icon, which is enclosed in the orange box in the following figure.



Comparing Images on the Palette

On the **Network**, **Device**, **Subscriber**, and **Content** tabs in Mobility Unified Reporting and Analytics (MURAL), you can save most charts and tables to the *palette*, a pop-up window where you can store and compare multiple images during the session. The charts and tables you can save to the palette have the export icon ( ) in the upper right corner of their display area.

This topic describes the following tasks:

- "Exporting Images to the Palette" below
- "Accessing the Palette and Comparing Images" on the next page
- "Attaching an Annotation to an Image" on page 123
- "Clearing Images from the Palette" on page 124
- "Saving the Contents of the Palette to a File" on page 125
- "Closing the Palette Window" on page 126

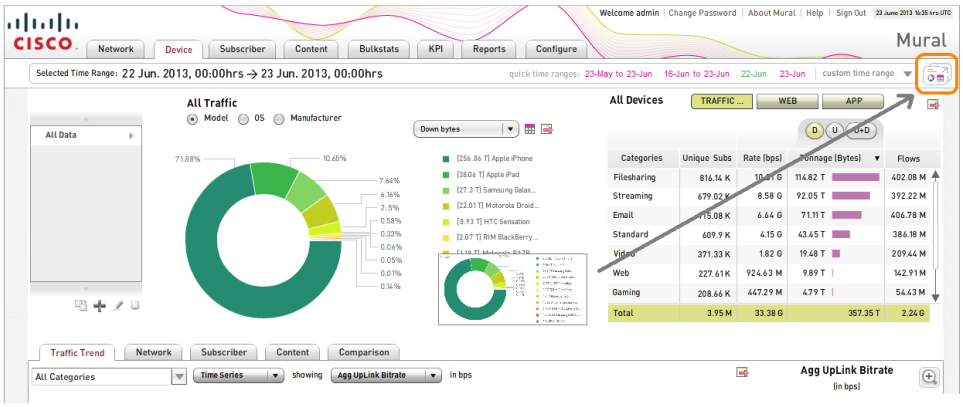
Exporting Images to the Palette

To export the image of a chart or table to the palette:

1. Click the export icon ( ) in the upper right corner of the display area.
2. Click **Add to Palette** on the menu that pops up.

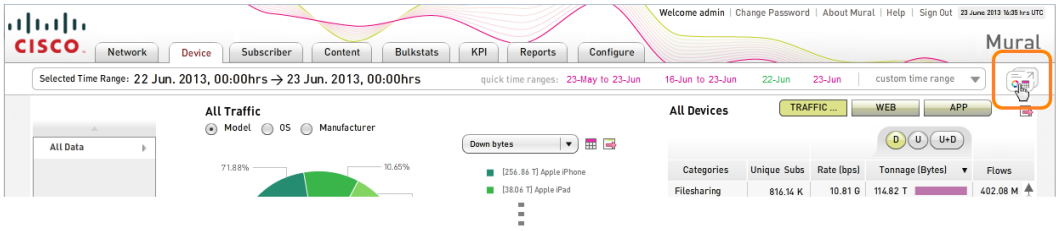


A small version of the image appears and floats quickly across the screen to the palette icon, which is enclosed in the orange box in the following figure.



Accessing the Palette and Comparing Images

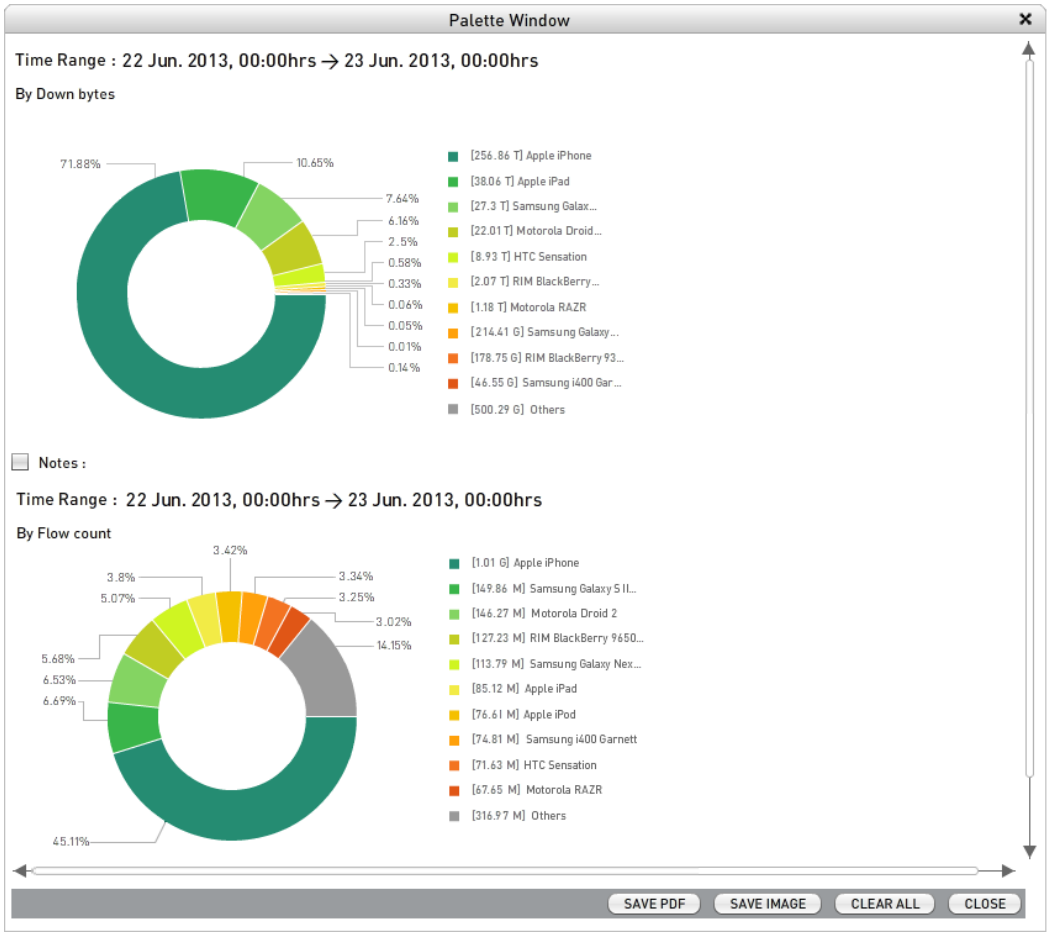
To open the palette window, click on the palette icon, which is in the upper right corner of the tab.



The palette window pops up. If there are no images on the palette, a set of instructions appears in the window.

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The following sample palette window shows two doughnut charts of the traffic distribution across devices during the same 24-hour period. The upper chart ranks devices by the amount of data downloaded and the lower chart by the number of flows. Two notable differences between the charts are that the Apple iPhone accounts for nearly three-quarters of the downloaded data but a much smaller proportion of the number of flows, and the Apple iPad ranks second in downloads but sixth in flows.



Attaching an Annotation to an Image

To attach an annotation to an image, click the **Notes** check box below the image and type into the box that appears. To erase a note, click the **Notes** check box again to remove the check.

When you save the contents of the palette as described in "Saving the Contents of the Palette to a File" on the facing page, notes are included along with the associated image, but for images without a note the empty **Notes:** field does not appear in the file.

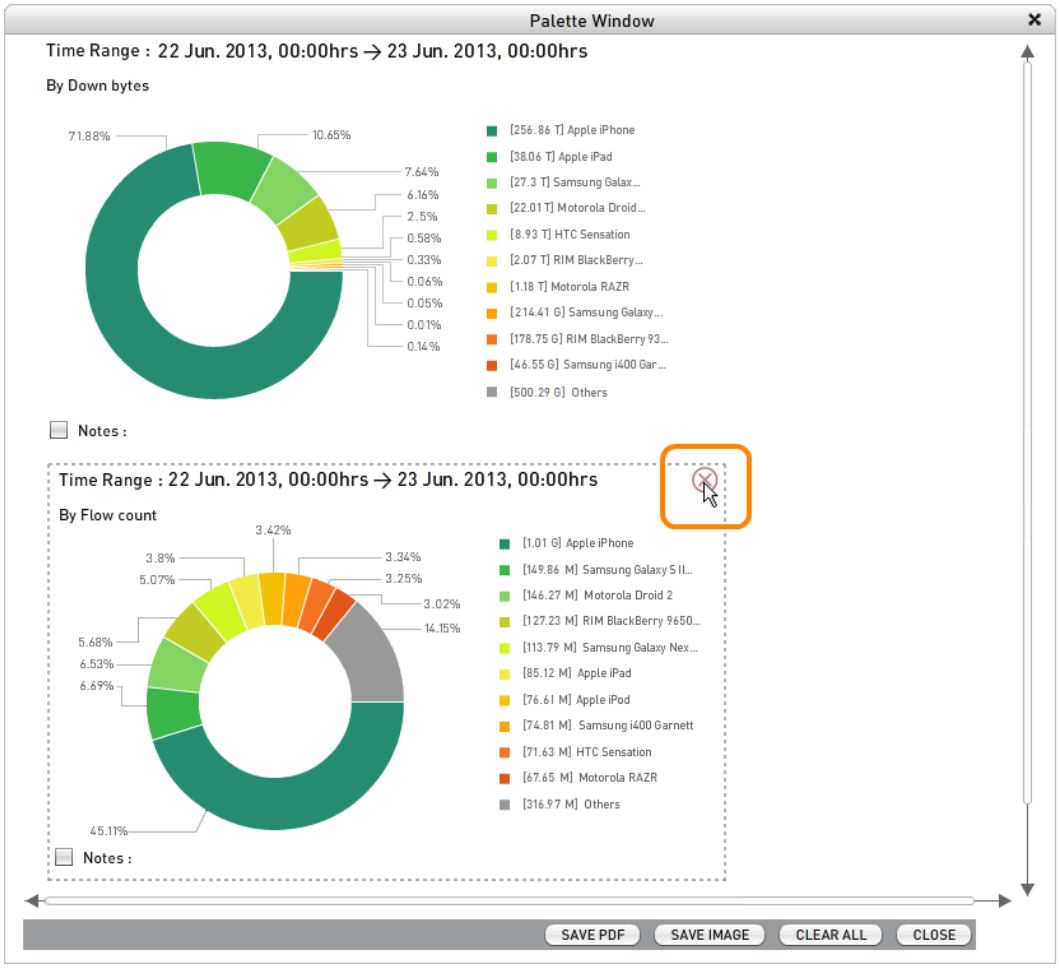
Clearing Images from the Palette

The contents of the palette are retained for the duration of the current MURAL session—you do not have to take action to save changes before closing the palette window. But you can erase images if you no longer need them.

To erase the entire contents of the palette, click the **CLEAR ALL** button at the bottom of the window.

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To remove an individual image from the palette (and associated note, if any), mouse over it. A dashed-line box appears around it, as shown on the lower image in the following figure. Click the clear-image ( ) icon in the upper right corner of the box. The image is erased and any images below it move up in the window.



Saving the Contents of the Palette to a File

As previously noted, the contents of the palette are retained for the duration of the current MURAL session, but discarded when it ends. You can save the contents to a file for later analysis.

To save the contents to a PDF file (one image per page), click the **SAVE PDF** button. In the file system window that pops up, choose the directory location and change the default name (**snapshot.pdf**) if desired.

To save the contents to a file as a single image in JPEG format, click the **SAVE IMAGE** button. In the file system window that pops up, choose the directory location and change the default name (**snapshot.jpg**) if desired.

Closing the Palette Window

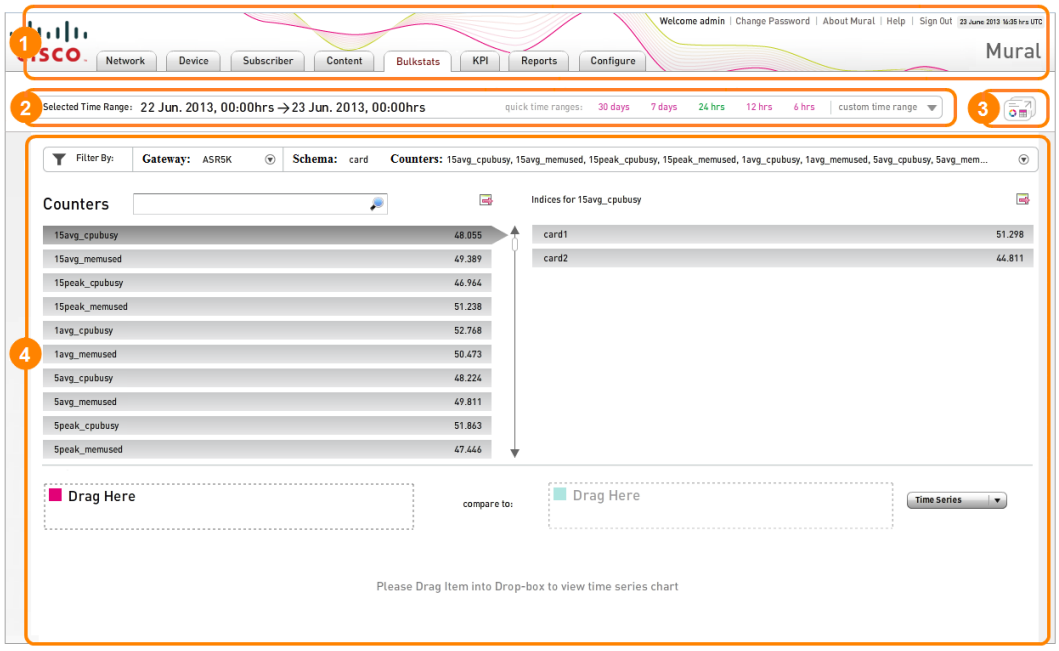
The main MURAL window is not accessible while the palette window is open. To close the window, click the **CLOSE** button at the bottom or the close-window icon (✖) in the title bar.

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Interpreting Performance Statistics for the ASR 5000

The **Bulkstats** tab in Mobility Unified Reporting and Analytics (MURAL) reports performance statistics for a specified Cisco ASR 5000 system. MURAL refers to the statistics as *counters* and groups them functionally into collections called *schemata*. For example, the **card** schema collects together statistics about the line cards in the ASR 5000 chassis and the **gprs** schema collects together statistics about General Packet Radio Service. This topic does not explain the meaning of the counters; see the *Cisco ASR 5000 Series Statistics and Counters Reference*.

The **Bulkstats** tab is divided functionally into several panes, numbered **1** through **4** in the following figure.



The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Bulkstats** to access the **Bulkstats** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing

the Main Tabs and Controlling the Session" on page 25.

2. Time range selector—Reports and sets the period of time for which data is reported on the tab. See "Setting the Time Range for Displayed Data" on page 29.
3. Palette icon—Opens the palette, which is a pop-up window where you can store and compare multiple images during the MURAL session. See "Comparing Images on the Palette" on page 121.
4. Display pane—In the upper half of the pane, reports values for counters from the selected gateway and schema. In the lower half, provides an interface for comparing hourly values for two counters. See the following sections:
    - "Interpreting the Bulkstats Display" below
    - "Displaying the List of Counters" on page 130
    - "Comparing Two Counters" on page 132
    - "Selecting the Gateway" on page 136
    - "Selecting the Schema" on page 138
    - "Displaying a Subset of Counters" on page 140

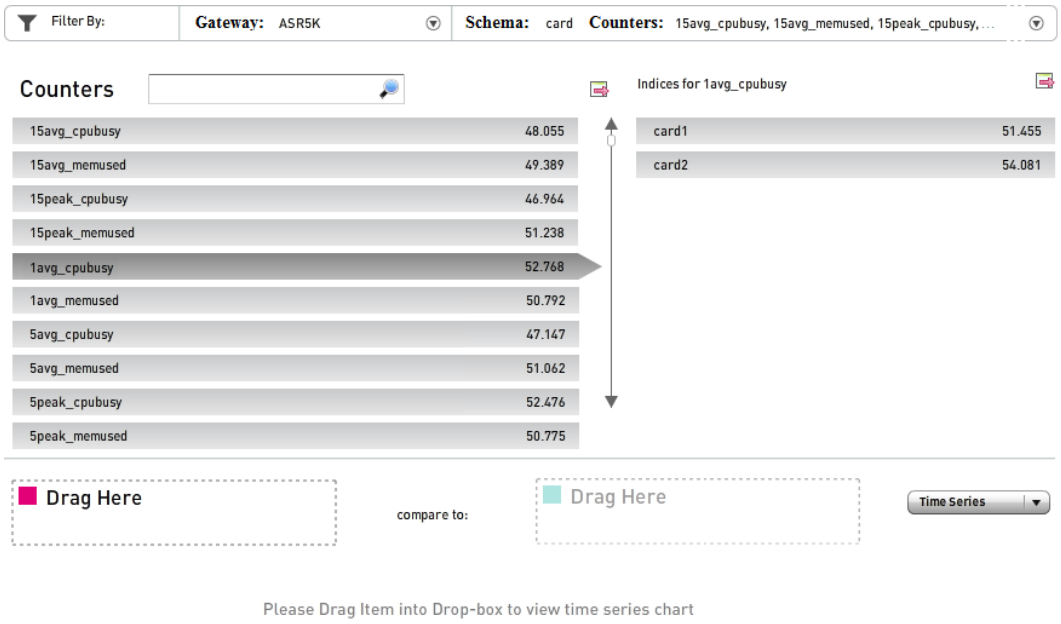
Interpreting the Bulkstats Display

The upper half of the main display pane on the **Bulkstats** tab reports values for counters from the currently selected schema on the currently selected gateway (individual ASR 5000 system). If values are not available for a schema, the words **No data available** appear in both halves of the pane.

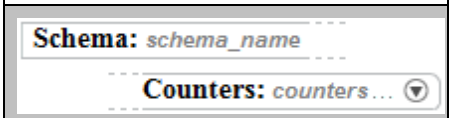
The following example is for the **ASR5K** gateway and **card** schema. The **1avg_cpubusy** counter is selected and its aggregated value for **ASR5K** is 52.768. The right half of the pane reports the value of **1avg_cpubusy** for the two entities in **ASR5K** to which the **card** schema applies (51.455 for **card1** and 54.081 for **card2**).

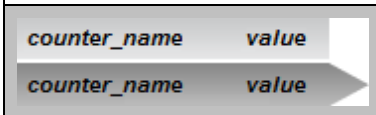
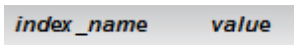
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The lower half of the pane is an interface for visually comparing the hourly values of two counters as they change over the course of the selected time range. For instructions on using the interface, see "Comparing Two Counters" on page 132.



The following table describes the elements in the pane.

Element	Description
	Names and sets the ASR 5000 for which counters are displayed. See "Selecting the Gateway" on page 136.
	Names and sets the schema from which counters are displayed and lists the counter names in alphabetical order. You can optionally display a subset of the counters from the schema. See "Selecting the Schema" on page 138 and "Displaying a Subset of Counters" on page 140.
	Displays only counters whose names include (in any position) the string of characters you type in the box. See "Displaying Only Counters that Match a Search String" on page 141.

Element	Description
	Copies the data in the pane to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.
Indices for *counter_name*	Specifies the counter being displayed in the right half of the pane for each entity to which the schema applies. If the schema applies to only one entity, this header reads No Indices for *counter_name* and the words No data available appear in the pane below it.
	Names each counter displayed in the left half of the pane and specifies its value. The counter with darker shading and a point at the right end is currently selected.
	Names each entity displayed in the right half of the pane and specifies the value for it of the counter named in the Indices for *counter_name* header.
	Names and sets the two counters or entities for which hourly values appear in the lower half of the pane. See "Comparing Two Counters" on page 132.
	Removes the right-hand (■) counter or entity from the display in the lower half of the pane. (The icon appears only when the ■ field has a value in it.) See "Comparing Two Counters" on page 132.
	Indicates and sets the type of chart displayed in the lower half of the pane (time-series line chart or bar chart for the hour interval with the highest counter value). See "Comparing Two Counters" on page 132.

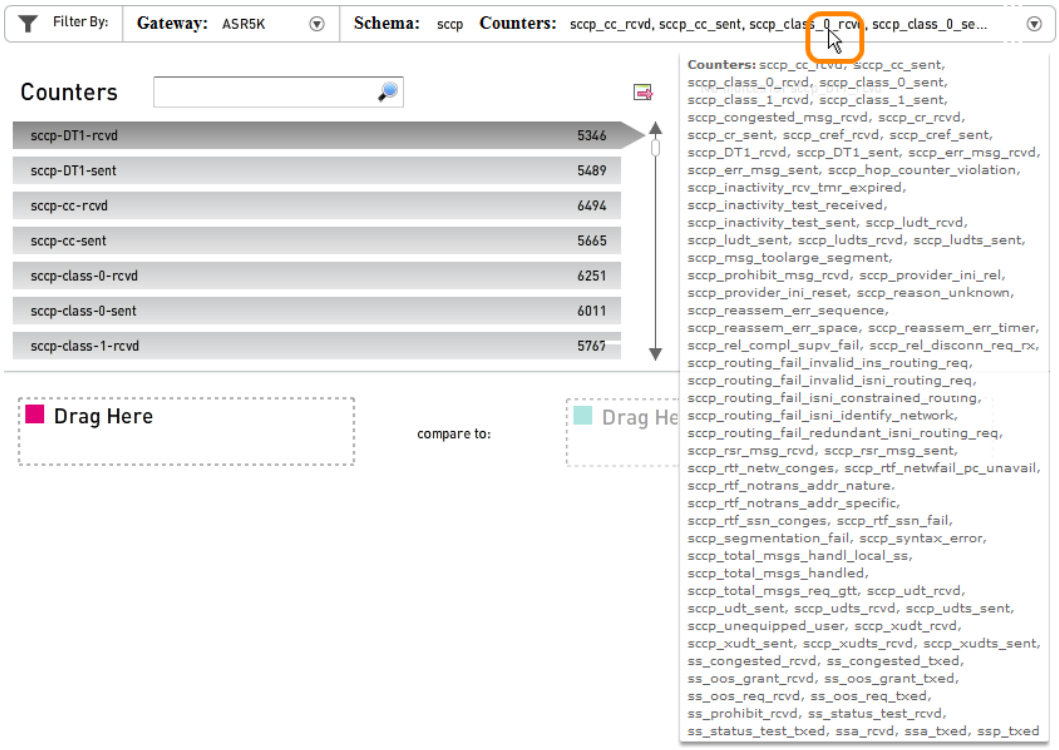
Displaying the List of Counters

The **Counters** field at the top of the **Bulkstats** pane lists as many of the currently displayed counters as fit in the field width. Names that start with a numeral are listed first, followed by names in alphabetical order.



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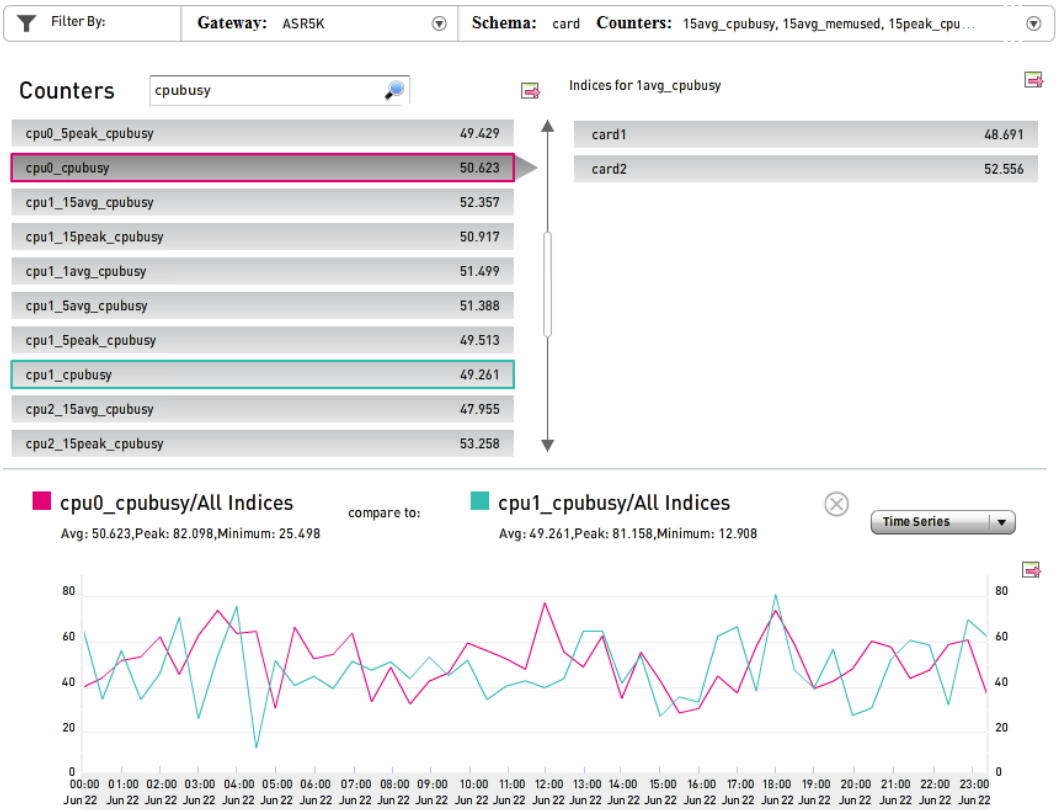
To display the complete list of currently displayed counters, mouse over the **Counters** field, as in this example for the **sccp** schema.



You can also view the complete list of available counters in the **Select Counter** window, as described in "Specifying a Subset of Counters During Schema Selection" on page 140, but in that interface they are not all visible at once.

Comparing Two Counters

In the lower half of the main display pane, you can visually compare hourly values for two counters as they change over the course of the selected time range. In the following example, activity is compared for two CPUs: the **cpu0_cpubusy** counter appears in magenta and the **cpu1_cpubusy** counter in turquoise.



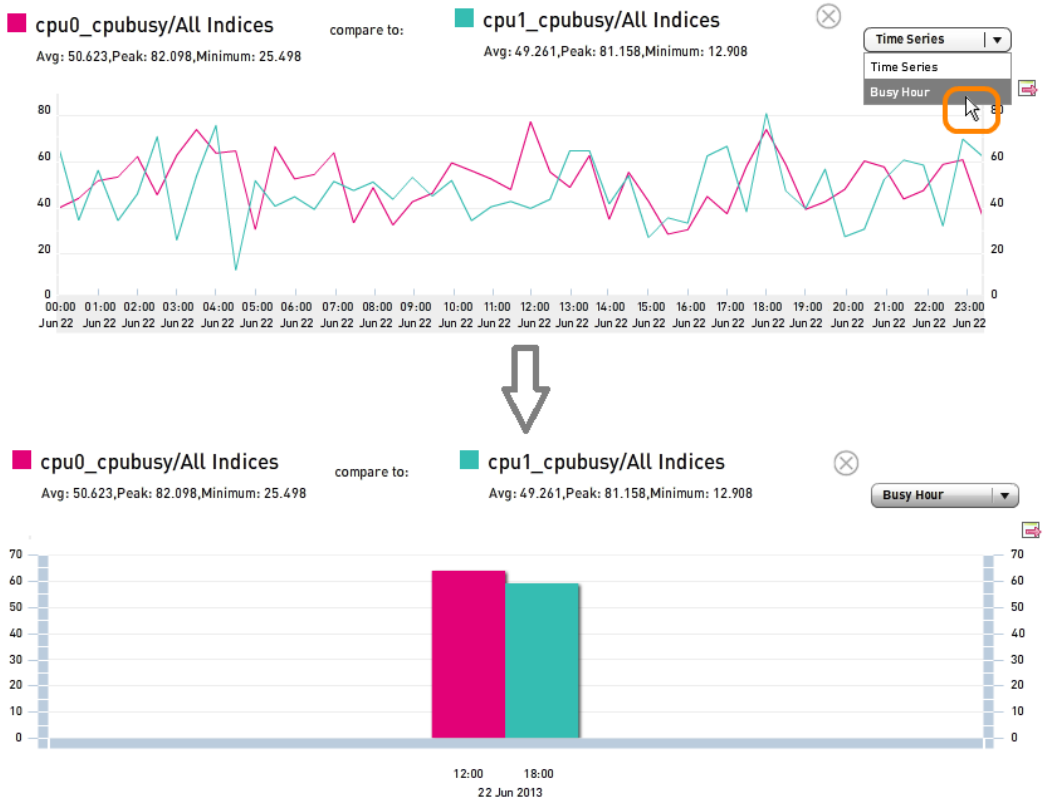
The names of the counters appear in two locations:

- In the counters list in the upper left part of the pane, enclosed in boxes colored to match the lines in the chart. The boxed counters are not necessarily always visible, for example if you scroll to a different part of the counters list.

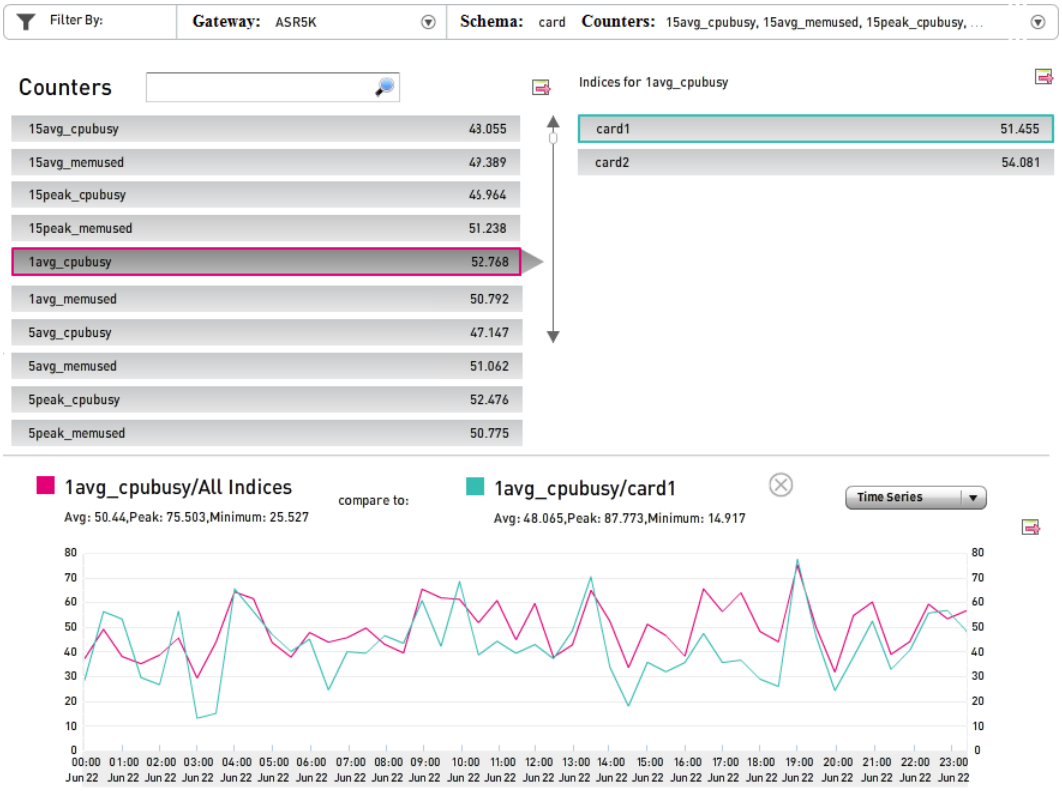
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- In the legend above the line chart, which also reports the average, peak (highest), and minimum (lowest) hourly values that occurred during the selected time range. The words **All Indices** following the counter name indicate that the values in the chart are aggregates for all entities to which the schema applies (in the example, **card1** and **card2**).

To display the hour in which the highest value occurred for both counters during the selected time range, click the **Time Series** drop-down menu button and select **Busy Hour** from the drop-down menu. In the following example, the highest average value occurred between 11:00 and 12:00 hours for the **cpu0_cpubusy** counter and between 17:00 and 18:00 hours for the **cpu1_cpubusy** counter.



You can compare any two counters from the left and right halves of the pane (the left-hand values being aggregates and the right-hand values being individual entities to which the schema applies). In the following example, the aggregated value of the **1avg_cpubusy** counter (selected in the left column and displayed in magenta) is compared to the counter's value for **card1** (selected in the right column and displayed in turquoise).

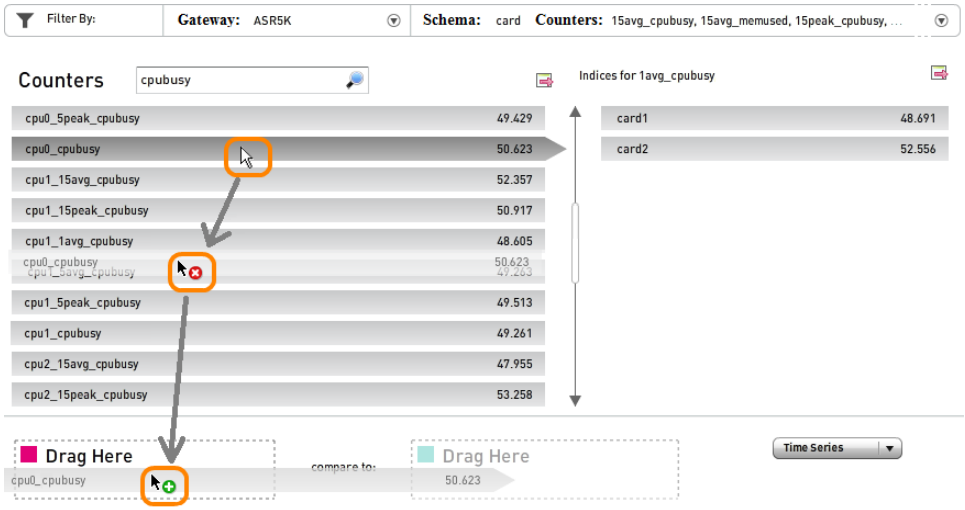


To specify the two counters to compare, perform the following steps.

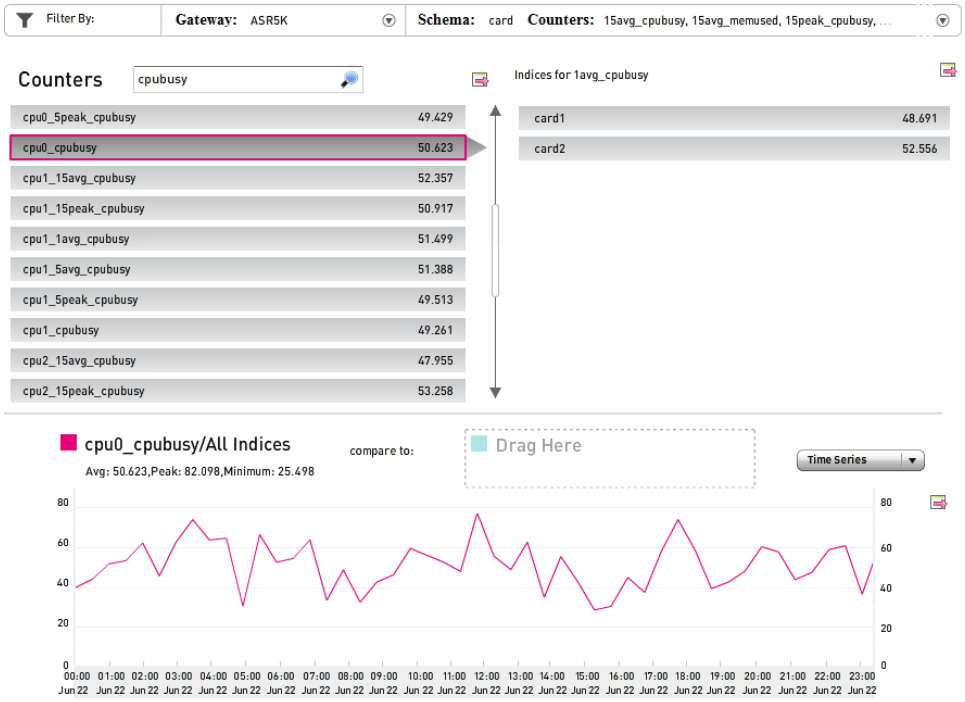
1. Navigate to the first counter, using the search box and scroll bar as necessary to make it easier to locate. In the figure shown in the next step, the string **cpubusy** has been typed in the search box. This makes the list of counters shorter, but it is still necessary to scroll down to make the **cpu0_cpubusy** counter visible in the pane.

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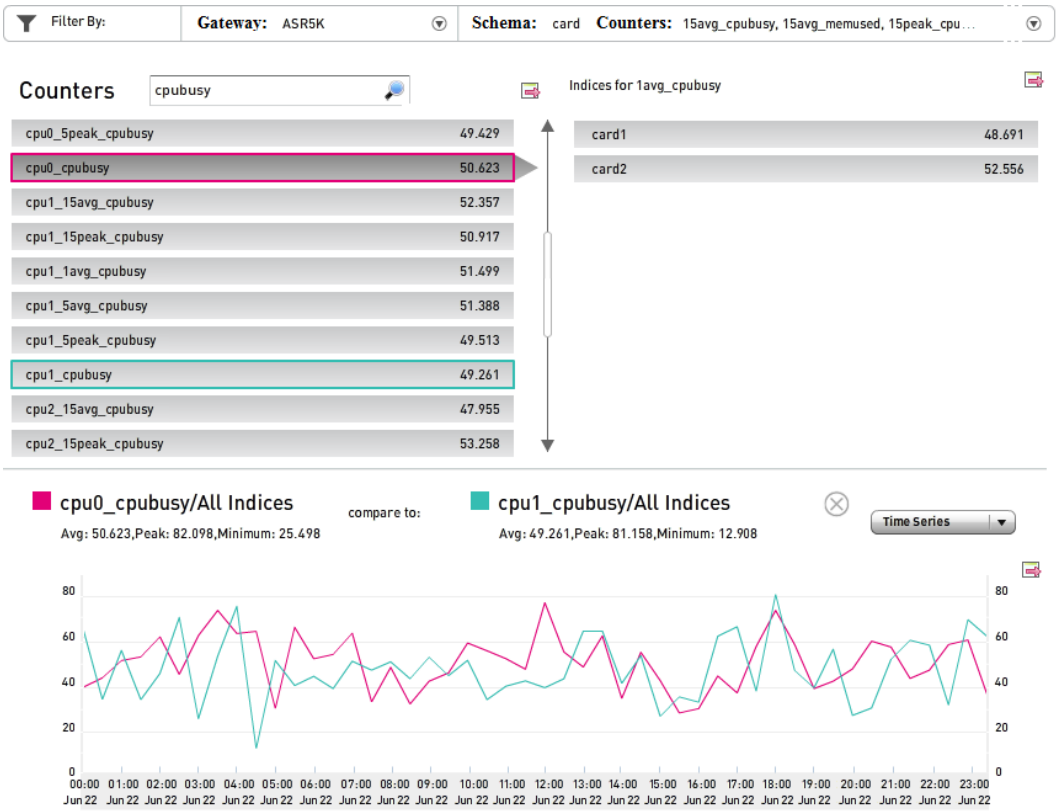
2. Click and hold down the mouse button on the counter as you drag it into the box in the lower left pane labeled **Drag Here** with the magenta square (■). As soon as you start to move the cursor, it changes to a black arrow with a red-X icon (⊗) next to it. When you reach the box and the icon changes to the green-cross icon (⊕), release the mouse button.



The figure shows how a time-series line chart appears with hourly values for the first counter.



3. Repeat Steps 1 and 2 for the second counter, dragging it into the box labeled **Drag Here** with the turquoise square ( ) in the lower right pane. The following figure depicts the resulting chart with the second counter, **cpu1_cpubusy**, added.



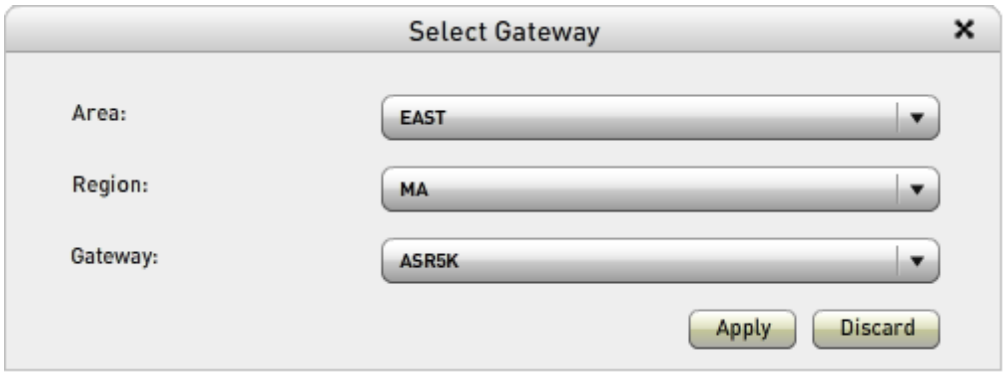
Selecting the Gateway

To select the gateway for which information appears in the main pane, click the open-window icon (⊙) at the right end of the **Gateway** field.



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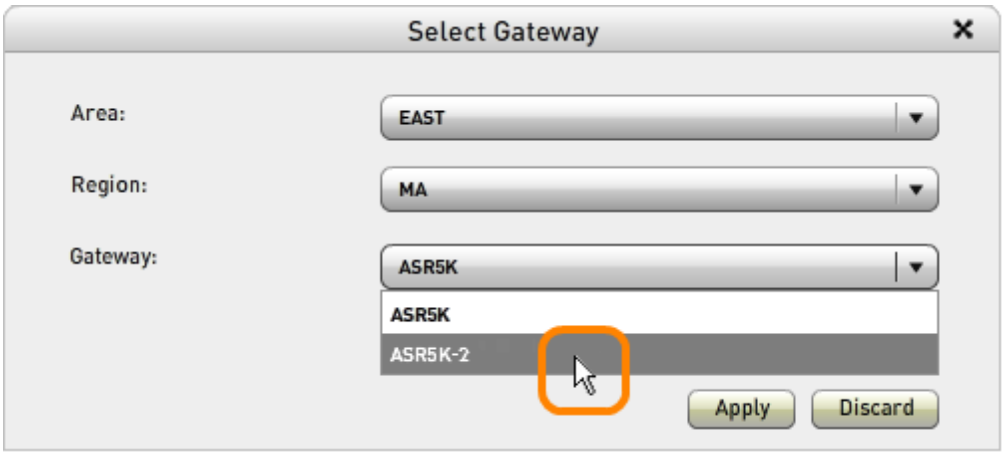
The **Select Gateway** window pops up to report the currently selected values for the gateway, as in the following example for a gateway called **ASR5K** in Massachusetts.



The choices available on the **Area**, **Region**, and **Gateway** drop-down menus are defined by your system administrator during initial MURAL configuration. In the usual configuration, they correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices for **Area** might be regions like **EAST** and **SOUTH**, the choices for **Region** the states in which network equipment is located, and the choices for **Gateway** individual ASR 5000 systems.

Note: Although the field names **Area** and **Region** are also used in the **Network** category of the filter interface on the **Network**, **Device**, **Subscriber**, and **Content** tabs, and the available values might be the same, the two interfaces do not function exactly the same way. In the filter interface, you can specify multiple values in multiple fields. In the **Select Gateway** window, you are specifying a single gateway and the choices available in the **Gateway** field depend on the settings in the two fields above it. If the desired gateway is not listed, you must change the value in one or both of the **Area** and **Region** fields to the value that applies to the gateway.

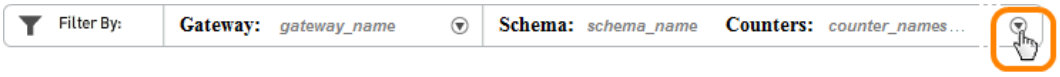
To select a different value on a drop-down menu, click the menu button and then your choice in the menu. In the following example, the **ASR5K-2** gateway is being selected.



To change to the new gateway, click the **Apply** button. To close the **Select Gateway** window without changing the current gateway, click the **Discard** button or the close-window icon (✖) in the window's title bar.

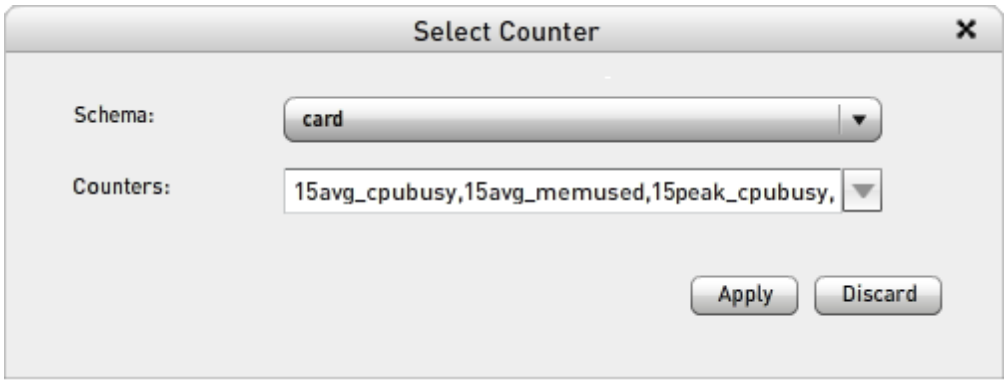
Selecting the Schema

To select the schema from which counters are reported, and optionally display only a subset of counters, click the open-window icon (⊙) at the right end of the **Schema** field.

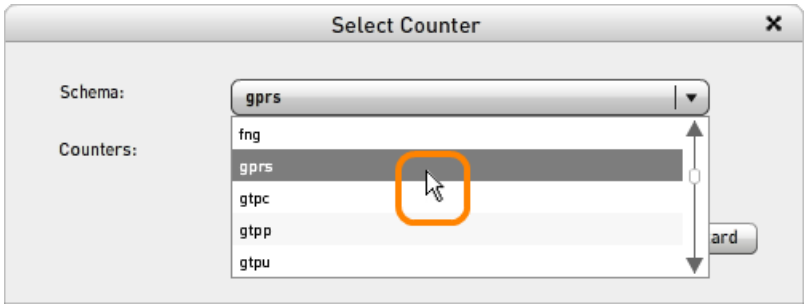


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The **Select Counter** window pops up to report the currently selected schema and the first few counters from the schema that are currently selected for inclusion in the pane, as in the following example for the **card** schema.



To select a different schema, click the **Schema** menu button and then your choice in the menu that drops down. Several dozen schemata are usually available; to navigate to the one you want, you can type a letter to jump down to the first counter whose name begins with it, use the scroll bar, or both. In the following example, the **gprs** schema is being selected.



After selecting the new schema, you can optionally select a subset of counters to display; for instructions, see "Specifying a Subset of Counters During Schema Selection" on the next page.

When you have finished your selections, click the **Apply** button. The new schema and set of counters appear in the pane. To close the **Select Counter** window without changing the current schema, click the **Discard** button or the close-window icon (✖) in the window's title bar.

Displaying a Subset of Counters

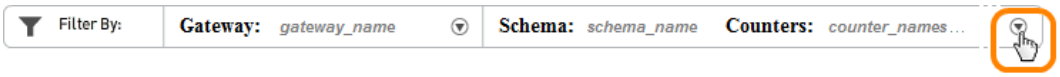
There are two ways to display only a subset of the counters from a schema, as explained in the following sections:

- "Specifying a Subset of Counters During Schema Selection" below
- "Displaying Only Counters that Match a Search String" on the facing page

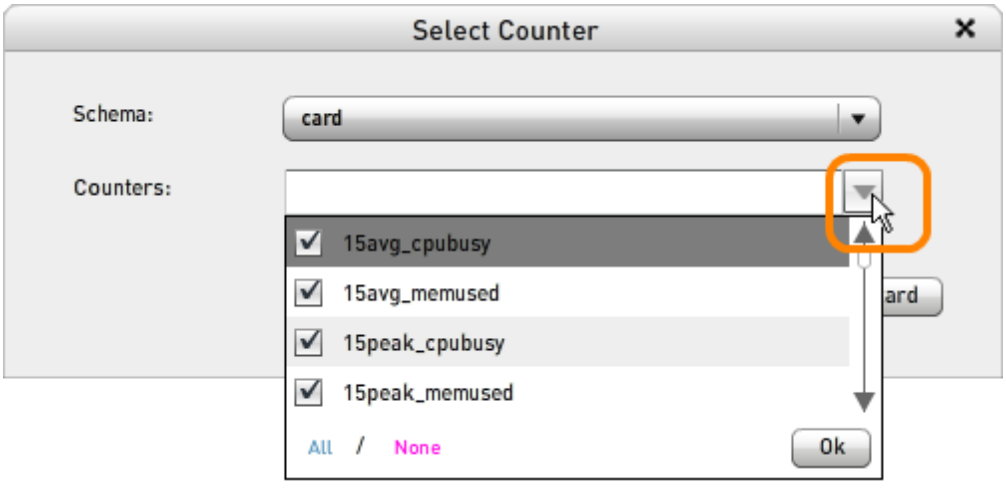
Specifying a Subset of Counters During Schema Selection

To specify that only a subset of the counters in a schema be displayed, perform the following steps:

1. If the **Select Counter** pop-up window is not already open, click the open-window icon ( ) at the right end of the **Schema** field.



2. In the **Select Counter** window, click the open-menu icon ( ) on the **Counters** drop-down menu box to expose the list of counters. (Counter names that begin with numerals appear first, followed by names in alphabetical order.)



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When the menu drops down, all values are checked, which selects them for inclusion in the display.

- To exclude a counter, click its check box to remove the check.
- To remove the check from all boxes, click None. (If there are a large number of counters and you want to display only a few of them, it is most efficient to deselect all of them this way and then check your selections.)
- To include all counters, click All.
- To finalize the list of counters to display and close the drop-down menu, click the **Ok** button. The selected values appear as a comma-separated list in the menu box.

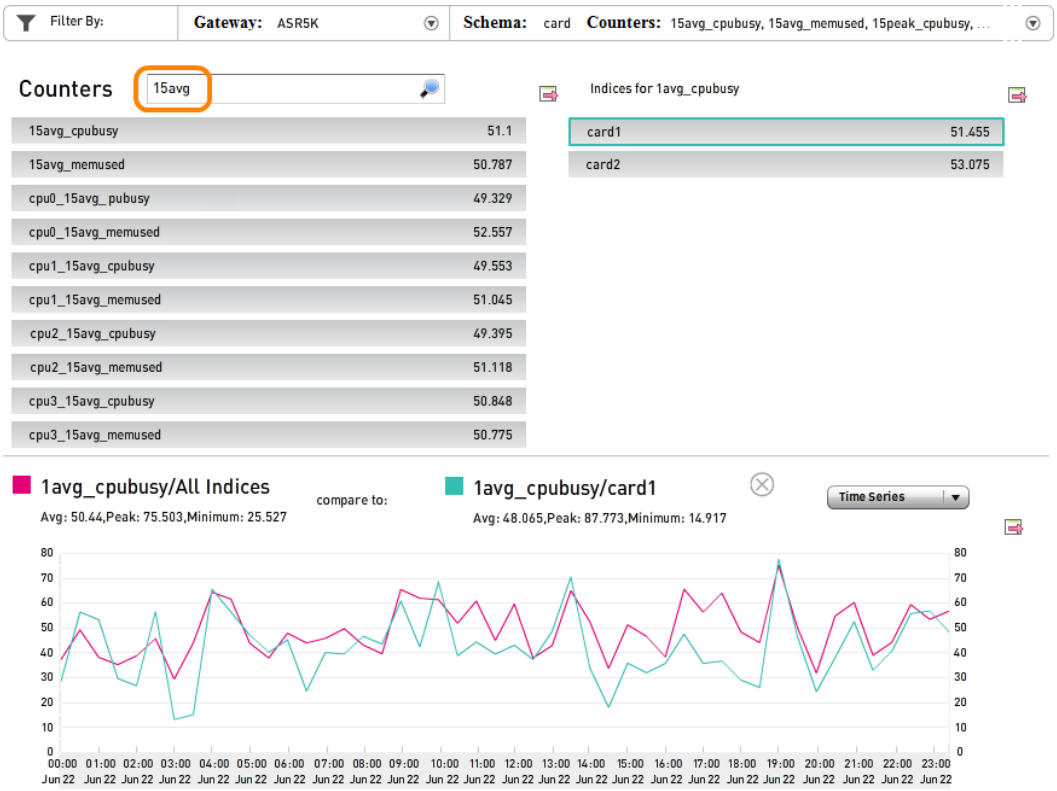
  Note: The **Ok** button is nonoperational if no counters are checked. You must check at least one.

3. To display the new set of counters, click the **Apply** button. To close the **Select Counter** window without changing the current set of counters, click the **Discard** button or the close-window icon (✖) in the window's title bar.

Displaying Only Counters that Match a Search String

To limit the list of counters in the left half of the upper pane to only those that have a certain character string in their names (in any position), type the characters in the **Counters** search box above the list. The list is updated immediately as you type each character. If no counters match the search string, the list disappears completely. You can also use this interface to search for particular counter names.

In the following example, the search string **15avg** limits the list to only the ten counters that report measurements averaged over a 15-minute interval. All ten counters fit in the display pane, so the scroll bar no longer appears to the right of the list.



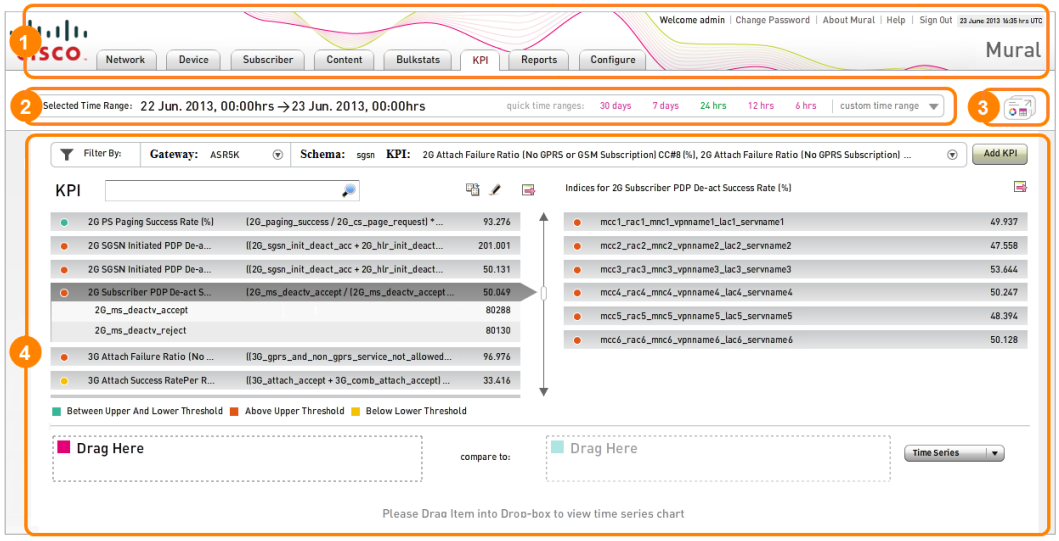
The figure illustrates how limiting the list to matching counter names does not change other aspects of the display pane, which is taken from the second example in "Comparing Two Counters" on page 132. The counter that was selected before the search (**1avg_cpubusy**) is still selected; it does not appear in the list because it does not match the search string. Similarly, the right half of the upper pane still reports the value of **1avg_cpubusy** for the two cards in the chassis. The lower half of the pane still tracks the aggregate value of the **1avg_cpubusy** counter against the value for **card1**.

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Interpreting Key Performance Indicators from the ASR 5000

The **KPI** tab in Mobility Unified Reporting and Analytics (MURAL) reports key performance indicators (KPIs) from the Cisco ASR 5000. KPIs are formulas that operate on the statistics generated by the ASR 5000 (which are reported individually on the **Bulkstats** tab as described in "Interpreting Performance Statistics for the ASR 5000" on page 127). MURAL refers to the statistics as *counters* and groups them functionally into collections called *schemata*. For example, the **apn** schema collects together statistics about access point names (APNs) and the **port** schema collects together statistics about ports on line cards. This topic does not explain the meaning of the counters; see the *Cisco ASR 5000 Series Statistics and Counters Reference*.

The **KPI** tab is divided functionally into several panes, numbered **1** through **4** in the following figure.



1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **KPI** to access the **KPI** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing the Main Tabs and Controlling the Session" on page 25.

2. Time range selector—Reports and sets the period of time for which data is reported on the tab. See "Setting the Time Range for Displayed Data" on page 29.
3. Palette icon—Opens the palette, which is a pop-up window where you can store and compare multiple images during the MURAL session. See "Comparing Images on the Palette" on page 121.
4. Display pane—In the upper half of the pane, reports values for KPIs and counters from the selected gateway and schema, and provides an interface for creating new KPIs. In the lower half, provides an interface for comparing hourly values for two KPIs or counters. See the following sections:
    - "Interpreting the KPI Display" below
    - "Displaying the List of KPIs" on page 148
    - "Comparing Hourly Values for Two KPIs or Counters" on page 148
    - "Selecting the Gateway" on page 152
    - "Selecting the Schema" on page 154
    - "Displaying a Subset of KPIs" on page 155
    - "Defining New KPIs" on page 157
    - "Cloning and Editing KPIs" on page 162

Interpreting the KPI Display

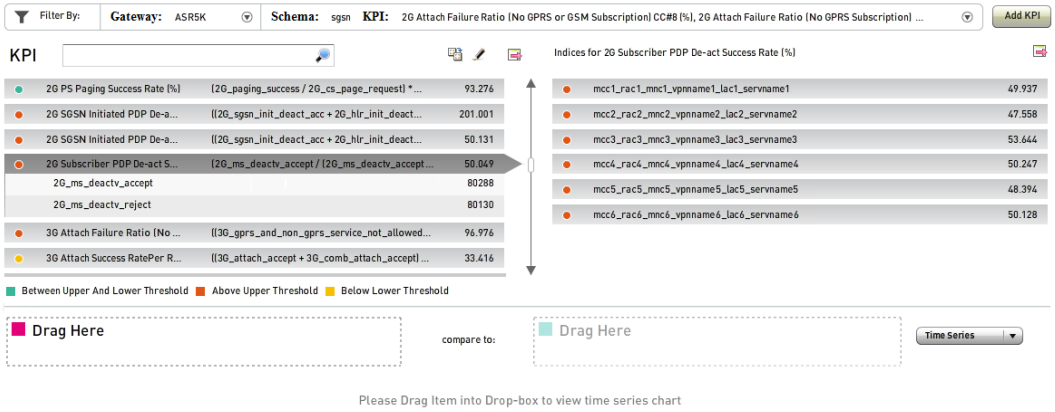
The upper half of the main display pane on the **KPI** tab reports values for KPIs and their component counters from the currently selected schema on the currently selected gateway (individual ASR 5000 system). If values are not available for a schema, the words **No data available** appear in both halves of the pane.

The following example is for the **ASR5K** gateway and **sgsn** schema. The KPI called **2G Subscriber PDP De-act Success Rate (%)** is selected and its aggregated value for gateway **ASR5K** is 50.049. The two counters in its formula are **2G_ms_deactv_accept** with a value of 80288 and **2G_ms_deactv_reject** with a value of 80130. The right half of the pane reports the KPI's value for the six entities to which the **sgsn** schema applies (**mcc1_rac1_**

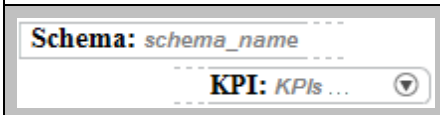
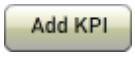
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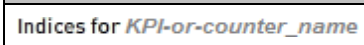
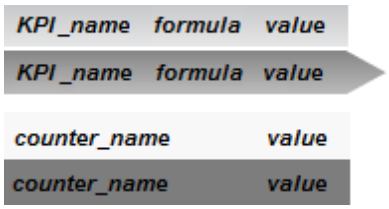
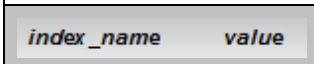
mnc1_vpnname1_lac1_servname1 through **mcc6_rac6_mnc6_vpnname6_lac6_servname6**).

The lower half of the pane is an interface for visually comparing the values of two KPIs or counters on an hourly basis as they change over the course of the selected time range. For instructions on its use, see "Comparing Hourly Values for Two KPIs or Counters" on page 148.



The following table describes the elements in the pane.

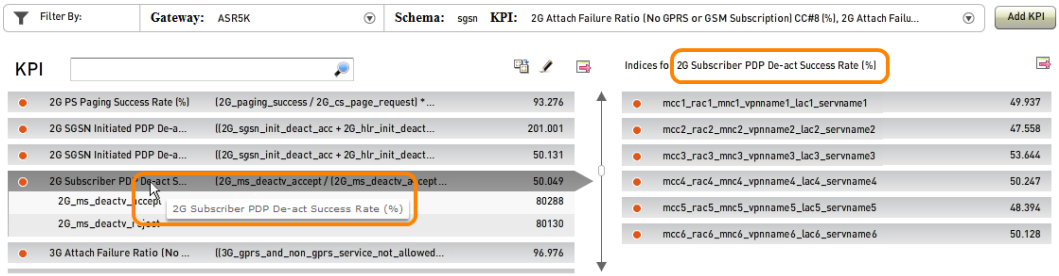
Element	Description
	Names and sets the ASR 5000 for which KPIs are displayed. See "Selecting the Gateway" on page 152.
	Names and sets the schema from which KPIs are displayed and lists the KPI names in alphabetical order. You can optionally display a subset of the KPIs from a schema. See "Selecting the Schema" on page 154 and "Specifying a Subset of KPIs During Schema Selection" on page 155.
	Opens the interface for creating new KPIs. See "Defining New KPIs" on page 157.
	Displays only KPIs whose names include (in any position) the string of characters you type in the box. (This interface cannot be used to search for counter names in KPI formulas.) See "Displaying Only KPIs that Match a Search String" on page 156.

Element	Description
	Clones or edits the selected KPI. See "Cloning and Editing KPIs" on page 162.
	Copies the data in the pane to a file or the palette. See "Exporting Data to a File or the Palette" on page 115.
	Specifies the KPI or counter being displayed in the right half of the pane for each entity to which the schema applies. If the schema applies to only one entity, this header reads  and the words  appear in the pane below it.
	Indicates whether the value of the KPI is between its upper and lower thresholds (), above its upper threshold (), or below its lower threshold (). The legend below the list of KPIs specifies the meaning of the colors.
	Names each KPI displayed in the left half of the pane, defines its formula, and specifies its value during the selected time range. The KPI with darker shading and a point at the right end is currently selected. When a KPI is selected, rows open below it to report the values of the counters in its formula. If a counter is selected, its row becomes dark gray (the KPI remains selected as well).
	Names each entity displayed in the right half of the pane and specifies the value for it of the KPI or counter named in the  header.
	Names and sets the two KPIs, counters, or entities for which hourly values appear in the lower half of the pane. See "Comparing Hourly Values for Two KPIs or Counters" on page 148.

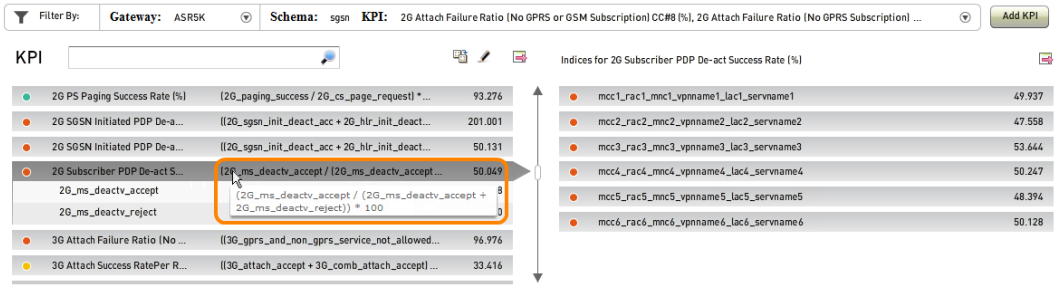
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Element	Description
	Removes the right-hand ( ) KPI, counter, or entity from the display in the lower half of the pane. (The icon appears only when the field has a value in it.) See "Comparing Hourly Values for Two KPIs or Counters" on the next page.
	Indicates and sets the type of chart displayed in the lower half of the pane (time-series line chart or bar chart for the hour interval with the highest counter value). See "Comparing Hourly Values for Two KPIs or Counters" on the next page.

Some KPI names are too long to appear in full in the list of KPIs. As indicated in the following figure, the full name appears in the **Indices for** header for the right half of the pane. You can also mouse over the name in the list to display the full value.



Similarly, formulas are usually too long to appear in full in the list of KPIs. To display the full formula for a KPI, mouse over its name in the list, as shown in the following figure for the **2G Subscriber PDP De-act Success Rate (%)** KPI. For information about the notation used in formulas, see "Defining New KPIs" on page 157.

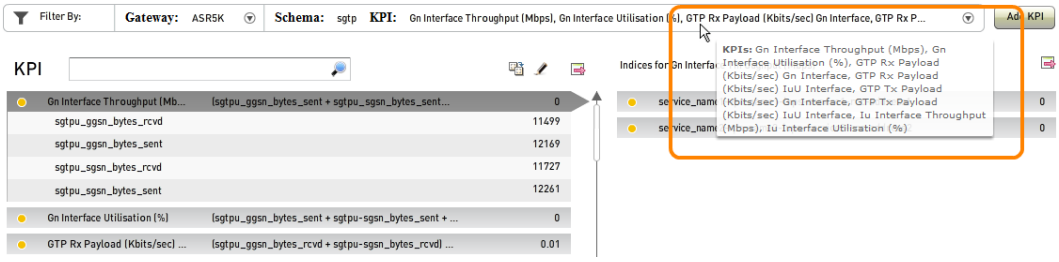


Displaying the List of KPIs

The **KPI** field at the top of the **KPI** pane lists as many of the currently displayed KPIs as fit in the current field width. Names that start with a numeral are listed first, followed by names in alphabetical order.



To display the complete list of currently displayed KPIs, mouse over the **KPI** field, as in this example for the **sgtp** schema.



You can also view the complete list of available counters in the **Select Counter** window, as described in "Specifying a Subset of KPIs During Schema Selection" on page 155, but in that interface they are not all visible at once.

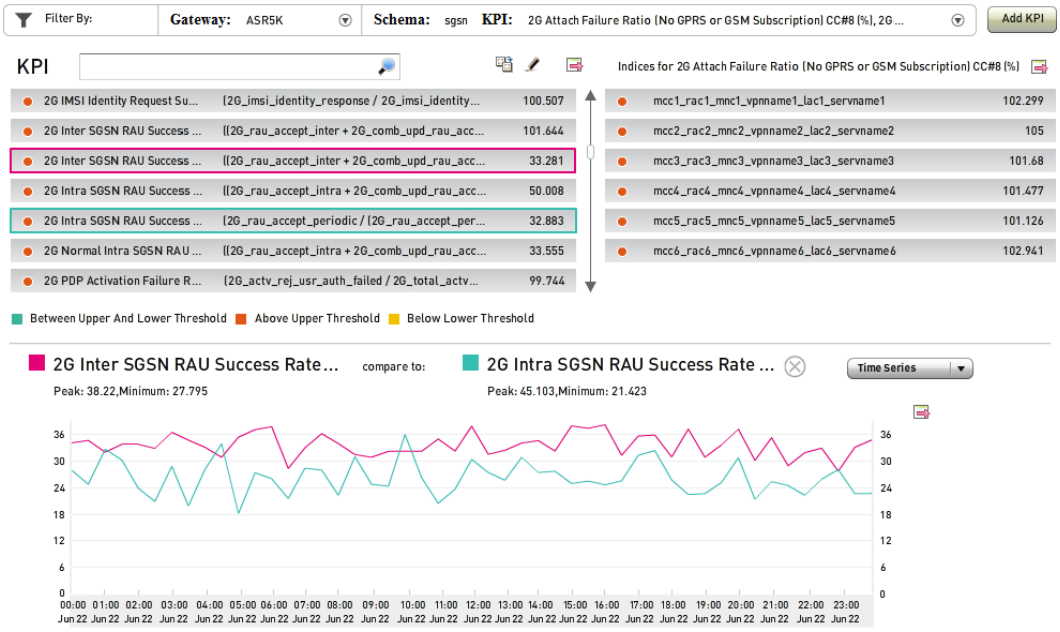
Comparing Hourly Values for Two KPIs or Counters

In the lower half of the main display pane, you can visually compare values on an hourly basis for two KPIs or counters as they change over the course of the selected time range. In the following example, activity is compared for the KPIs called **2G Inter SGSN RAU Rate per RA (%)**, which appears in magenta, and **2G Intra SGSN RAU Rate per RA (%)**, which appears in turquoise. The names of the KPIs appear in two locations:

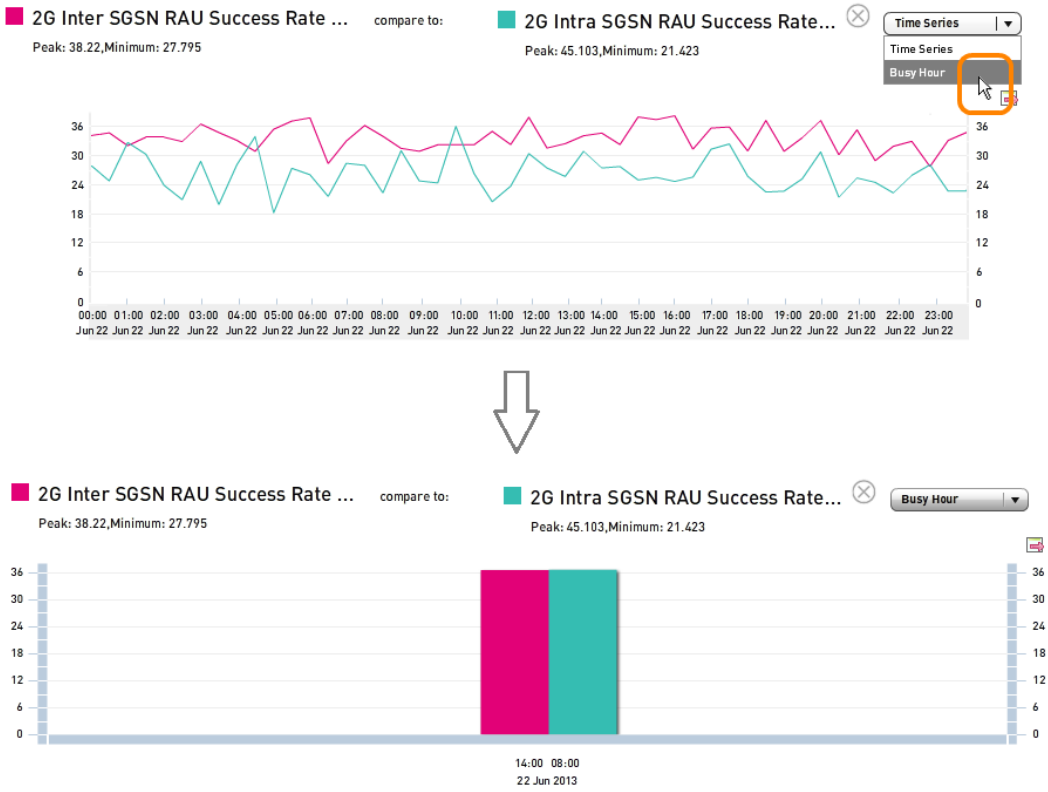
- In the KPIs list in the upper left quadrant of the pane, enclosed in boxes colored to match the lines in the chart. The boxed counters are not necessarily always visible, for example if you scroll to a different part of the KPIs list.

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- In the legend above the line chart, which also reports the peak (highest) and minimum (lowest) hourly values that occurred during the selected time range.



To display the hour in which the highest value occurred for both counters during the selected time range, click on the **Time Series** drop-down menu button and select **Busy Hour** on the menu that drops down. In the following example, the highest average value occurred between 13:00 and 14:00 hours for **2G Inter SGSN RAU Rate per RA (%)** and between 07:00 and 08:00 hours for **2G Intra SGSN RAU Rate per RA (%)**.

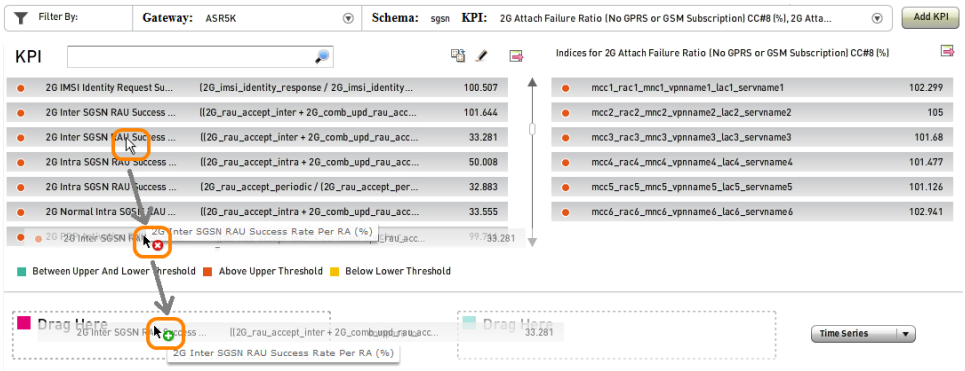


You can compare any two KPIs or counters from the left and right halves of the pane. To specify the two entities to compare, perform the following steps.

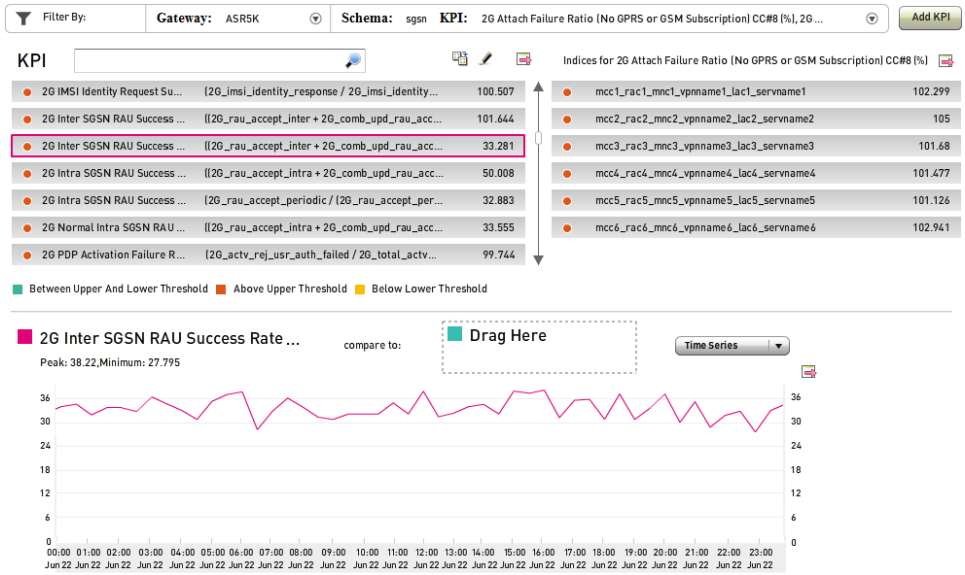
1. Navigate to the first KPI or counter, using the search box and scroll bar as necessary to make it easier to locate.

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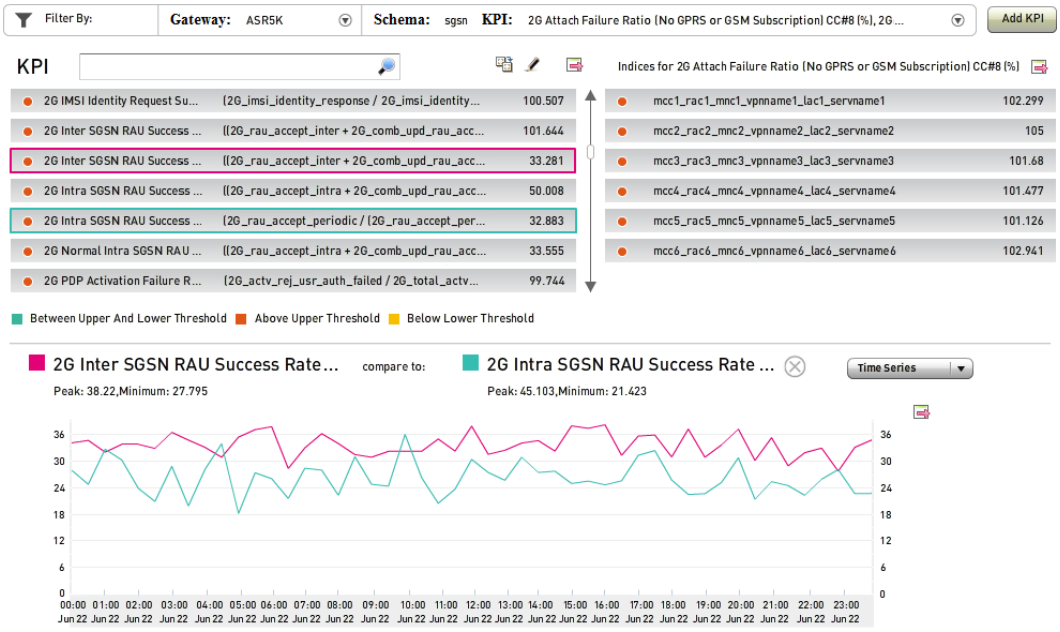
2. Click and hold down the mouse button on the KPI or counter name as you drag it into the box labeled **Drag Here** with the magenta square (■) in the lower left pane. As soon as you start to move the cursor, it changes to a black arrow with a red-X icon (⊗) next to it. When you reach the box and the icon changes to the green-cross icon (⊕), release the mouse button.



A time-series line chart appears with hourly values for the first KPI.



3. Repeat Steps 1 and 2 for the second counter or entity, dragging it into the box labeled **Drag Here** with the turquoise square (■) in the lower right pane. The following figure depicts the resulting chart with the second KPI, **2G Intra SGSN RAU Success Rate per RA (%)**, added.

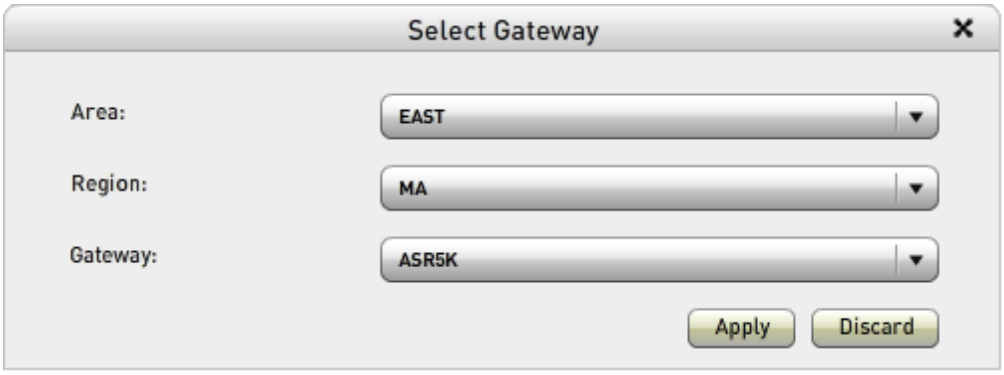


Selecting the Gateway

To select the gateway for which information appears in the main pane, click the open-window icon (⊙) at the right end of the **Gateway** field.



The **Select Gateway** window pops up to report the currently selected values for the gateway, as in the following example for a gateway called **ASR5K** in Massachusetts.



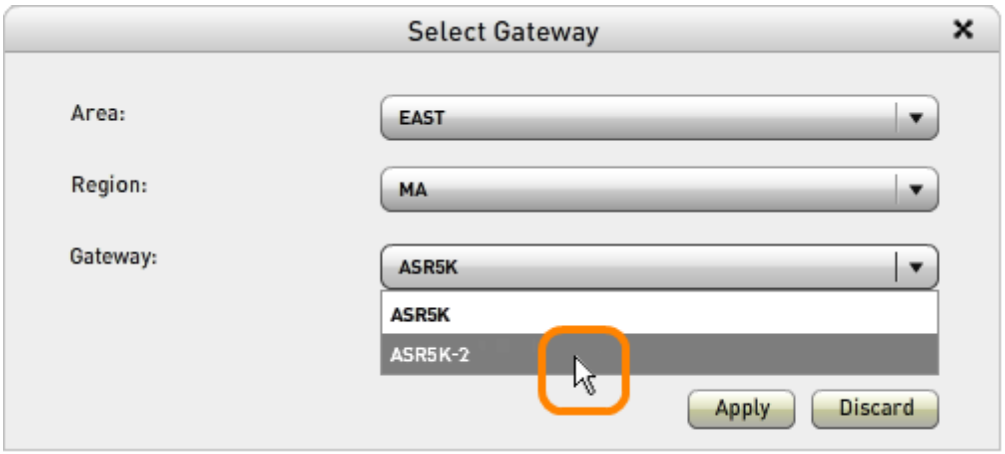
The choices available on the **Area**, **Region**, and **Gateway** drop-down menus are defined by your system administrator during initial MURAL configuration. In the usual configuration, they

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correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices for **Area** might be regions like **EAST** and **SOUTH**, the choices for **Region** the states in which network equipment is located, and the choices for **Gateway** individual ASR 5000 systems.

Note: Although the field names **Area** and **Region** are also used in the **Network** category of the filter interface on the **Network**, **Device**, **Subscriber**, and **Content** tabs, and the available values might be the same, the two interfaces do not function exactly the same way. In the filter interface, you can specify multiple values in multiple fields. In the **Select Gateway** window, you are specifying a single gateway and the choices available in the **Gateway** field depend on the settings in the two fields above it. If the desired gateway is not listed, you must change the value in one or both of the **Area** and **Region** fields to the value that applies to the gateway.

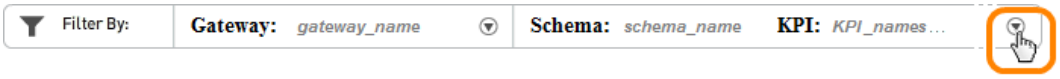
To select a different value on a drop-down menu, click the menu button and then your choice in the menu. In the following example, the **ASR5K-2** gateway is being selected.



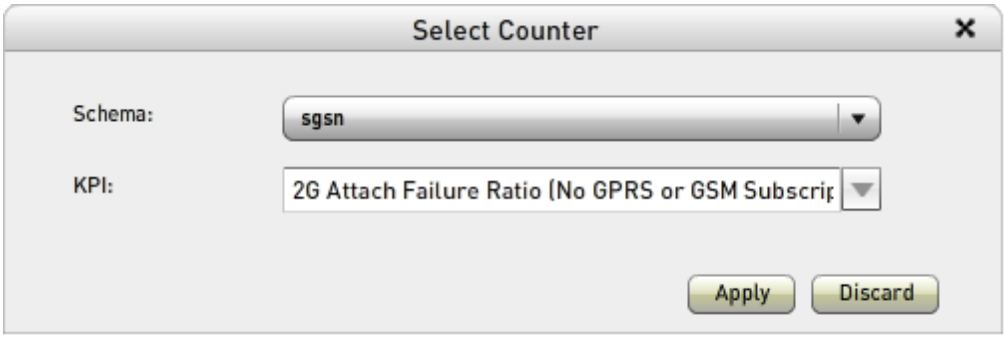
To change to the new gateway, click the **Apply** button. To close the **Select Gateway** window without changing the current gateway, click the **Discard** button or the close-window icon (✖) in the window's title bar.

Selecting the Schema

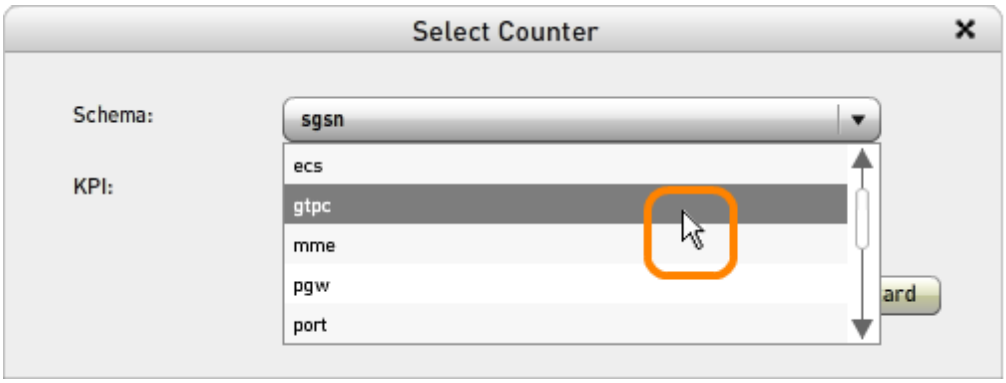
To select the schema for which information appears in the main pane, and optionally display only a subset of KPIs, click the open-window icon (⊙) at the right end of the **Schema** field.



The **Select Counter** window pops up to report the currently selected schema and the first few KPIs from the schema that are currently selected for inclusion in the pane, as in the following example for the **sgsn** schema.



To select a different schema, click on the menu button and then on your choice in the drop-down menu. In the following example, the **gtpc** schema is being selected.



After selecting the new schema, you can optionally select a subset of KPIs to display; for instructions, see "Specifying a Subset of KPIs During Schema Selection" on the facing page.

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When you have finished your selections, click the **Apply** button to display KPIs from the new schema. To close the **Select Counter** window without changing the current schema, click the **Discard** button or the close-window icon (✖) in the window's title bar.

Displaying a Subset of KPIs

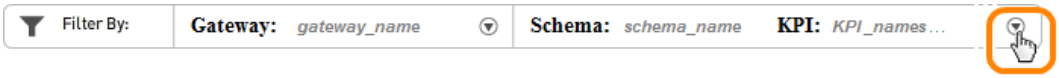
There are two ways to display only a subset of the KPIs from a schema, as explained in the following sections:

- "Specifying a Subset of KPIs During Schema Selection" below
- "Displaying Only KPIs that Match a Search String" on the next page

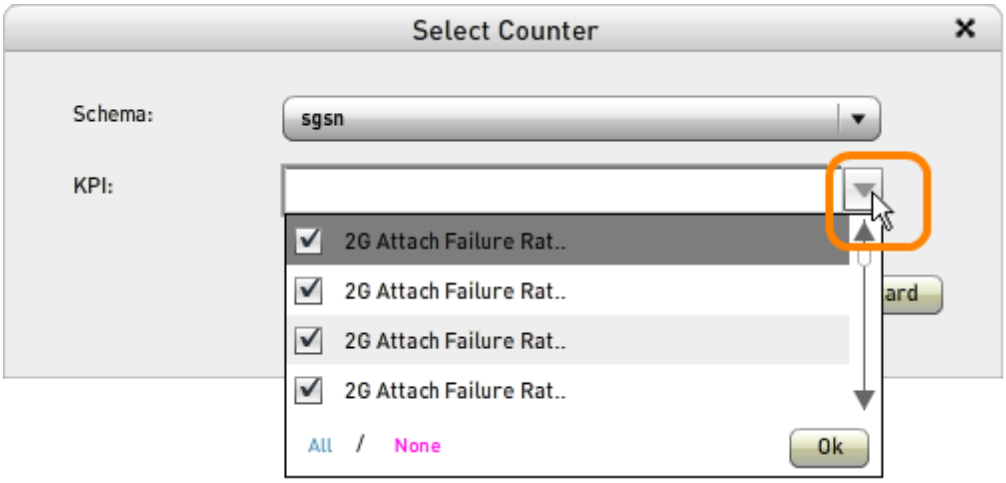
Specifying a Subset of KPIs During Schema Selection

To specify that only a subset of the KPIs in a schema be displayed, perform the following steps:

1. If the **Select Counter** pop-up window is not already open, click the open-window icon (⊙) at the right end of the **Schema** field.



2. On the **Select Counter** window, click the open menu icon ( ) on the **KPI** drop-down menu box to expose the list of KPIs. (KPI names that begin with numerals appear first, followed by names in alphabetical order.)



When the menu drops down, all values are checked, which selects them for inclusion in the display.

- To exclude a KPI, click its check box to remove the check.
- To remove the check from all boxes, click None. (If there are a large number of KPIs and you want to display only a few of them, it is most efficient to deselect all of them this way and then check your selections.)
- To include all KPIs, click All.
- To finalize the list of KPIs to display and close the drop-down menu, click the **Ok** button. The selected values appear as a comma-separated list in the menu box.

  Note: The **Ok** button is nonoperational if no KPIs are checked. You must check at least one.

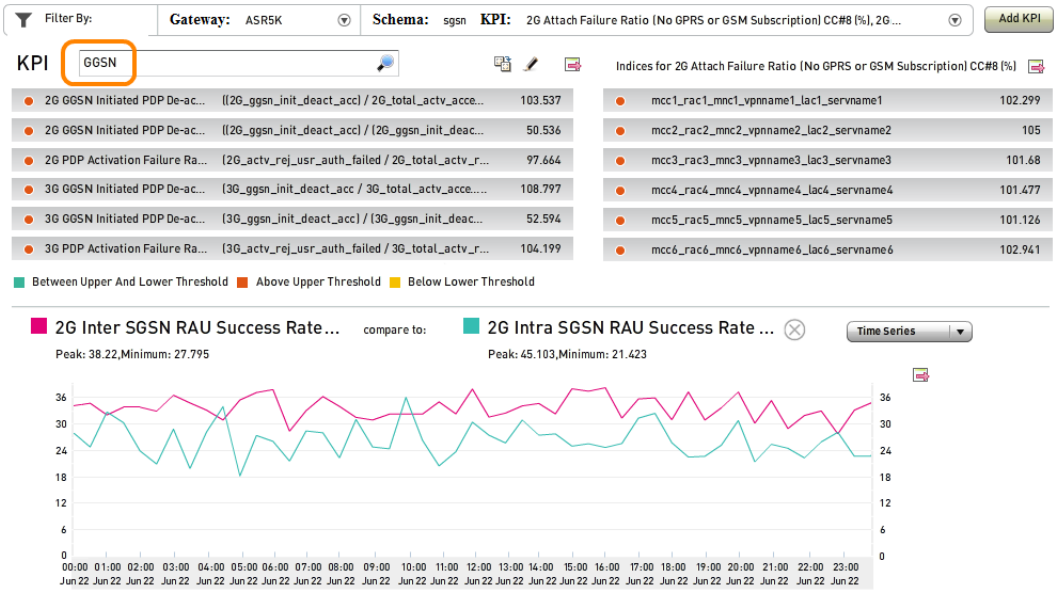
3. To display the new set of KPIs, click the **Apply** button. To close the **Select Counter** window without changing the current set of KPIs, click the **Discard** button or the close-window icon (✖) in the window's title bar.

Displaying Only KPIs that Match a Search String

To limit the list of KPIs in the left half of the upper pane to only those that have a certain character string in their names (in any position), type the characters in the **KPI** search box above the list. The list is updated immediately as you type each character. If no counters match the search string, the list disappears completely. You can also use this interface to search for particular KPI names (but not for the counters that are components in a KPI's formula).

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In the following example, the search string **GGSN** limits the list to only six KPIs. Because they all fit in the display pane, the scroll bar no longer appears to the right of the list.

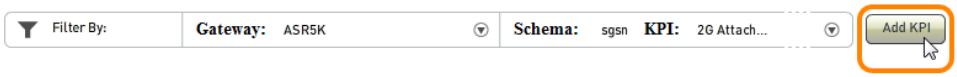


The example illustrates how limiting the list to matching KPI names does not change other aspects of the display pane, which is taken from the example in "Comparing Hourly Values for Two KPIs or Counters" on page 148. The KPI that was selected before the search (**2G Subscriber PDP De-act Success Rate (%)**) is still selected; it does not appear in the list because it does not match the search string. Similarly, the right half of the pane still reports the value of the **2G Subscriber PDP De-act Success Rate (%)** KPI for the six entities to which the **sgsn** schema applies. The lower half of the pane still tracks hourly values for the **2G Inter SGSN RAU Rate per RA (%)** and **2G Intra SGSN RAU Rate per RA (%)** KPIs.

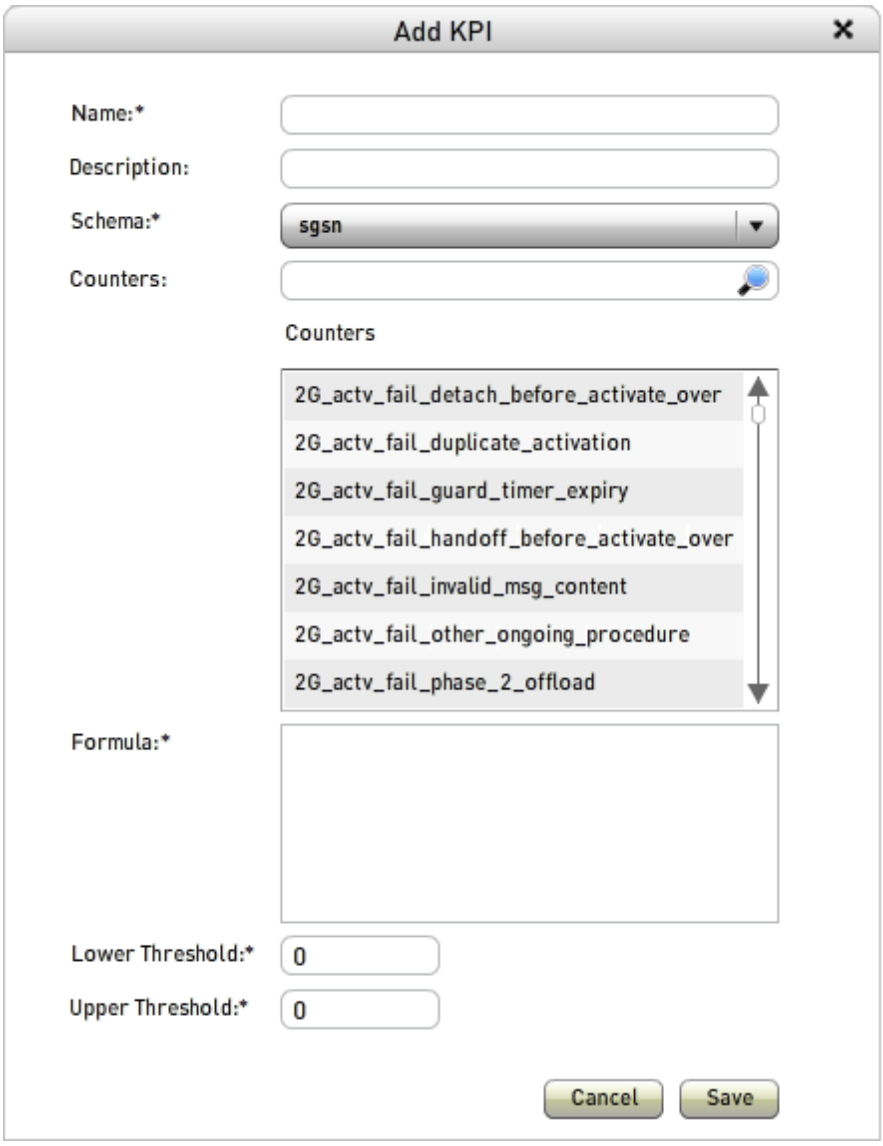
Defining New KPIs

You can define new KPIs in existing schemata. Perform the following steps:

1. Click the **Add KPI** button to the right of the **Schema** field.



The **Add KPI** window pops up, with the **Schema** field set to the schema currently selected on the KPI tab, and the **Counters** box populated with the counters from that schema (in the figure, the schema is **sgsn**).



2. Type values in the text fields:

   - **Name**—The name of the new KPI, unique within the schema. It can contain upper- and lowercase letters, numbers, and spaces.
   - **Description**—(Optional) A phrase that describes the KPI. It can be up to 256

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characters in length.

- **Lower threshold**—A numerical value. When the value of the KPI is less than this number, the yellow threshold indicator () appears in front of its name in the KPIs list. When the value is greater than this number but less than the upper threshold, the indicator is green ().
- **Upper threshold**—A numerical value. When the value of the KPI is greater than this number, the red threshold indicator () appears in front of its name in the KPIs list. When the value is less than this number but greater than the lower threshold, the indicator is green ().

3. If the schema in which you want to add the KPI does not currently appear in the **Schema** field, click on the drop-down menu button and then on your choice in the menu. The list of counters in the **Counters** box is updated.
4. Define the formula. It can be helpful to write out the formula before you start to define it. Formulas obey the standard mathematical order of operations and use the following notation:
   - Addition—Plus sign (**+**)
   - Subtraction—Hyphen (**-**)
   - Multiplication—Asterisk (*****)
   - Division—Forward slash (**/**)

Use parentheses (**( )**) to enclose operations that need to be performed out of standard order. In the following formula for the **3G Authentication Success Rate (%)** KPI, for example, the parentheses around the four counters in the denominator (`3G_auth_cipher_response` through `3G_auth_unacceptable`) mean they are summed first. The parentheses around the numerator (`3G_auth_cipher_response`) and summed denominator mean the division operation is performed before the result is multiplied by 100. To make the following formula easier to read, the terms are spread across several lines and there are extra spaces around the symbols.

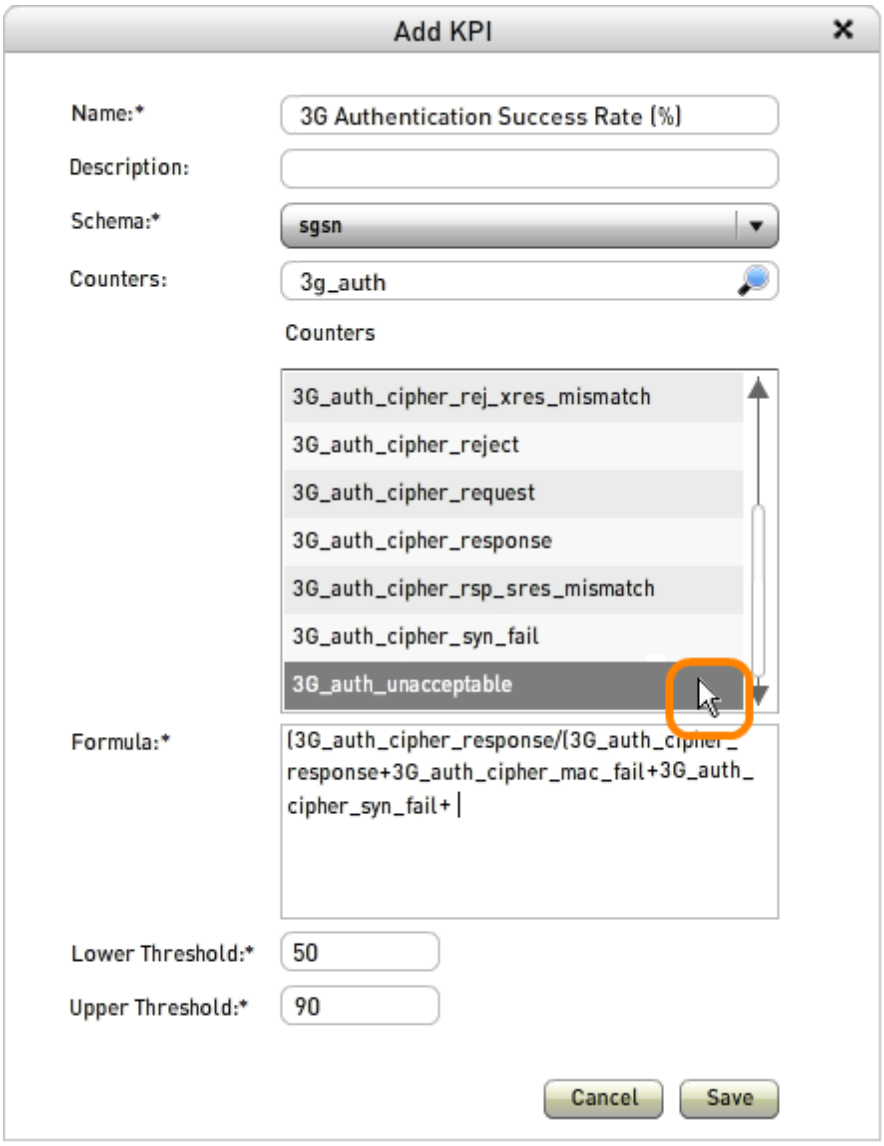
```
(3G_auth_cipher_response /
   ( 3G_auth_cipher_response + 3G_auth_cipher_mac_fail
       + 3G_auth_cipher_syn_fail + 3G_auth_unacceptable )
 ) * 100
```

To enter counter names in the formula, you can either type them directly into the **Formula** box, or perform the following steps to select them from the **Counters** box:

a. Use the scroll bar to navigate to the counter. You can shorten the list of counters to only those that have a certain character string in their names (in any position) by typing the characters in the **Counters** search box ( ).

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b. Double-click the counter to add it to the **Formula** box at the position of the cursor (the pipe symbol [|]). In the following figure, the last counter, **3g_auth_unacceptable**, is being added to the formula.



5. To create the new KPI, click the **Save** button. To close the **Add KPI** window without adding the new KPI, click the **Cancel** button or the close-window icon (✖) in the window's title bar.

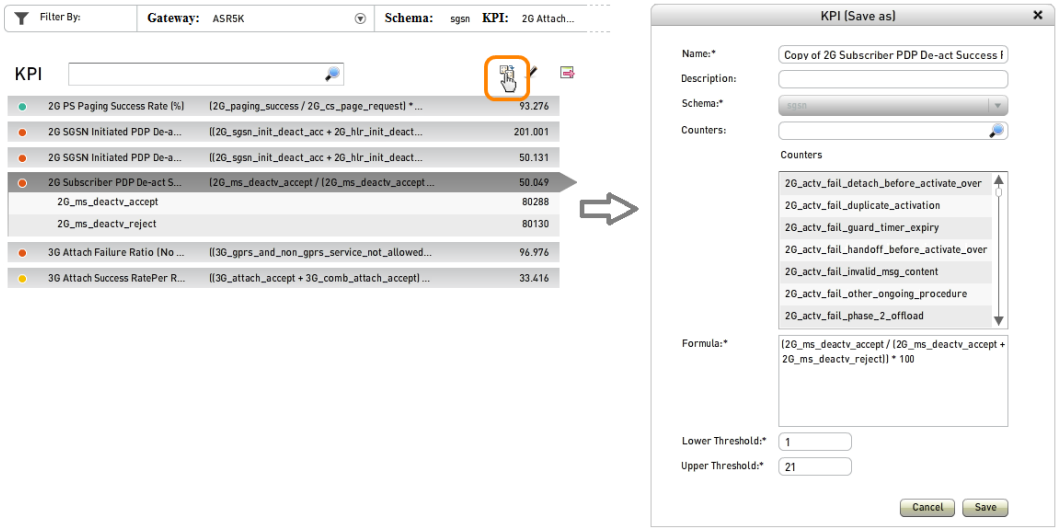
Cloning and Editing KPIs

You can both clone and edit (modify) KPIs. *Cloning* refers to creating a copy of a KPI and saving it with a different name, presumably after modifying it. The source KPI for the clone is not changed.

Cloning a KPI

To clone a KPI, perform the following steps.

1. Select the KPI you want to clone by clicking its row in the KPIs list.
2. Click the clone icon ( ). The **KPI (Save as)** window pops up. In the following example, the KPI called **2G Subscriber PDP De-act Success Rate (%)** is being cloned.



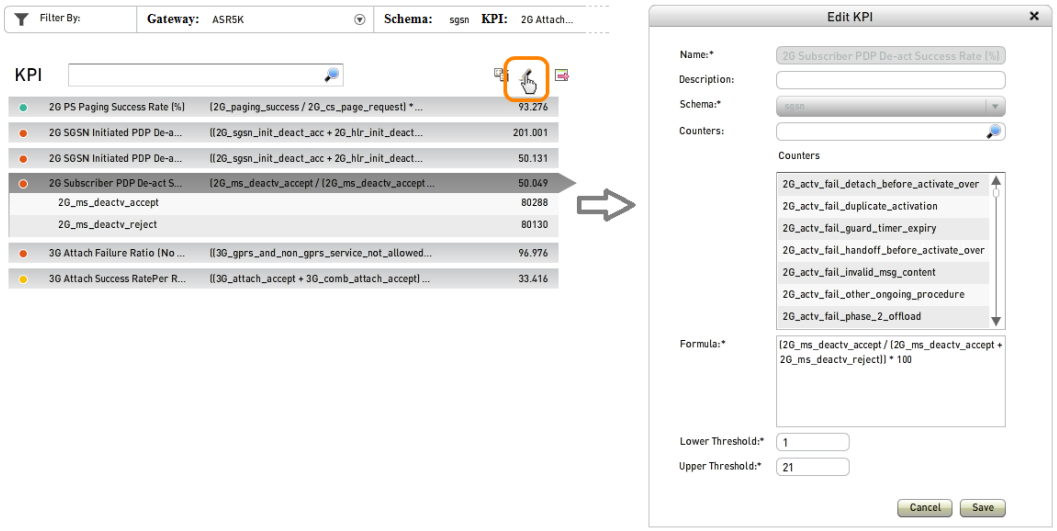
3. Make the desired changes (the only field you cannot change is **Schema**). For instructions on searching the list of counters, constructing a formula, and changing the lower and upper thresholds, see "Defining New KPIs" on page 157.
4. To create the new KPI, click the **Save** button. To close the **KPI (Save as)** window without adding the new KPI, click the **Cancel** button or the close-window icon (✖) in the window's title bar.

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Editing KPIs

To modify a KPI, perform the following steps.

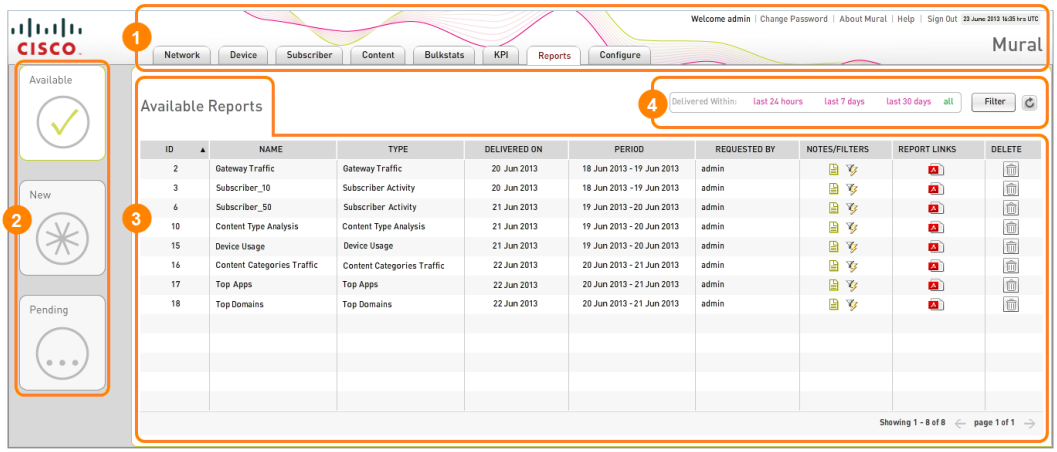
1. Select the KPI you want to edit by clicking its row in the KPIs list.
2. Click the edit icon ( ). The **Edit KPI** window pops up. In the following example, the KPI called **2G Subscriber PDP De-act Success Rate (%)** is being edited.



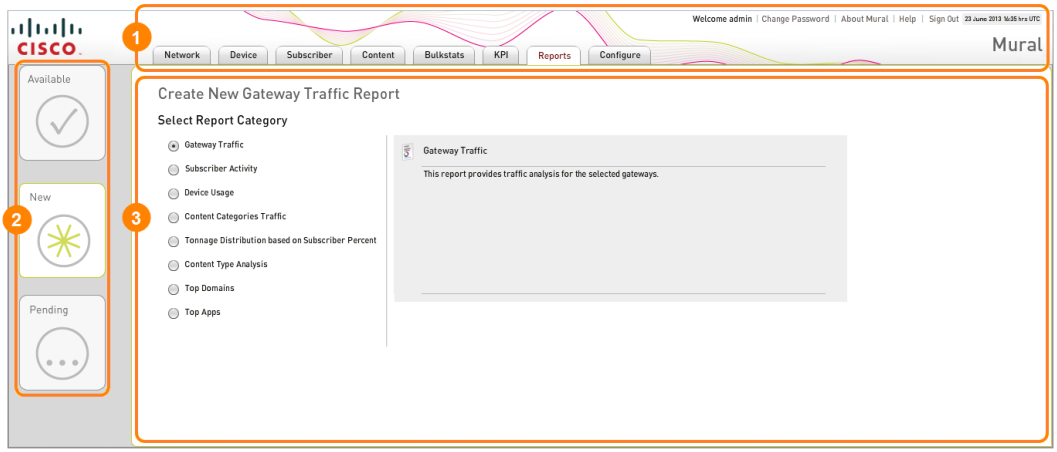
3. Make the desired changes (the only fields you cannot change are **Name** and **Schema**). For instructions on searching the list of counters, constructing a formula, and changing the lower and upper thresholds, see "Defining New KPIs" on page 157.
4. To save your changes, click the **Save** button. To close the **Edit KPI** window without saving changes, click the **Cancel** button or the close-window icon ( ) in the window's title bar.

Scheduling and Interpreting Statistical Reports

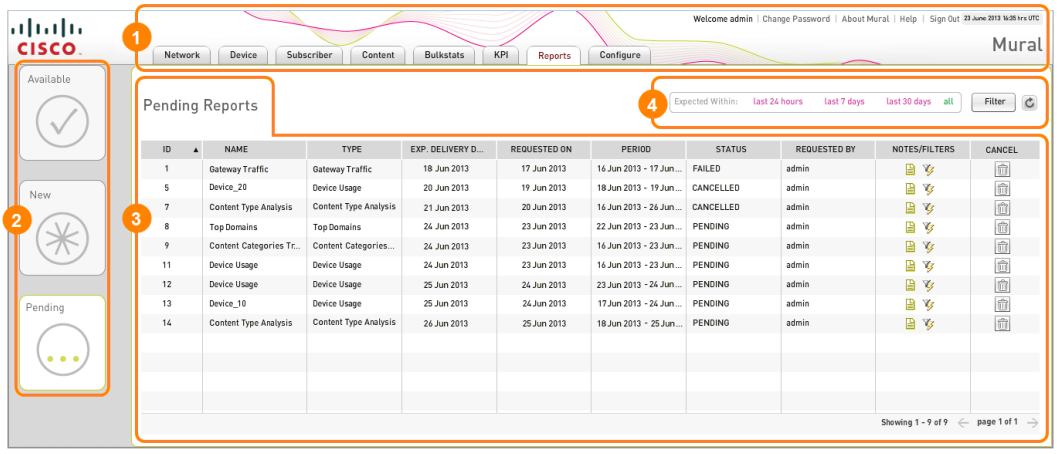
The **Reports** tab in Mobility Unified Reporting and Analytics (MURAL) is an interface for reviewing and scheduling statistical reports. Three windows featuring different content can appear one at a time on the tab: **Available Reports**, **Create New Report**, and **Pending Reports**. When you first access the tab during a MURAL session, the **Available Reports** window is open and lists all existing reports. (A description of the functional areas in the orange boxes follows the figures.)



The **Create New Report** window is an interface for creating new instances of the various report types.



The **Pending Reports** window lists reports that are scheduled for later delivery.



Each window is divided functionally into several panes, which are numbered in the figures.

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Reports** to access the **Reports** tab). On the right side, reports status information about the current MURAL session and provides access to interfaces for changing your password, displaying help topics, and closing the session. See "Accessing the Main Tabs and Controlling the Session" on page 25.

2. Window selector—Provides access to the three windows on the tab. Click the icon to open the appropriate window (the icon for the open window turns green).

3. Main pane—Displays the type of information featured in the window:

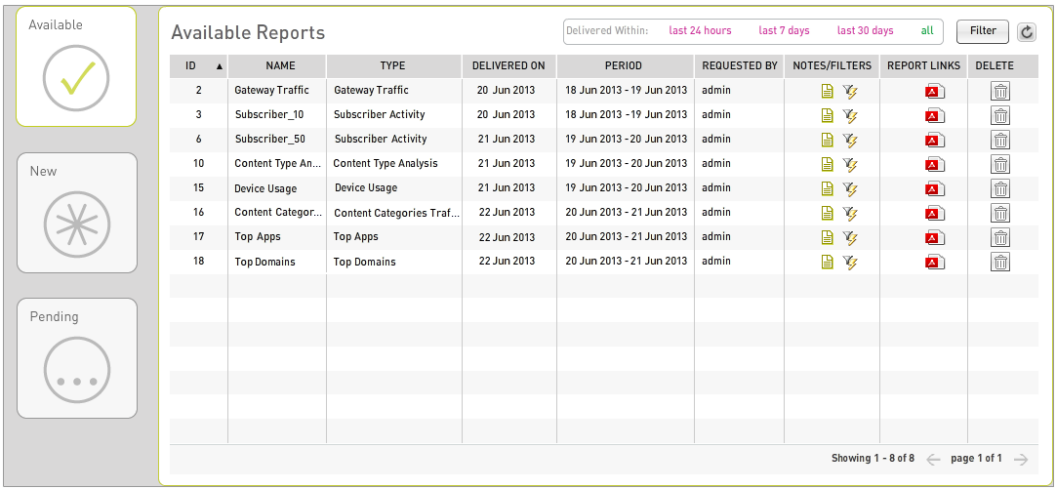
    - In the **Available Reports** window, reports that were delivered during the previous day, week, or month. See "Reviewing Generated Reports" on the facing page.
    - In the **Create New Report** window, the interface for scheduling new reports to be generated. See "Scheduling Reports" on page 169.
    - In the **Pending Reports** window, reports that are scheduled to be generated in the next day, week, or month. See "Administering Scheduled Reports" on page 185.

4. Filter—(**Available Reports** and **Pending Reports** windows) Limits the list of reports to those with specific characteristics, including name, report type, delivery date, requester, and coverage period. See "Filtering a List of Reports" on page 187.

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Reviewing Generated Reports

The **Available Reports** window lists the existing reports that you can review. To access the window, click the **Available** icon in the navigation bar on the left side of the tab. As shown in the following figure, the icon turns green.



The table provides the following information about each report:

- **ID**—Unique numerical identifier assigned by MURAL.
- **NAME**—Report name, assigned in the **Report Name** field on the **Review and Submit** screen of the **Create New Report** window when the report was scheduled (see "Reviewing and Submitting the Report Request" on page 183).
- **TYPE**—Report type, as set on the **Select Report Category** screen of the **Create New Report** window when the report was scheduled (see "Selecting the Report Type" on page 170).
- **DELIVERED ON**—Date the report was generated and added to the list of available reports.
- **PERIOD**—Range of dates covered by the report, as set on the **Select Report Period** screen of the **Create New Report** window when the report was scheduled (see "Specifying the Covered Period of Time" on page 172).
- **REQUESTED BY**—MURAL user ID of the user who scheduled the report.

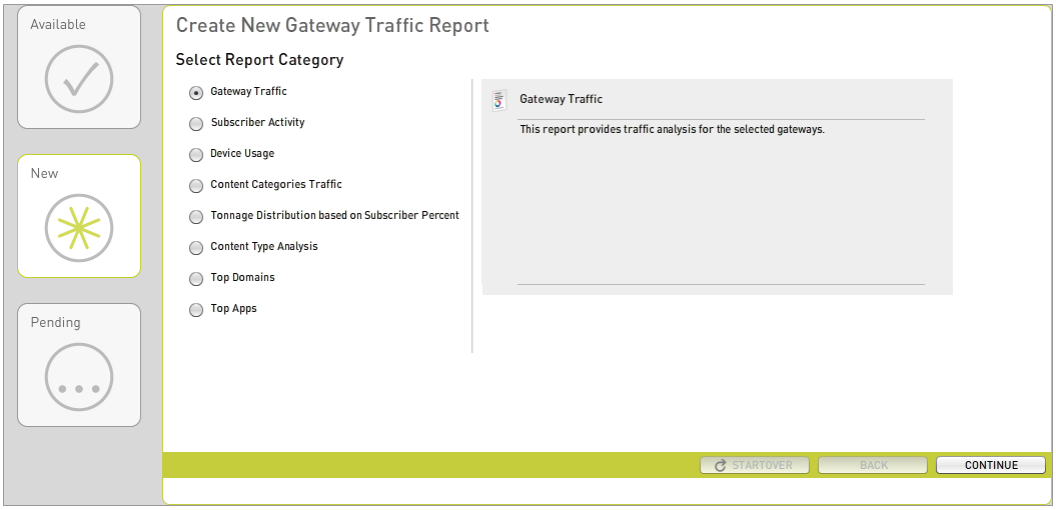
- **NOTES/FILTERS**—Icons for opening pop-up windows that display information about the report:
  - To open the **Notes** pop-up window, click the notes icon (). Notes can be entered in the **Notes** box on the **Review and Submit** screen of the **Create New Report** window when a report is scheduled (see "Reviewing and Submitting the Report Request" on page 183).
  - To open the **FILTERS** pop-up window, click the filter icon (). The reported set of filter criteria was defined on the **Select Filters** screen of the **Create New Report** window when the report was scheduled (see "Filtering the Set of Network Entities Included in the Report" on page 180).
- **REPORT LINKS**—Icon for saving the report as a PDF (**.pdf**) or compressed (**.zip**) file, or viewing the PDF report immediately.
  - To save the report to the local file system:
    1. Click the PDF file icon () and then **Save Report**.
    2. In the **Download Alert** window that pops up, click the **OK** button.
    3. In the file system window that pops up, choose the directory location and change the default name (***Report-name*.pdf**) if desired.
  - To view the PDF report, click the file icon () and then **Open Report**.
- **DELETE**—Icon for removing a report from the reports database. Click the trash can icon ( ).

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By default the table lists all available reports. To limit the list to reports with specific characteristics (including name, report type, delivery date, requester, and coverage period), use the filter interface in the upper right corner of the main pane. For more information, see "Filtering a List of Reports" on page 187.

Scheduling Reports

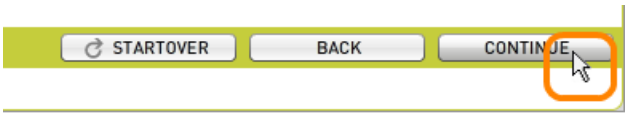
The **Create New Report** window is an interface for scheduling generation of MURAL reports. To access the window, click the **New** icon in the navigation bar on the left side of the tab. As shown in the figure, the icon turns green. When you first access the **Create New Report** window during a MURAL session, the first report type in the list is selected.



MURAL guides you through the report-scheduling process by presenting a screen for each step:

- "Selecting the Report Type" on the next page
- "Specifying the Covered Period of Time" on page 172
- "Filtering the Set of Network Entities Included in the Report" on page 180
- "Reviewing and Submitting the Report Request" on page 183

After providing the required information on each of the first three screens, click the **CONTINUE** button in the lower right corner to continue to the next step (on the final screen the button says **SUBMIT** instead).



Until you submit the finalized report request, you can change the selections on any of the screens by clicking the **BACK** button to go back one screen at a time. You can also click the **STARTOVER** button to return to the initial **Select Report Category** screen, clearing your selections on all screens.

Selecting the Report Type

On the **Select Report Category** screen, click the radio button for the type of report to create, then click the **CONTINUE** button.



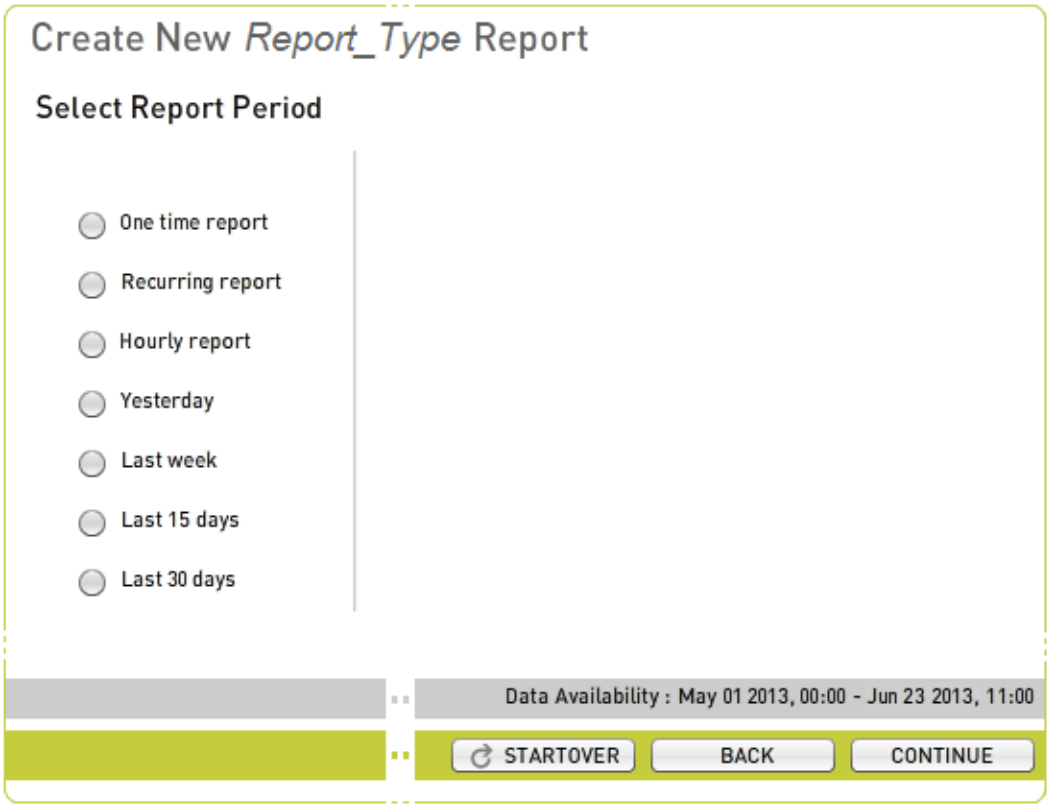
Reports include multiple statistics (for example, volume and rate of traffic, subscriber count, flow count, and so on) for the indicated types of network entities:

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- **Gateway Traffic**—Gateways (sites where network equipment is located)
- **Subscriber Activity**—Subscribers that account for the greatest amount of traffic
- **Device Usage**—Models of mobile device that account for the greatest amount of traffic
- **Content Categories Traffic**—Categories of content that account for the greatest amount of traffic
- **Tonnage Distribution based on Subscriber Percent**—Subscribers, grouped into percentiles based on their level of activity, who account for specified percentages of total traffic
- **Content Type Analysis**—Generic types of content (such as **text**, **video**, **application**, and **images**) that account for the greatest amount of traffic
- **Top Domains**—Content provider websites that served the greatest amount of content
- **Top Apps**—Specific mobile applications (such as browsers, streaming video sites, and social media portals) that account for the greatest amount of traffic

Specifying the Covered Period of Time

On the **Select Report Period** screen, you specify the period of time for which to include data in the report. For all report types except **Tonnage Distribution based on Subscriber Percent** reports, the following time periods are available; click the appropriate radio button.

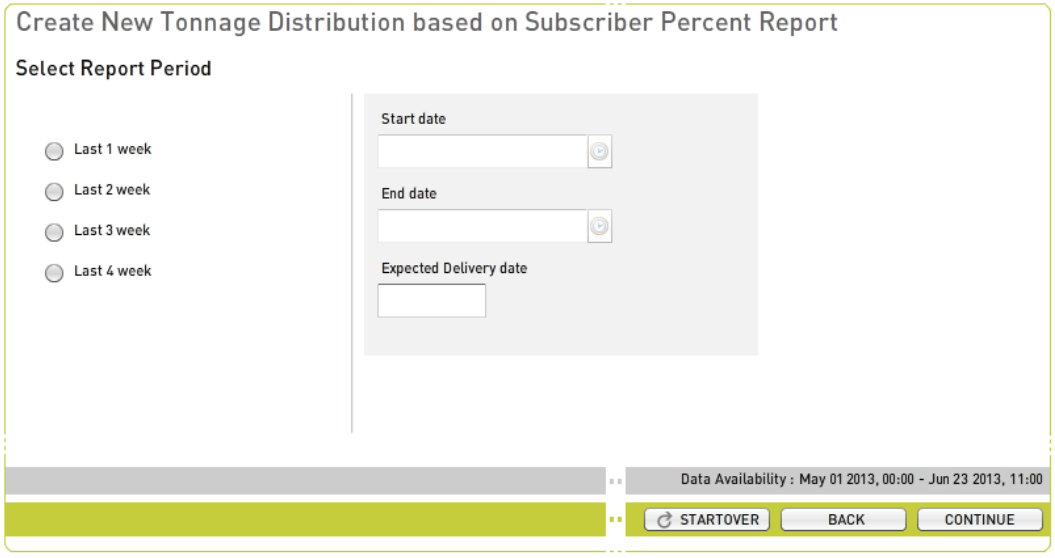


- **One time report**—Single report that covers the period between specified start and end times. See "Scheduling a Report that Covers a Specified Period" on page 176.
- **Recurring report**—Specified number of reports at the specified frequency (daily, weekly, or monthly). They cover the period that starts at the specified time and ends with the last requested report (which can be in the future). See "Scheduling a Recurring Report" on page 177.
- **Hourly report**—Single report that covers the specified number of hours after the specified start time. See "Scheduling a Report that Covers a Specified Number of Hours on One Day" on page 178.

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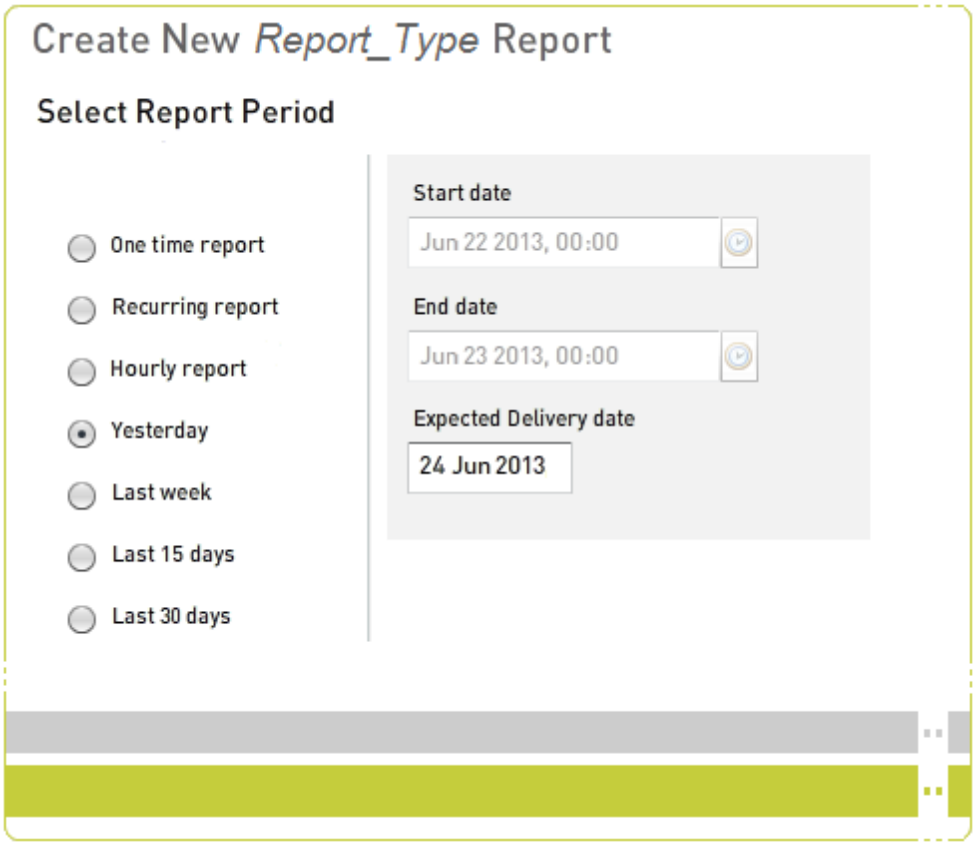
- **Yesterday**, **Last week**, **Last 15 days**, or **Last 30 days**—Single reports that cover the period that started at 00:00 hours the indicated number of days ago (1, 7, 15, or 30 days) and ended at 00:00 hours on the current day. See "Scheduling a Report that Covers a Standard Period Ending Today" on page 179.

For **Tonnage Distribution based on Subscriber Percent** reports, click the appropriate radio button to schedule generation of a report that covers the indicated number of calendar weeks, ending at 00:00 hours on Monday of current week. For example, for a **Last 2 week** report requested on 23 June 2013 (a Sunday), the end time is 00:00 the previous Monday, 17 June, and the start time is two weeks before that, 00:00 hours on Monday 3 June.



For all report types, the **Data Availability** field in the lower right corner of the screen specifies the range of time for which data is available. In the preceding figures, it is slightly more than six weeks from 00:00 hours on 1 May through 11:00 hours on 23 June.

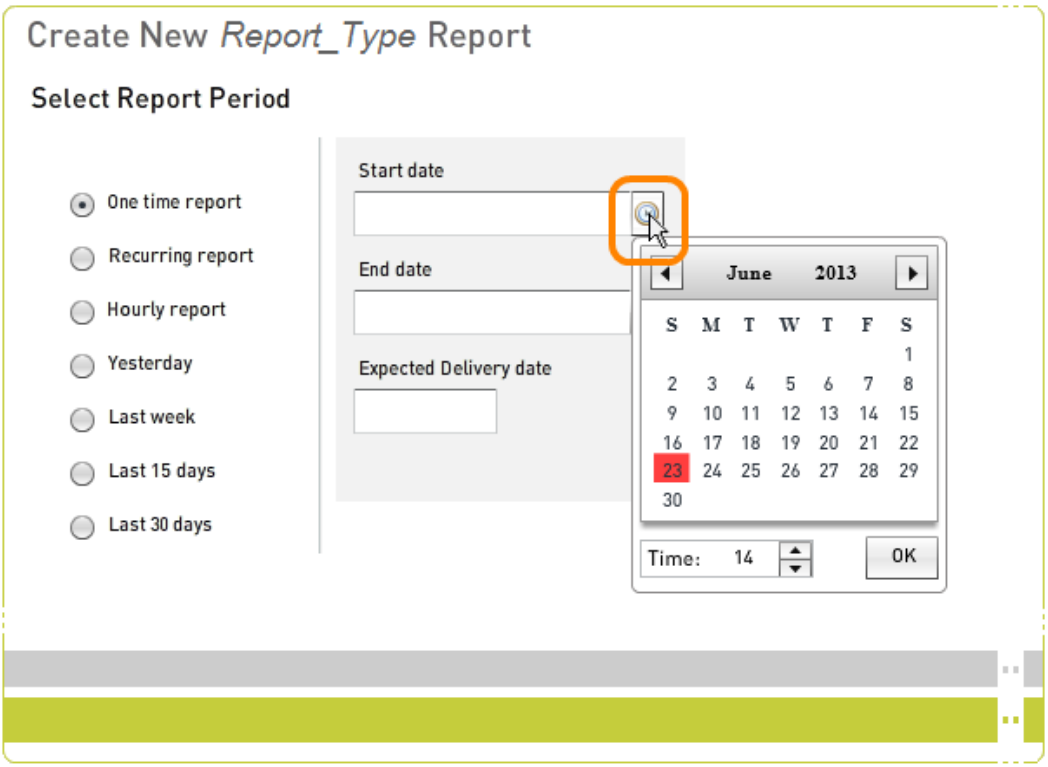
After you specify the required information for any of the time periods, MURAL fills in the **Expected Delivery date** field with the date on which the report or reports will be available, usually one day after the current day. (For recurring reports, it provides a date for each report; see "Scheduling a Recurring Report" on page 177.) In the following example, a **Yesterday** report requested on 23 June will be delivered on 24 June.



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Using the Calendar Interface to Specify Start and End Dates

When you create a one-time, recurring, or hourly report, you use the calendar interface to specify the date and time at which the coverage period starts, ends, or both. To open the calendar interface, click the clock icon () at the right end of the time selector box. On the calendar that pops up, a red box marks the current day and the **Time** box is set to the current hour of the day. The following example shows the settings when the calendar interface is opened between 14:00 and 15:00 hours on 23 June.



To move to the previous or next month, click the button in the upper left corner () or upper right corner () of the calendar.

To select the day, click it in the body of the calendar (its selection is indicated by the red box).

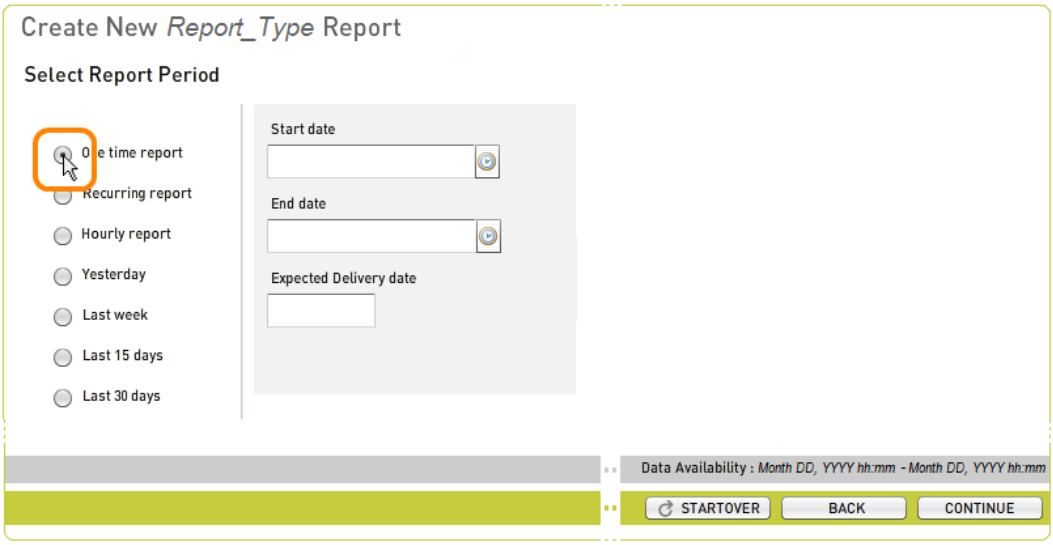
To select the time, click the up and down arrow buttons () at the right end of the **Time** box, or type a value in the box.

To set the date and time, click the **OK** button in the lower right corner of the calendar. The day and time appear in the time selector box.

Scheduling a Report that Covers a Specified Period

To schedule generation of a single report that covers the period between specified start and end times, perform the following steps.

1. Click the **One time report** radio button, if it is not already selected (it is the default).



2. Click the clock icon (🕑) at the right end of the **Start date** box and set the date and time as described in "Using the Calendar Interface to Specify Start and End Dates" on the previous page. You can specify any time after the first date and time in the **Data Availability** field.

3. Repeat the previous step for the **End date** box. You can specify any time after the start time, including a future date and time.

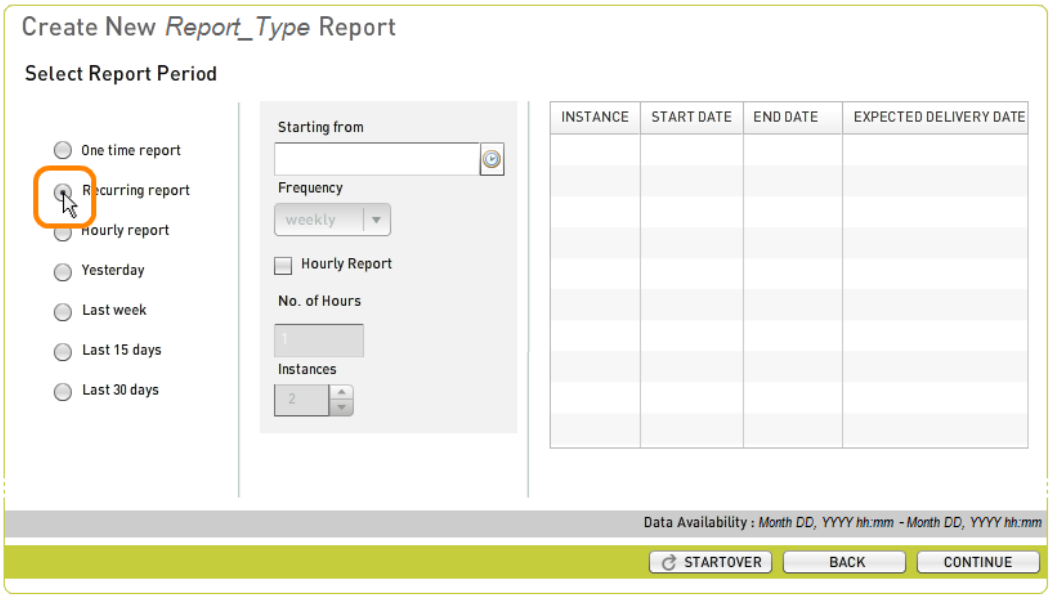
4. Click the **CONTINUE** button. For information about the next screen, proceed to "Filtering the Set of Network Entities Included in the Report" on page 180.

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Scheduling a Recurring Report

To schedule generation of multiple instances of a report at a specified frequency (daily, weekly, or monthly), perform the following steps.

1. Click the **Recurring report** radio button.



2. Click the clock icon ( ) at the right end of the **Starting from** box and set the date and time as described in "Using the Calendar Interface to Specify Start and End Dates" on page 175. You can specify any time after the first date and time in the **Data Availability** field.

3. Click the **Frequency** drop-down menu button and then the desired frequency (**weekly**, **monthly**, or **daily**). The table to the right updates to display the start, end, and delivery dates for each instance of the report (by default, two instances).

4. By default, each report covers the entire period between the times specified in the **START DATE** and **END DATE** columns. To change the coverage period to a specified number of hours after the start time, click the **Hourly Report** check box and then type a number from **1** through **24** in the **No. of Hours** box. This option makes the most sense when the frequency is **daily**.

5. Specify the number of reports to generate in the **Instances** box. You can type a value in

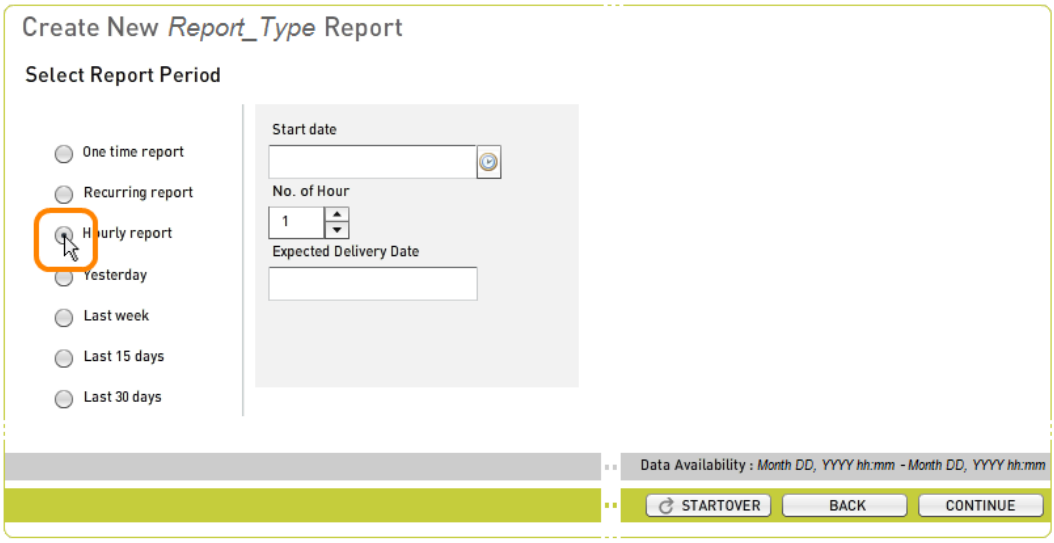
the box or click the up and down arrow buttons ( ) to increment or decrement the value by one for each click. The table is updated at each click to list the specified number of reports.

6. Click the **CONTINUE** button. For information about the next screen, proceed to "Filtering the Set of Network Entities Included in the Report" on page 180.

Scheduling a Report that Covers a Specified Number of Hours on One Day

To schedule generation of a single report that covers a specified number of hours after a specified start time, perform the following steps.

1. Click the **Hourly report** radio button.



2. Click the clock icon ( ) at the right end of the **Start date** box and set the date and time as described in "Using the Calendar Interface to Specify Start and End Dates" on page 175. You can specify any time after the first date and time in the **Data Availability** field.

3. Type a number from **1** through **24** in the **No. of Hours** box. The report covers this number of hours after the start date.

4. Click the **CONTINUE** button. For information about the next screen, proceed to "Filtering the Set of Network Entities Included in the Report" on page 180.

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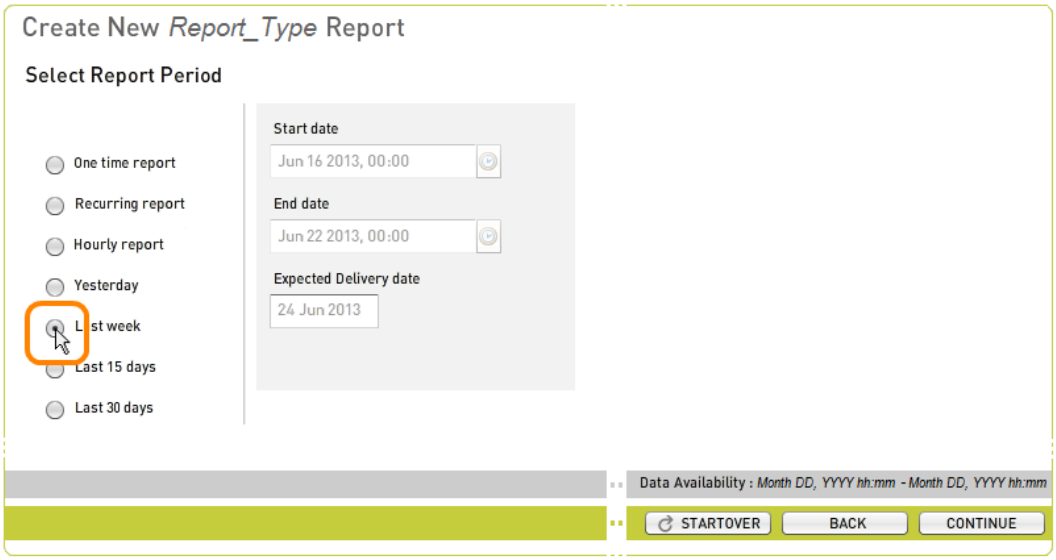
Scheduling a Report that Covers a Standard Period Ending Today

To schedule generation of a single report that covers a standard time period ending at 00:00 hours on the current day, perform the following steps.

1. Click the radio button for the appropriate period:

   - **Yesterday**—The preceding 24 hours
   - **Last week**—The preceding 7 days
   - **Last 15 days**—The preceding 15 days
   - **Last 30 days**—The preceding 30 days

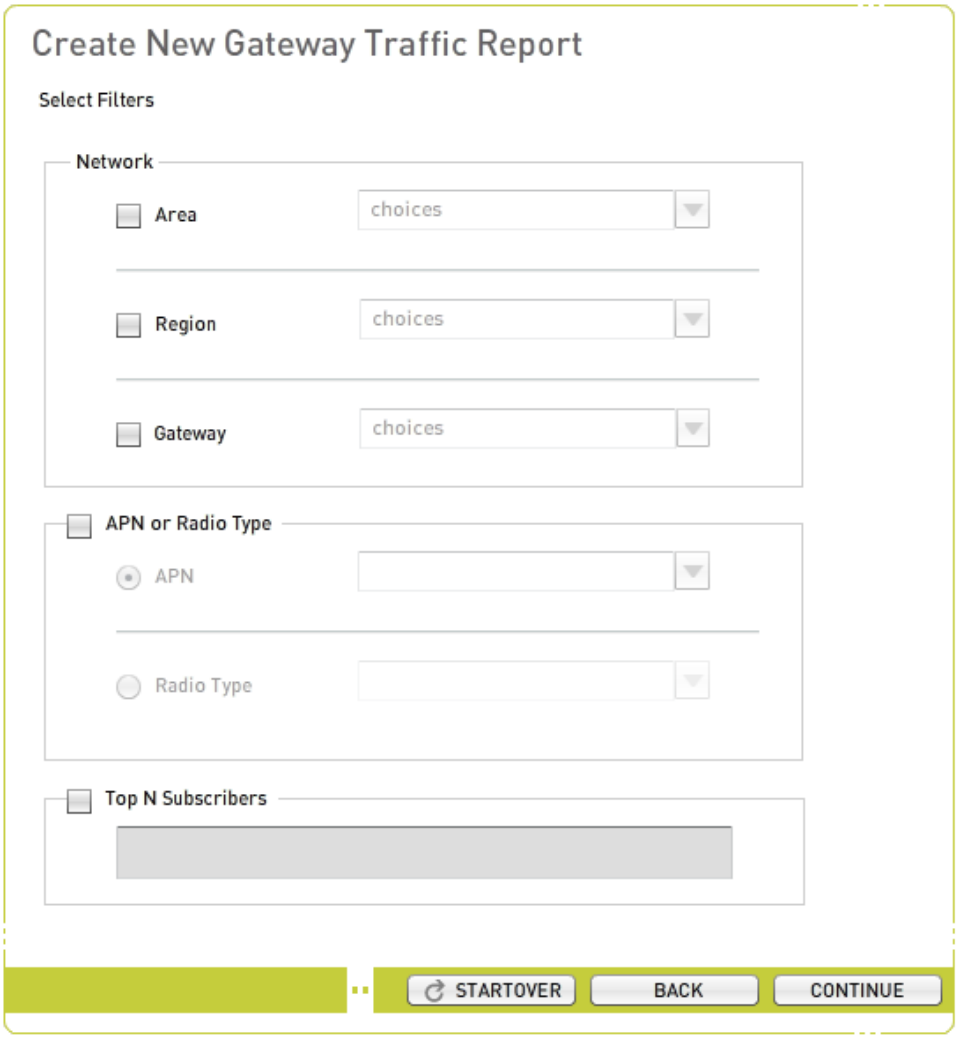
   MURAL fills in the start, end, and delivery dates. In the following example, a **Last week** report requested on 23 June will be delivered on 24 June.



2. Click the **CONTINUE** button. For information about the next screen, proceed to "Filtering the Set of Network Entities Included in the Report" on the next page.

Filtering the Set of Network Entities Included in the Report

On the **Select Filters** screen, you can optionally specify filter criteria that network entities must match in order to be included in the report. The following example is for **Gateway Traffic** reports.



If you want all relevant entities to be included in the report, click the **CONTINUE** button without defining any criteria. If you want to create and apply a filter, use the instructions in the following two sections and then click the **CONTINUE** button.

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Specifying the Categories of Criteria Included in a Filter

The available categories of criteria on the **Select Filters** screen depend on the type of report you selected on the **Select Report Category** screen in "Selecting the Report Type" on page 170. To activate a category so that criteria from it can be included in the filter, click its check box. The associated drop-down menu, radio buttons, or text box is no longer grayed out.

The filter categories that are available for the various report types include the following:

- **APN or RadioType**—Click the **APN** or **Radio Type** radio button to select criteria from that category. The lists of criteria are configured by your system administrator during initial MURAL configuration:
    - **APN**—Access point names
    - **Radio Type**—Mobile technologies such as GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access)
- **Basis on which report needs to be generated**—Click the **DC**, **APN**, or **RAT** radio button to specify the type of entity for which information is reported about the percentage of traffic accounted for by subscribers grouped into percentiles based on their level of activity:
    - **DC**—Distribution centers (gateways)
    - **APN**—Access point names
    - **RAT**—Radio access types
- **Network**—Click the check box for one, two, or all categories (**Area**, **Region**, and **Gateway**). Your system administrator defined the criteria in them during initial MURAL configuration. In the usual configuration, they correspond to geographic areas where network equipment is located. For a network in the United States, for example, the choices in the **Area** category might be regions like **Northeast** and **South**, the choices for **Region** the states in which network equipment is located, and the choices for **Gateway** cities or points of presence (PoPs).

The criteria you select in either or both of the **Area** and **Region** categories determine which criteria are available in the categories below it. For example, if you select the single criterion **California** in the **Region** category, then the available criteria in the **Gateway** category are limited to locations defined to belong to the California region.

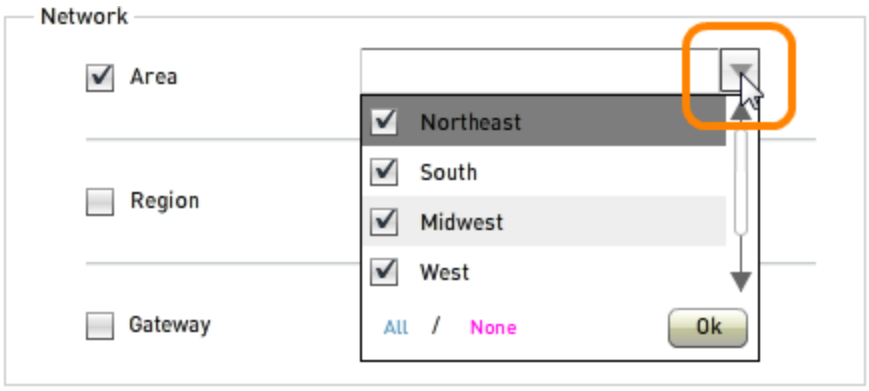
For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" on the facing page.

- **Top N Apps**—Type in the box the number (1 through **N**) of the applications that generate the most traffic to include in the report, if other than the default of **10**.
- **Top N Content Categories**—Type in the box the number (1 through **N**) of the most accessed categories of content to include in the report.
- **Top N Devices**—Type in the box the number (1 through **N**) of the most used models of mobile device to include in the report.
- **Top N Domains**—Type in the box the number (1 through **N**) of the domains that generate the most traffic to include in the report, if other than the default of **10**.
- **Top N Subscribers**—Type in the box the number (1 through **N**) of the most active subscribers to include in the report. To compile the list of most active subscribers, MURAL tracks subscribers over a period of several weeks and ranks their activity level with an algorithm that considers both the volume of traffic and the number of hits and flows each one generates. The subscribers in the list are not necessarily active at the time the filter is applied. For **Content Type Analysis** reports, the default value is **1000**.

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Selecting Filter Criteria from a Drop-Down Menu

To select criteria from a category's drop-down menu, click the open-menu icon ( ) at the right end of the menu box. The following figure shows an example for the **Area** category.



When the menu drops down, all values are checked, which selects them for inclusion in the filter.

- To exclude a value from the filter, click its check box to remove the check.
- To remove the check from all boxes, click None. (If there are a large number of values and you want to include only a few of them in the filter, it is most efficient to deselect all of them this way and then check your selections.)
- To include all values in the filter, click All.
- To add the selected values to the filter and close the drop-down menu, click the **Ok** button. The selected values appear as a comma-separated list in the white box.

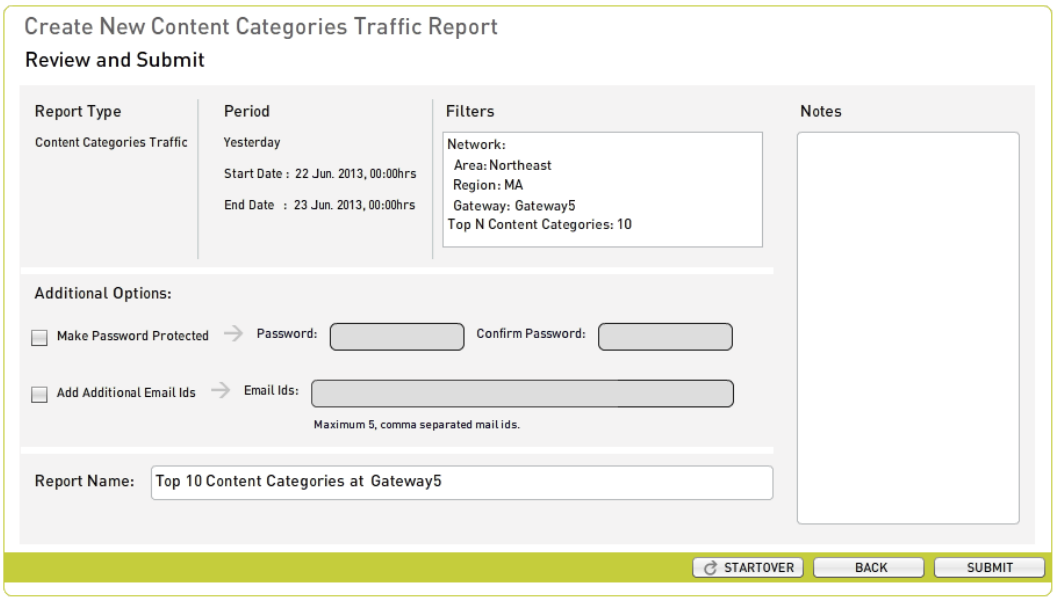
  Note: The **Ok** button is nonoperational if no values are checked.

If you decide that you do not want to apply the criteria you have selected on a drop-down menu, click the category's check box to remove the check. Your selections are discarded and the category is not included in the filter.

Reviewing and Submitting the Report Request

The **Review and Submit** screen summarizes the selections you made on the previous three screens. In the following figure, the **Report Type**, **Period**, and **Filters** fields describe a request

made on 23 June for a report about the ten content categories that were accessed most often on 22 June (**Yesterday**) at the gateway in Massachusetts called **Gateway5**.



You can still change settings in the three fields by clicking the **BACK** button to go back one screen at a time. You can also click the **STARTOVER** button to return to the initial **Select Report Category** screen, clearing your selections on all screens.

In the other fields you can define additional characteristics of the report.

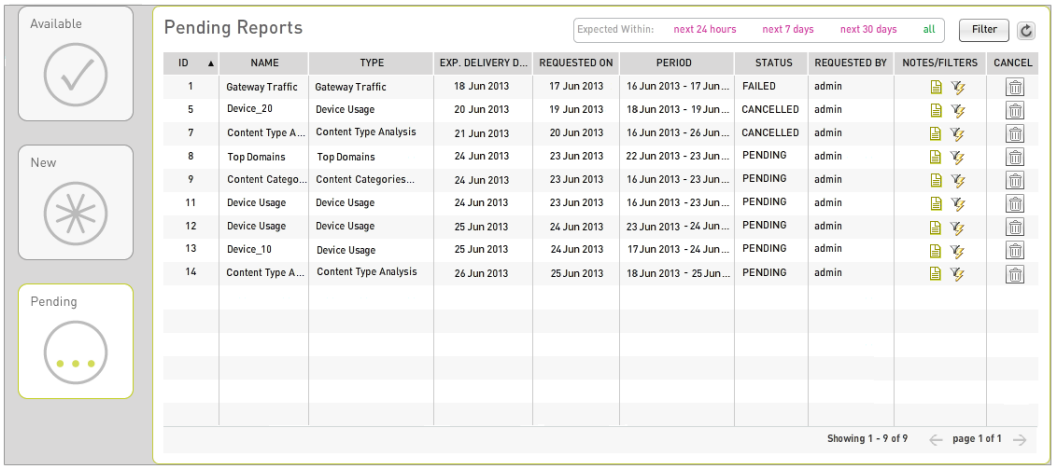
- To require the reader of the report to provide a password, click the **Make Password Protected** check box and type the password in the boxes.
- To add up to five additional recipients to the email list, click the **Add Additional Email Ids** check box and type the email addresses in the box. Separate them with commas but not spaces.
- To assign a nondefault report name, type it in the **Report Name** box. In the figure, the default name **Content Categories Traffic** is changed to **Top 10 Content Categories at Gateway5**.
- To add notes about the report, type them in the **Notes** box. They will be accessible from the **NOTES/FILTERS** column for the report as listed on the **Available** and **Pending** windows.

When you complete your selections, click the **SUBMIT** button to schedule the report.

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Administering Scheduled Reports

The **Pending Reports** window lists reports that are scheduled to be generated. To access the window, click the **Pending** icon in the navigation bar on the left side of the tab. As shown in the figure, the icon turns green.



By default the table lists all pending reports. To limit the listed reports to those with specific characteristics (including name, report type, delivery date, requester, and coverage period), use the filter interface in the upper right corner of the main pane. For more information, see "Filtering a List of Reports" on page 187.

The table provides the following information about each report:

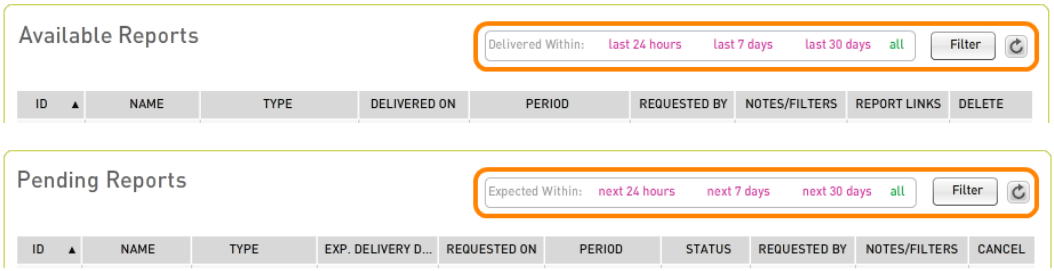
- **ID**—Unique numerical identifier assigned by MURAL.
- **NAME**—Report name, assigned in the **Report Name** field on the **Review and Submit** screen of the **Create New Report** window when the report was scheduled (see "Reviewing and Submitting the Report Request" on page 183).
- **TYPE**—Report type, as set on the **Select Report Category** screen of the **Create New Report** window when the report was scheduled (see "Selecting the Report Type" on page 170).
- **EXPECTED DELIVERY DATE**—Date the report will be generated and added to the list of available reports.

- **REQUESTED ON**—Date the report was scheduled.
- **PERIOD**—Range of dates covered by the report, as set on the **Select Report Period** screen of the **Create New Report** window when the report was scheduled (see "Specifying the Covered Period of Time" on page 172).
- **STATUS**—Report status:
  - **CANCELLED**—Reported was canceled before being generated (see the **CANCEL** item in this list)
  - **FAILED**—Report was not generated
  - **PENDING**—Report has not yet been generated
- **REQUESTED BY**—MURAL user ID of the user who scheduled the report.
- **NOTES/FILTERS**—Icons for opening pop-up windows that display information about the report:
  - To open the **Notes** pop-up window, click the notes icon (). Notes can be entered in the **Notes** box on the **Review and Submit** screen of the **Create New Report** window when a report is scheduled (see "Reviewing and Submitting the Report Request" on page 183).
  - To open the **FILTERS** pop-up window, click the filter icon (). The reported set of filter criteria was defined on the **Select Filters** screen of the **Create New Report** window when the report was scheduled (see "Filtering the Set of Network Entities Included in the Report" on page 180).
- **CANCEL**—Icon () for canceling the generation of a pending report.

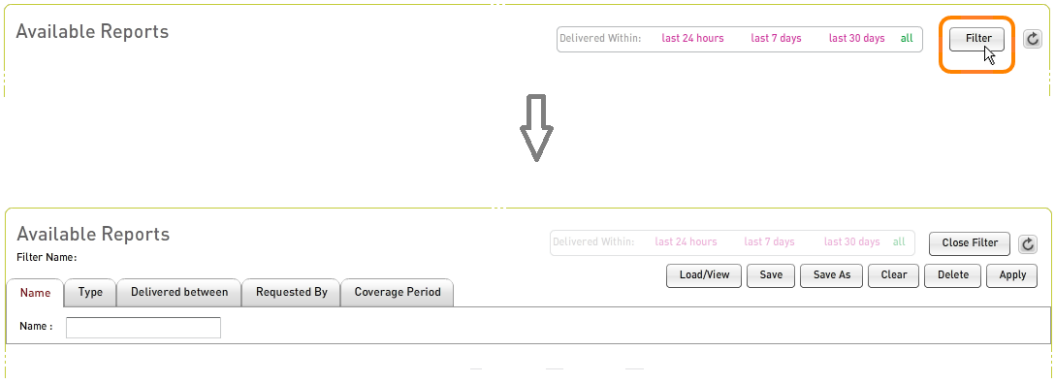
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Filtering a List of Reports

By default the **Available Reports** and **Pending Reports** windows list all reports of that type. To limit the listed reports to those with specific characteristics (including name, report type, delivery date, requester, and coverage period), use the filter interfaces in the upper right corner of the main pane.



To open the filter interface, click the **Filter** button. The following figure shows an example for the **Available Reports** window.



To close the filter interface without changing the applied filter (if any), click the **Close Filter** button. The displayed list of reports does not change.

To undo the application of a filter and return to the full list of reports, click the **Clear** button and then the **Apply** button.

The following sections describe the functions you can perform with the filter interface:

- "Defining and Applying Filters" on the next page
- "Saving Filters and Applying Saved Filters" on page 193

Defining and Applying Filters

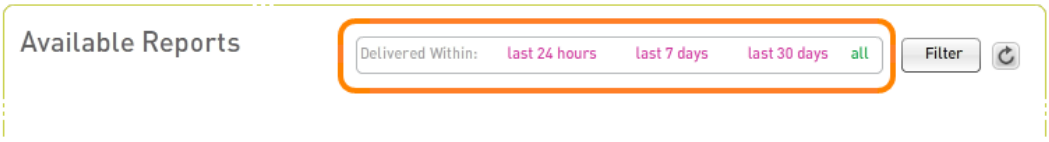
The following sections explain how to filter the list of reports based on different criteria:

- "Filtering by Generation Time" below
- "Filtering by Report Name" on the facing page
- "Filtering by Requester ID" on page 190
- "Filtering by Coverage Period" on page 191
- "Filtering by Delivery Status" on page 192

Filtering by Generation Time

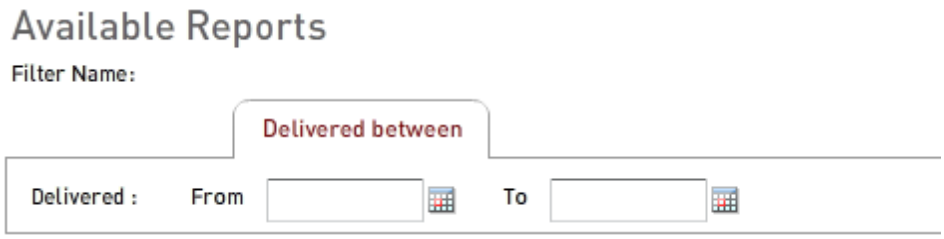
You can filter reports based on the time they were generated (in the **Available Reports** window) or the time they are scheduled for generation (in the **Pending Reports** window).

To specify a standard duration of 24 hours, 7 days, or 30 days that ends at 00:00 hours on the current day (in the **Available Reports** window) or starts at 00:00 hours the next day (in the **Pending Reports** window), click the appropriate name. The currently selected duration appears in green (it is **all** by default).

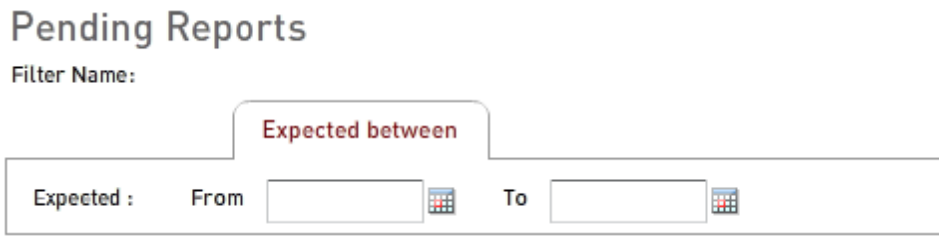


To specify a custom duration, perform the following steps:

1. Click the **Delivered between** tab (in the **Available Reports** window) or the **Expected between** tab (in the **Pending Reports** window).



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2. Click the calendar icon ( ) to the right of the **From** box to open the calendar interface.



   To move to the previous or next month, click the button in the upper left corner ( ) or upper right corner ( ) of the calendar.

   To select the day, click it in the body of the calendar.

3. Repeat the previous step to set the date in the **To** box.

4. Click the **Apply** button.

Filtering by Report Name

To display only reports that have a specified character string in their names (in any position), perform the following steps:

1. Click the **Name** tab.



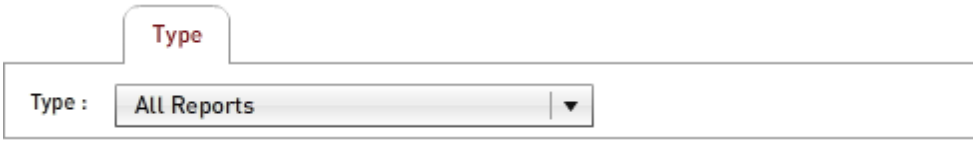
2. In the **Name** box, type the string of characters.

3. Click the **Apply** button.

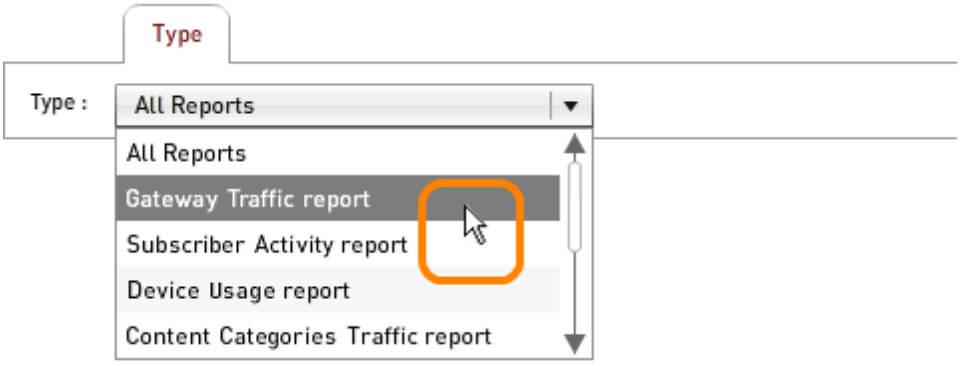
Filtering by Report Type

To display only reports of one type, perform the following steps:

1. Click the **Type** tab.



2. Click the drop-down menu box, and then the report type.



3. Click the **Apply** button.

Filtering by Requester ID

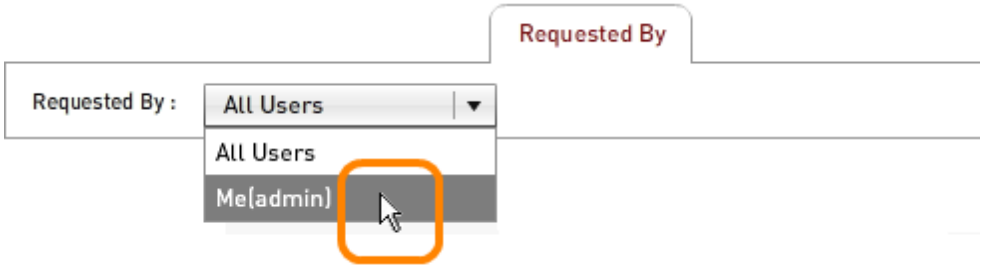
To display only reports that were scheduled by a particular user ID, perform the following steps:

1. Click the **Requested By** tab.



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2. Click the drop-down menu box, and then the user ID.



3. Click the **Apply** button.

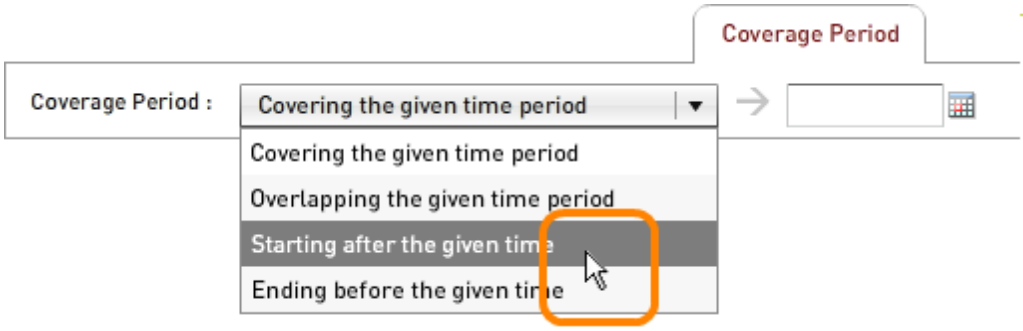
Filtering by Coverage Period

To display only reports that cover a specified time period, perform the following steps:

1. Click the **Coverage Period** tab.



2. Click the drop-down menu box, and then the period type.



3. Click the calendar icon ( ) to the right of the **From** box to open the calendar interface.



   To move to the previous or next month, click the button in the upper left corner ( ) or upper right corner ( ) of the calendar.

   To select the day, click it in the body of the calendar.

4. Repeat the previous step to set the date in the **To** box.

5. Click the **Apply** button.

Filtering by Delivery Status

To display only reports in the **Pending Reports** window that have a particular status, perform the following steps:

1. Click the **Status** tab.



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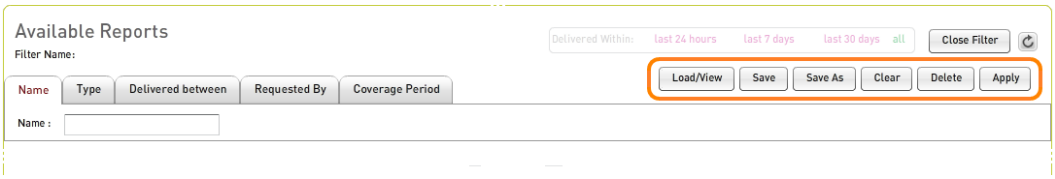
2. Click the **All** drop-down menu box, and then the status.



3. Click the **Apply** button.

Saving Filters and Applying Saved Filters

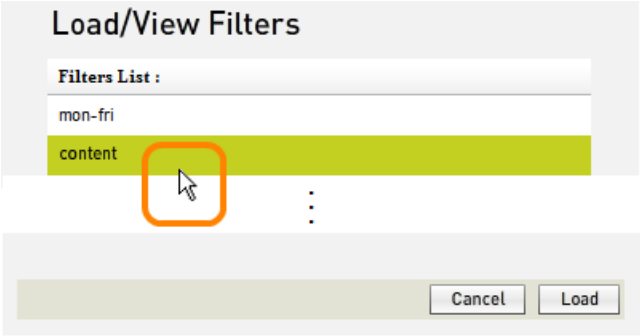
You can save the filters that you create and apply them later. The figure shows the filter interface as it appears in the **Available Reports** window.



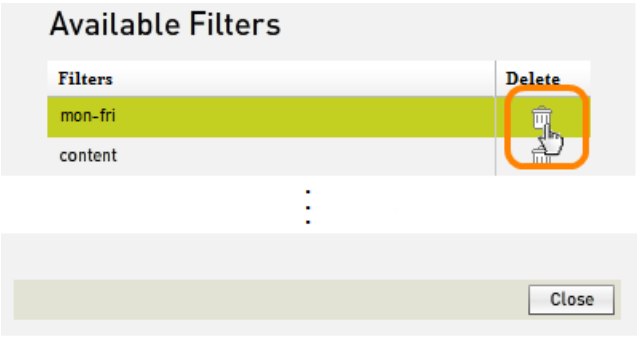
To save a filter that you have defined or is currently applied, click the **Save** button (or the **Save As** button to save it under a different name). In the **Save** window that pops up, type a name for the filter in the **Filter name** box and click the **Save** button.



To view the list of saved filters, click the **Load/View** button. To apply a filter from the **Load/View** window that pops up, click the filter name and then the **Load** button.



To remove a filter from the list of saved filters, click the **Delete** button. In the **Available Filters** window that pops up, click the filter name and then trash can icon (🗑).



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Administering User Accounts

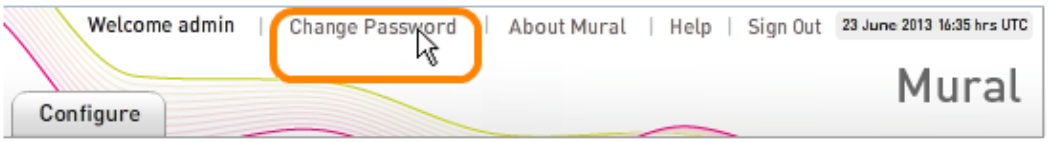
This topic explains how to perform the following administrative tasks in Mobility Unified Reporting and Analytics (MURAL).

- "Changing Your Account Password" below
- "Creating a User Account" on the next page
- "Searching for User Accounts" on page 197
- "Changing the Password, Permissions, Profile Information, and Status of a User Account" on page 199
- "Removing a User Account" on page 200

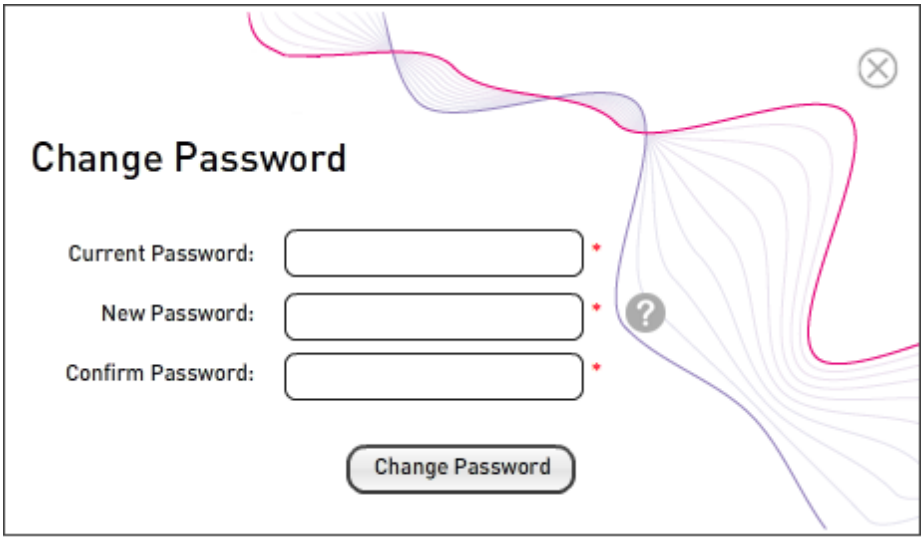
Changing Your Account Password

To change the password for your MURAL user account, perform the following steps:

1. Click **Change Password** in the title bar.



2. In the pop-up window, type your current and new passwords. Passwords must be at least eight characters in length and include at least one uppercase letter and one digit. In addition to letters and digits, passwords can include the following characters: **-!@#$%^&*_+**.



3. To change the password, click the **Change Password** button. To close the window without changing your password, click the close-window icon ( ) in the upper right corner of the window.

Creating a User Account

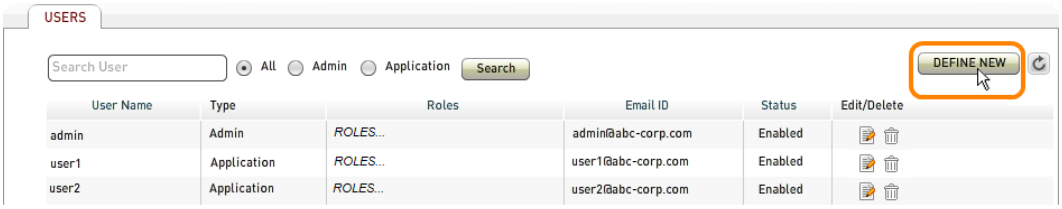
To create a MURAL user account, the **User Type** field in your MURAL account must be set to **Admin**. For instructions, see the step about the **User Details** pop-up window in the following procedure.

1. If the **Configure** tab is not already open, click **Configure** in the title bar.



2. Click the **DEFINE NEW** button in the upper right corner.

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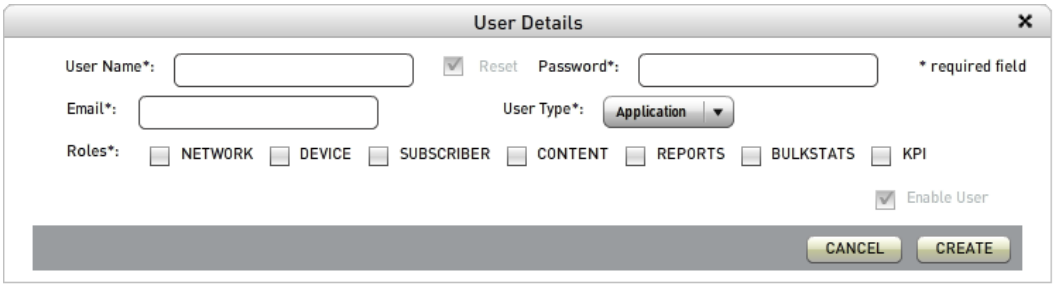
3. In the **User Details** window that pops up:

   a. Type the username, password, and email address. Passwords must be at least eight characters in length and include at least one uppercase letter and one digit. In addition to letters and digits, passwords can include the following characters: **-!@#$%^&*_+**.

   b. In the **User Type** field, choose the appropriate value from the drop-down menu:

      - **Application**—User can access information on each tab for which the check box is checked in the **Roles** field
      - **Admin**—User can administer user accounts in addition to accessing tabs corresponding to checked roles

   c. In the **Roles** field, click the check box for each tab you want the user to be able to access.



4. To create the account, click the **CREATE** button. To close the **User Details** window without creating a new account, click the **CANCEL** button or the close-window icon (✖) in the window's title bar.

Searching for User Accounts

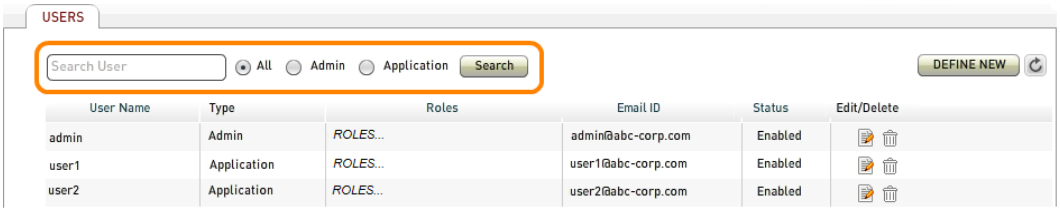
The number of user accounts listed on the **USERS** tab depends on the size of the browser window. If the list of accounts extends to the bottom of the window but does not include an

account of interest, you can use the search feature to locate it. You can also use the search feature to display subsets of accounts that share a sequence of letters in their names.

1. If the **Configure** tab is not already open, click **Configure** in the title bar.

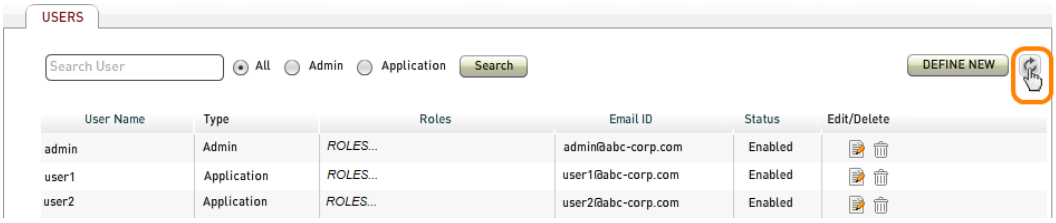


2. Type one or more characters in the **Search User** box. The results include all accounts that have the sequence of letters anywhere in their names.



3. Click the appropriate radio button to choose the types of accounts included as search candidates:
   - **All**—All accounts (the default)
   - **Admin**—Only accounts with the **User Type** field set to **Admin**
   - **Application**—Only accounts with the **User Type** field set to **Application**
4. Click the **Search** button. The list of accounts is updated to include only matching names.

To display the full list of accounts again, click the refresh button ( ) to the right of the **DEFINE NEW** button.



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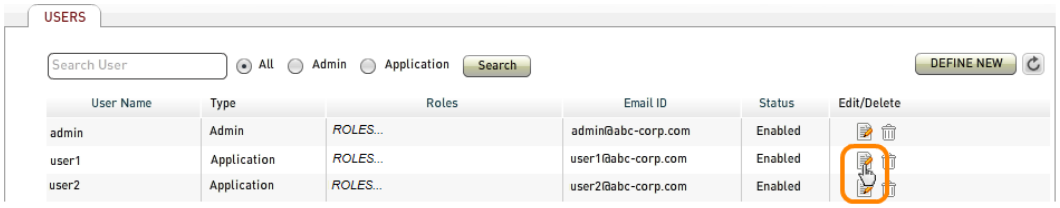
Changing the Password, Permissions, Profile Information, and Status of a User Account

To edit a user account as described in this section, the **User Type** field in your MURAL account must be set to **Admin**. For instructions, see the step about the **User Details** pop-up window in the following procedure.

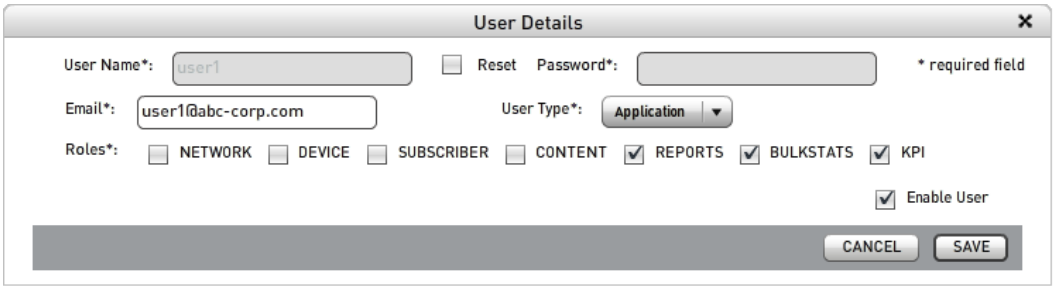
1. If the **Configure** tab is not already open, click **Configure** in the title bar.



2. Click the edit icon () in the **Edit/Delete** column of the account you want to modify.



3. In the **User Details** window that pops up, you can change any field except **Name** (the following figure depicts the account called **user1**).



- To reset the password, click the **Reset** check box that is to the left of the **Password** field, then type the new password in the field. Passwords must be at least eight characters in length and include at least one uppercase letter and one digit. In addition to letters and digits, passwords can include the following characters: **-!@#$%^&*_+**.

- To change the email address, type the new address in the **Email** field.
- To change the account type, click the button in the **User Type** field and then the desired value from the drop-down menu.
    - **Application**—User can access information on each tab for which the check box is checked in the **Roles** field
    - **Admin**—User can administer user accounts in addition to accessing tabs corresponding to checked roles
- To change permissions, click check boxes in the **Roles** field to grant (☑) or remove (☐) each permission.
- To disable the account, click the **Enable User** check box in the lower right corner of the window, removing the check. This prevents the user from logging in to MURAL but does not remove the account from the user database. For removal instructions, see "Removing a User Account" below.
- To re-enable a disabled account, click the **Enable User** check box to replace the check.

4. Click the **SAVE** button. To close the **User Details** window without modifying the account, click the **CANCEL** button or the close-window icon (✖) in the window's title bar.

Removing a User Account

To remove a user account, the **User Type** field in your MURAL account must be set to **Admin**. For instructions, see the step about the **User Details** pop-up window in "Creating a User Account" on page 196.

1. If the **Configure** tab is not already open, click **Configure** in the title bar.



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2. Click the trash can icon (🗑) in the **Edit/Delete** column of the account you want to remove.

