MURAL User Guide

Version 3.9

Americas Headquarters

Cisco Systems, Inc.

170 West Tasman Drive

San Jose, CA 95134-1706 USA

http://www.cisco.com

Tel: 408 526-4000

     800 553-NETS (6387)

Fax: 408 527-0883

Table of Contents

Introducing MURAL

Mobility Unified Reporting and Analytics (MURAL) provides network operators with near-real-time insight into traffic patterns on their networks. Traffic distribution is analyzed across multiple dimensions, including data centers, radio access types, mobile devices, subscribers, and content types. Each primary dimension has its own screen (referred to as a *tab*) in the user interface, with charts and tables you can use to further analyze the traffic cross-dimensionally.

For details about the traffic dimension featured on each tab, see the indicated topics:

- **Network**—Analysis of traffic distribution across the gateways in your network. See "Analyzing Traffic Distribution Across Network Sites" on page 5.

- **Radio Access**—Analysis of traffic distribution across radio access types (RATs) used by your subscribers. See "Analyzing Traffic Distribution Across Radio Access Types" on page 11.

- **Device**—Analysis of traffic distribution across the mobile devices (such as smart phones and tablet computers) that subscribers used to access the network. See "Analyzing Traffic Distribution Across Mobile Devices" on page 17.

- **Subscriber**—Analysis of traffic distribution across subscriber segments. See "Analyzing Traffic Distribution Across Subscriber Segments" on page 23.

- **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 29.

- **Bulkstats**—Summaries of performance statistics for the Cisco ASR. See"Interpreting Performance Statistics for the ASR" on page 147.

- **KPI**—Summaries of key performance indicators (KPIs) for the Cisco ASR. See"Interpreting Key Performance Indicators from the ASR" on page 165.

- **Reports**—Summaries of traffic analysis for different periods of time (days, weeks, months). See "Scheduling and Interpreting Statistical Reports" on page 187.

For a discussion of cross-dimensional analysis, see "Performing In-Depth Data Analysis" on page 131.

Navigating the Opening Page

After you provide your username and password on the login page, the opening page you see depends on whether your system administrator has installed associated applications in addition to MURAL:

- IfMURAL is configured as the only application (the*stand-alone* configuration), the opening page displays the launcher with **Content Analytics** and **System Monitoring Interface**. You can click the **Launch Application** button to launch the corresponding application instance.

  Note: System Monitoring Interface (SMI) tab is available for administrator only. If you notice a warning sign on the SMI tab, it indicates that the HDFS is down or/and CoreJob is lagging by two hours or more. Launch the application to get further details.

- If associated applications are installed along with MURAL (the *landing-page* configuration), a landing page is displayed as the opening page.
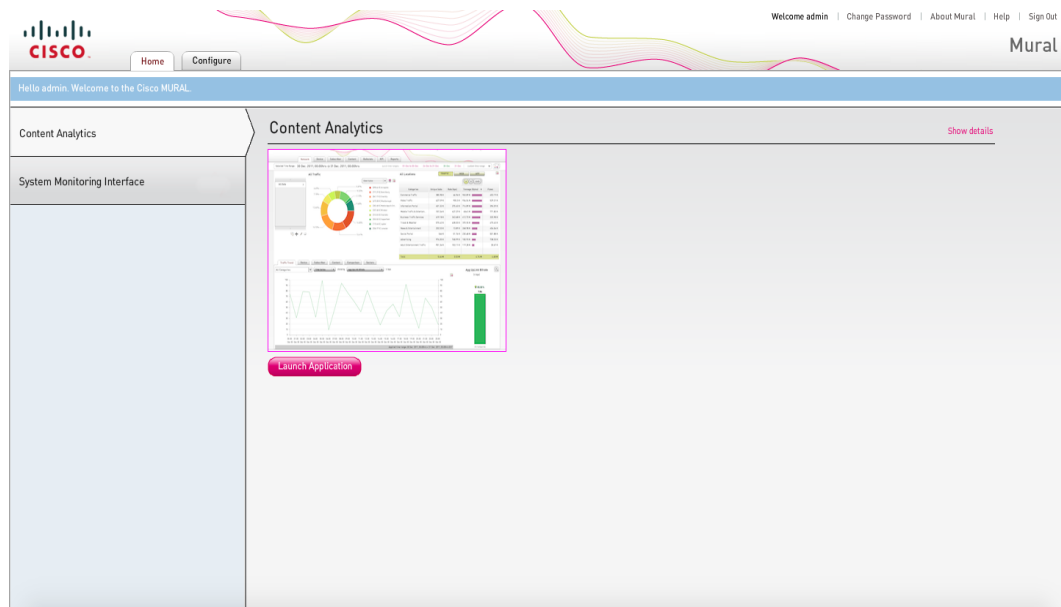
The landing page features two tabs:

- The **Home** tab (open by default) lists the available applications in a navigation panel on the left side of the screen. Perform the following to launch an application:

  - To open MURAL Content Analytics, click **Content Analytics** in the left-hand navigation pane and then click the **Launch Application** icon in the main pane. The **Network** tab is displayed; see "Analyzing Traffic Distribution Across Network Sites" on page 5.
  - To open System Monitoring Interface, click **System Monitoring Interface** and then click **Launch Application** icon in the main page. The interface provides various tabs to check the system monitoring.

- The **Configure** tab provides the interface for administering user accounts.

The figures in this document depict the stand-alone configuration of MURAL.

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 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.
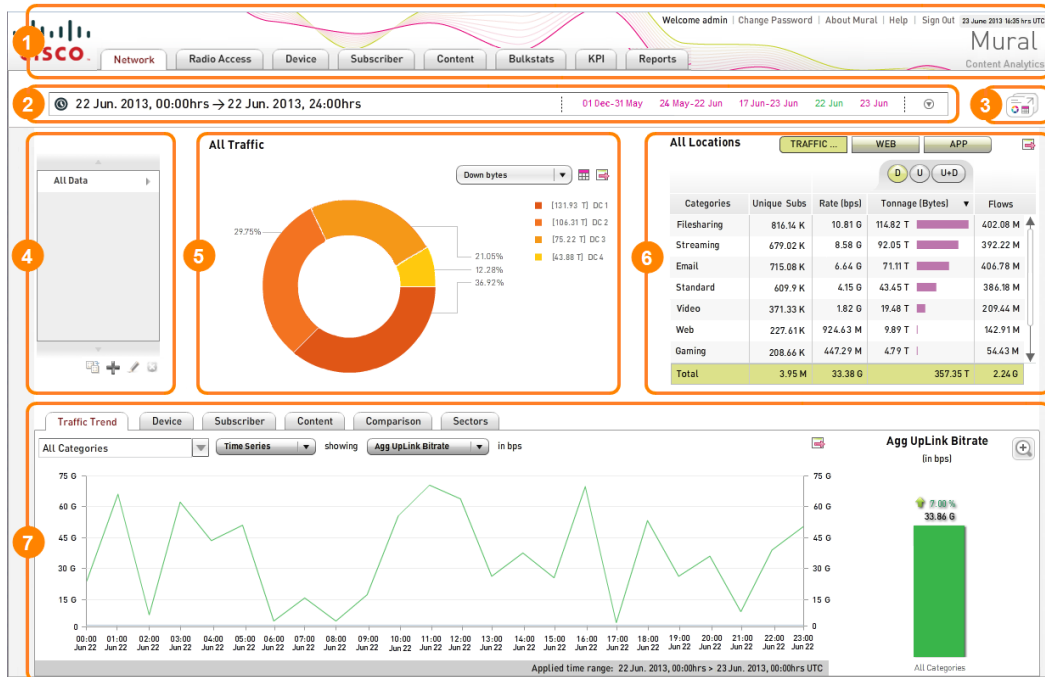
The panes in the numbered boxes provide the following functionality:

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 35.

2. Time range selector—Use this panel to set the period of time for which data is reported on the tab. By default, previous day's data is displayed. See"Setting the Time Range for Displayed Data" on page 39.

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 141.

4. Filter panel—Use this panel to define and apply filters that limit the data inboxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the devices that match the filter criteriaservices or devices that match the filter criteriasubscribers who generate the most traffic. When no filter is applied, the data includes all devices.See "Using Filters to Fine-Tune the Reported Data" on page 51.

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 71.

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

   - **TRAFFIC TYPE**—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 various service providers, such as **google.com** or **apple.com**

   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   - **SECURED WEB**—Traffic is categorized by security protocols, that is **HTTP** and **HTTPS**, HTTPS is added to show the encrypted data. By default, the doughnut chart displays the list of all the service providers. You can click HTTP or HTTPS from the table to view the list of corresponding service providers.

   See "Analyzing Traffic by Category" on page 83.

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 93.

   - 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 71 and "Interpreting Usage Statistics" on page 117.

   - On the **Comparison** subtab, traffic patterns over time are tracked in a time-series line chart for three of the sites in box **5**. See "Comparing Network Entities" on page 109.

   - On the **Sectors** subtab, statistics for network sectors are presented in a table. See "Analyzing Traffic in Mobile Network Sectors" on page 127.

For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 131.

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 doughnut chart in 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 service providers including **google.com**, which accounted for the largest amount of download traffic. To learn more about the service provider, **google** you click its row in the service providers 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 distribution of devices for **google.com**.
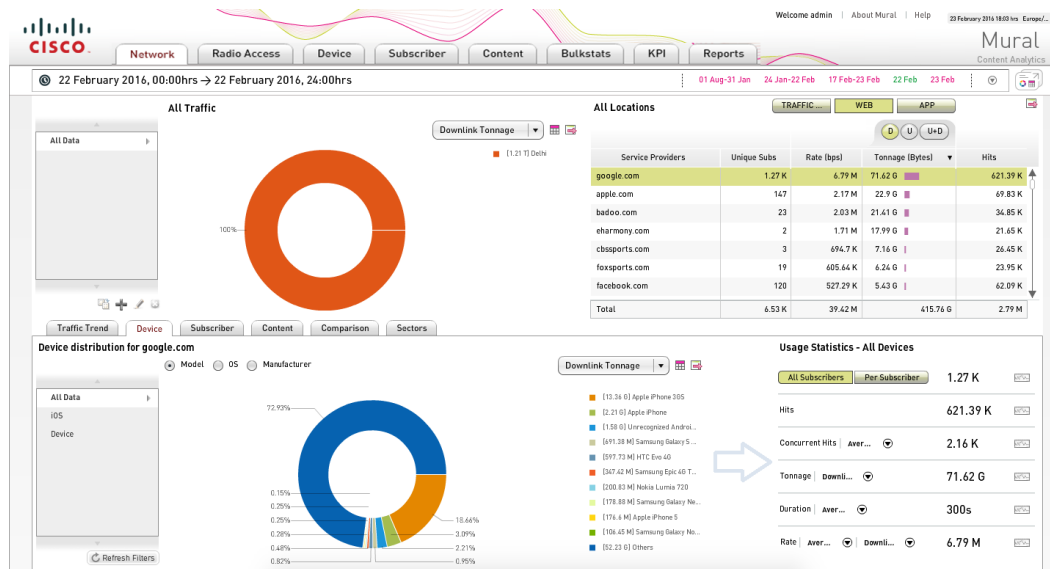
You switch to the **Subscriber** subtab to examine subscriber distribution for google.-com as the service provider, where you notice that the subscribers in the **Heavy** segment accounted for the majority of the traffic, and that the average duration is far higher than normal. This indicates that the spike in network traffic at **DC 1** is the result of a viral video, which is most likely temporary and so does not war-rant provisioning additional permanent capacity.

Copyright © 2016, Cisco Systems, Inc.
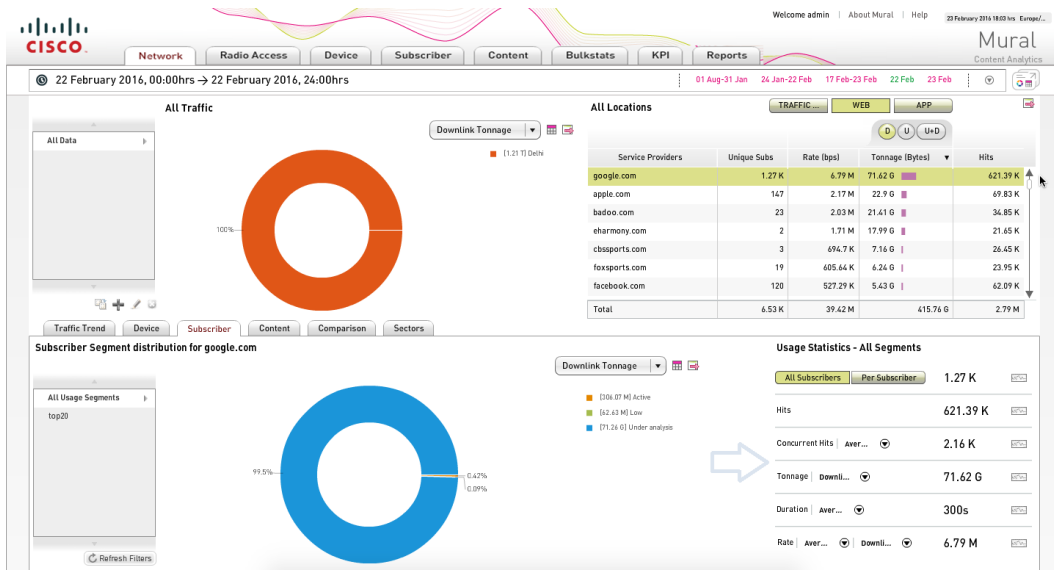
Analyzing Traffic Distribution Across Radio Access Types

The **Radio Access** tab in Mobility Unified Reporting and Analytics (MURAL) reports the distribution of network traffic across the radio access types that subscribers use to connect to your network.

Navigating the Radio Access Tab

The **Radio Access** tab is divided functionally into several panes, numbered **1** through **7** in the following figure.
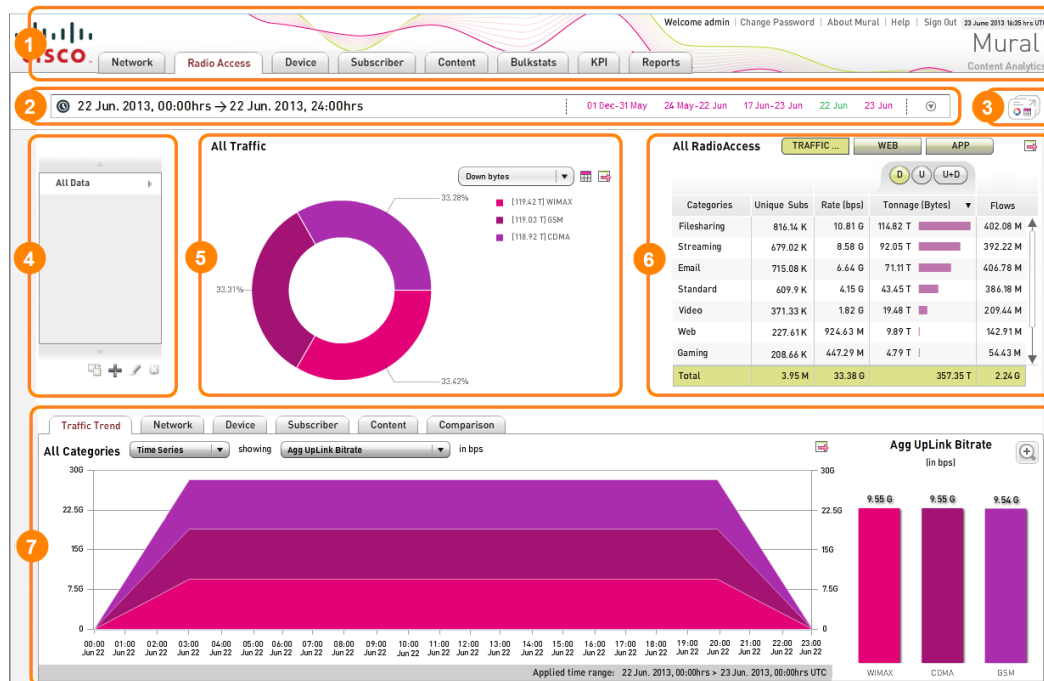
The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized information on each tab (click **Radio Access** to access the **Radio Access** 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 35.

2. Time range selector—Use this panel to set the period of time for which data is reported on the tab. By default, previous day's data is displayed. See"Setting the Time Range for Displayed Data" on page 39.

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 141.

4. Filter panel—Use this panel to define and apply filters that limit the data inboxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the devices that match the filter criteriaservices or devices that match the filter criteriasubscribers who generate the most traffic. When no filter is applied, the data includes all devices.See "Using Filters to Fine-Tune the Reported Data" on page 51.

5. Traffic distribution—Indicates the proportion of total network traffic that used each radio access type. When you first access the **Radio Access** 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 71.

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

   - **TRAFFIC TYPE**—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 various service providers, such as **google.com** or **apple.com**

   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   - **SECURED WEB**—Traffic is categorized by security protocols, that is **HTTP** and **HTTPS**, HTTPS is added to show the encrypted data. By default, the doughnut chart displays the list of all the service

providers. You can click HTTP or HTTPS from the table to view the list of corresponding service providers.

See "Analyzing Traffic by Category" on page 83.

7. Subtabs—Provide detailed information about individual content categories or radio access types. 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 chart for one or more of the radio access types in box **5**. See "Analyzing Traffic Trend Data" on page 93.

- On the **Network**, **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 71 and "Interpreting Usage Statistics" on page 117.

- On the **Comparison** subtab, traffic patterns over time are tracked in a time-series chart for three of the radio access types in box **5**. See "Comparing Network Entities" on page 109.

For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 131.

Analyzing Traffic Distribution on Subtabs of the Radio Access Tab

On the **Radio Access** tab, the **Network**, **Device**, **Subscriber**, and **Content** subtabs present additional information compared to those subtabs on other top-level tabs. Instead of a doughnut chart with traffic distribution data, a horizontal bar chart further breaks down the traffic distribution for each gateway, device, subscriber class, or content type across the radio access types represented in the doughnut chart in the upper part of the main pane.

The following figure depicts the **Device** subtab on the **Radio Access** tab. For each of the device models that appear in the doughnut chart on the top-level **Device** tab (see "Navigating the Device Tab" on page 18), the horizontal bar chart reports the proportion of traffic accounted for by the three radio access types in the doughnut chart on this tab (WIMAX, GSM, and CDMA).
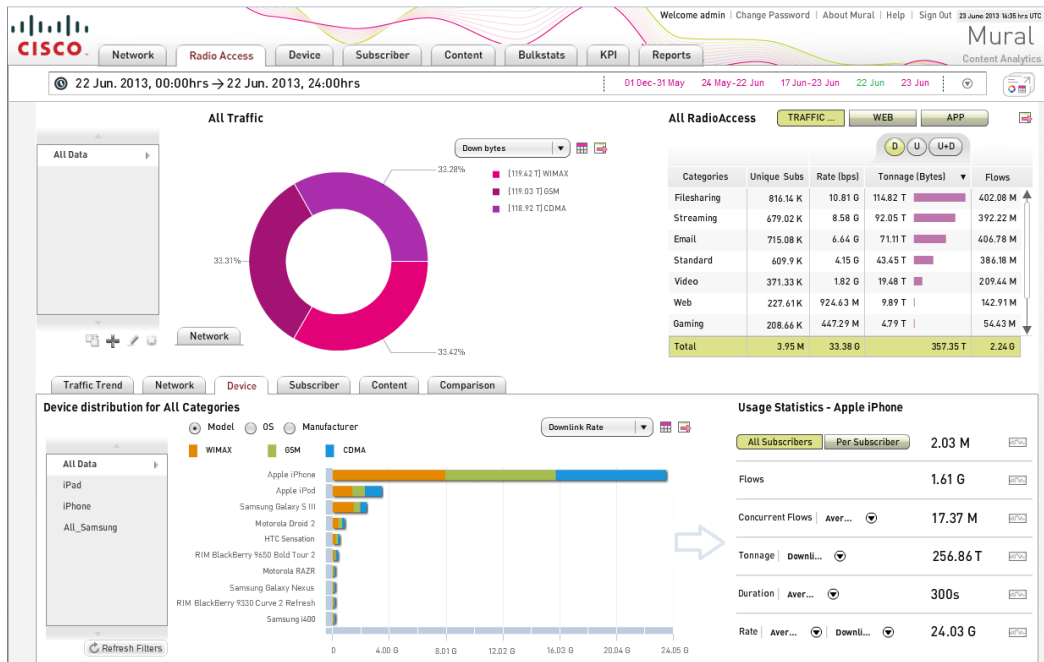
To display the exact value for a combination of entity and radio access type (here, the Apple iPhone and WIMAX type) , mouse over the bar.
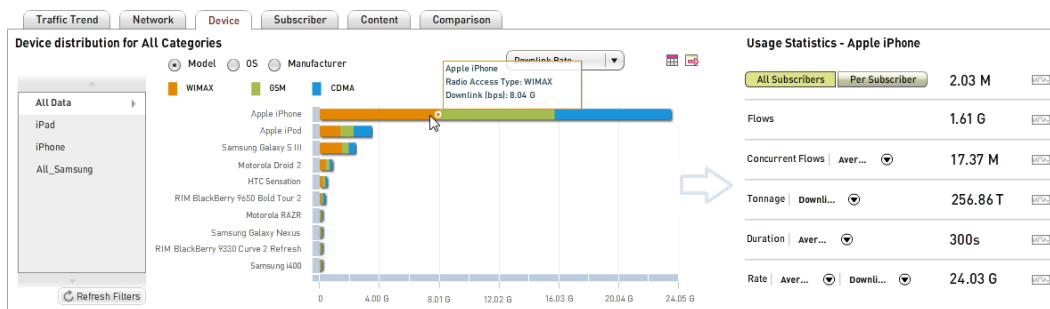
By default, the **Usage Statistics** table reports values for the first (top) horizontal bar on the subtab. To display values for another entity, click anywhere on its horizontal bar.

For discussion of the **Traffic Trend** and **Comparison** subtabs on the **Radio Access**
tab, see "Analyzing Traffic Trend Data" on page 93 and "Comparing Network Entit-
ies" on page 109.

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.
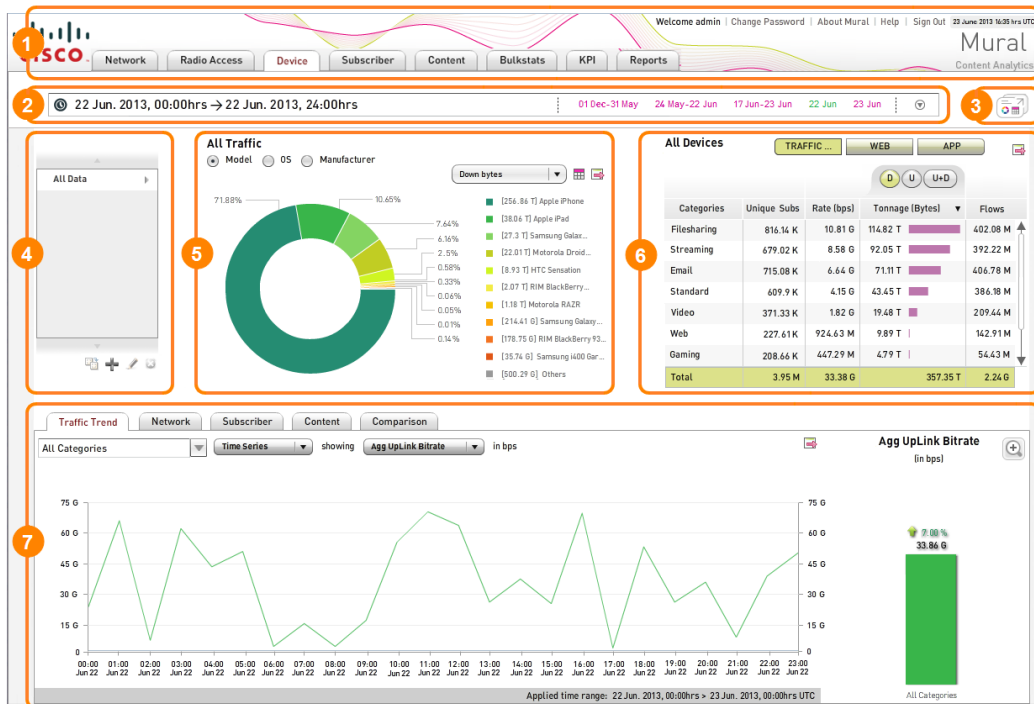
The panes in the numbered boxes provide the following functionality:

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 35.

2. Time range selector—Use this panel to set the period of time for which data is reported on the tab. By default, previous day's data is displayed. See"Setting the Time Range for Displayed Data" on page 39.

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 141.

4. Filter panel—Use this panel to define and apply filters that limit the data inboxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the devices that match the filter criteriaservices or devices that match the filter criteriasubscribers who generate the most traffic. When no filter is applied, the data includes all devices.See "Using Filters to Fine-Tune the Reported Data" on page 51.

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 71.

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

   - **TRAFFIC TYPE**—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 various service providers, such as **google.com** or **apple.com**

   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   - **SECURED WEB**—Traffic is categorized by security protocols, that is **HTTP** and **HTTPS**, HTTPS is added to show the encrypted data. By default, the doughnut chart displays the list of all the service providers. You can click HTTP or HTTPS from the table to view the list of corresponding service providers.

   See "Analyzing Traffic by Category" on page 83.

7. Subtabs—Provide detailed information about individual content categories or 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 93.

- 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 71 and "Interpreting Usage Statistics" on page 117.

- On the **Comparison** subtab, traffic patterns over time are tracked in a time-series line chart for three of the devices in box **5**. See "Comparing Network Entities" on page 109.

For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 131.

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.
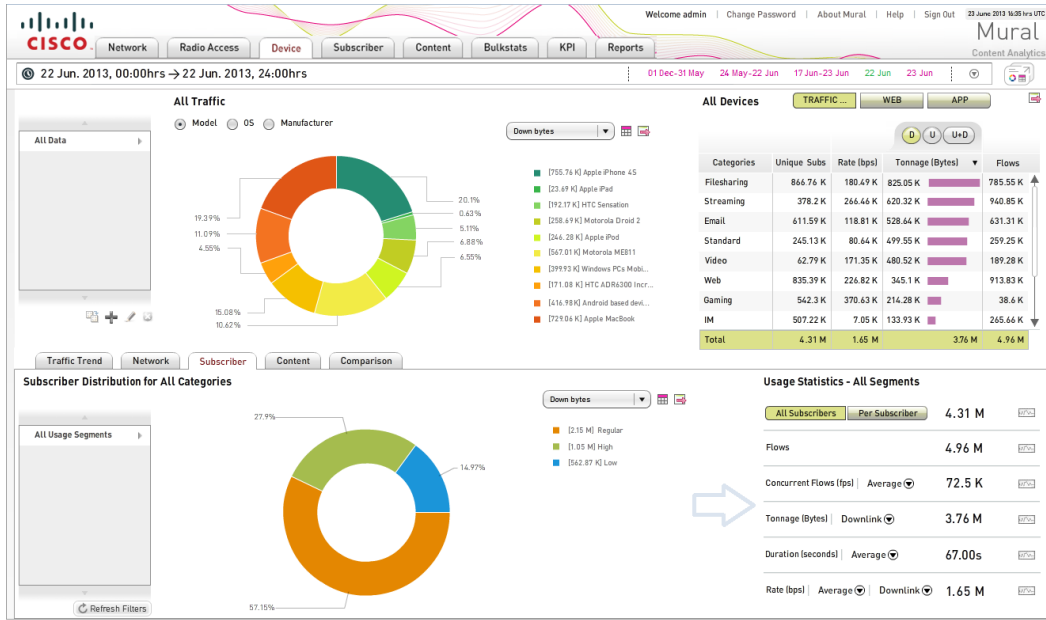
When you click on the wedge for the iPhone 4S in the doughnut chart, popping it outward from the doughnut as shown in the following figure, the data in the categories table and **Subscriber** subtab change to represent iPhone 4S users only. At a glance you can see the most popular content categories 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.
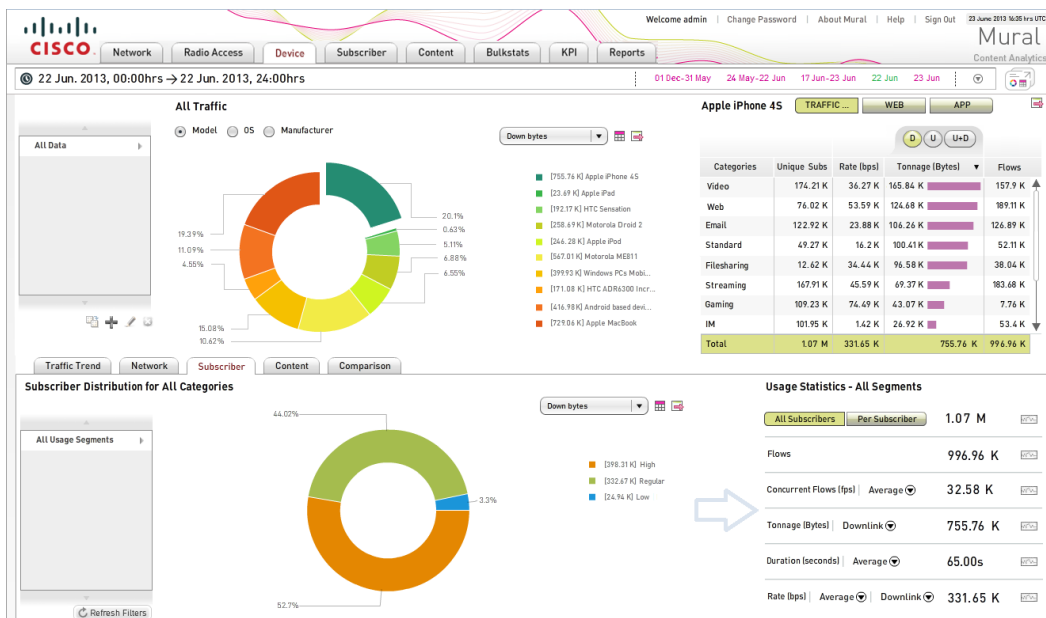
Analyzing Traffic Distribution Across Subscriber Segments

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 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.
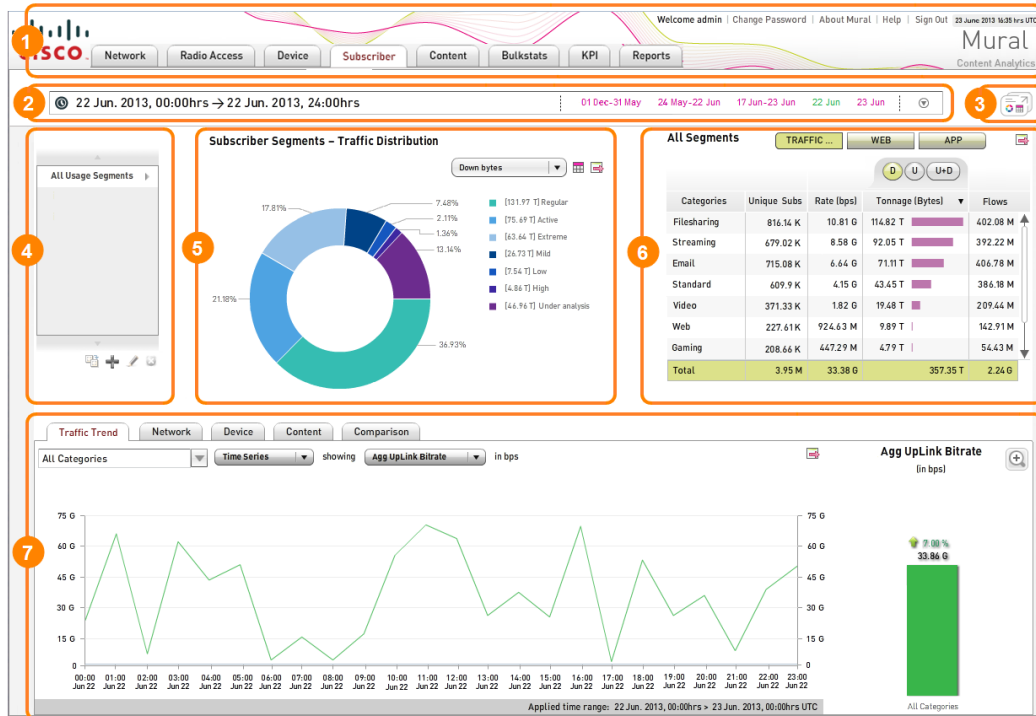
The panes in the numbered boxes provide the following functionality:

1. MURAL title bar—On the left side, provides access to the specialized inform-
   ation 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 Con-
   trolling the Session" on page 35.

2. Time range selector—Use this panel to set the period of time for which data
   is reported on the tab. By default, previous day's data is displayed. See"Set-
   ting the Time Range for Displayed Data" on page 39.

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 141.

4. Filter panel—Use this panel to define and apply filters that limit the data inboxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the devices that match the filter criteriaservices or devices that match the filter criteriasubscribers who generate the most traffic. When no filter is applied, the data includes all devices.See "Using Filters to Fine-Tune the Reported Data" on page 51.

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.

   The segments are made up of individual users of mobile devices who generated the indicated average daily volume of traffic in the previous month. Following are default values for each segment; consult your system administrator to determine if they were changed during configuration of MURAL at your site.

   - Extreme—More than 600 megabytes (MB)

   - High—300 to 600 MB

   - Active—150 to 300 MB

   - Regular—60 to 150 MB

   - Mild—30 to 60 MB

   - Low—Less than 30 MB

   The **Under analysis** segment represents currently active subscribers that were not active during the entire previous month and so have not been assigned to one of the six classes.

When you first access the **Subscriber** tab, the data is presented in a dough-nut chart, but you can also view it in table format. For more information, see "Analyzing Traffic Distribution" on page 71.

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

   - **TRAFFIC TYPE**—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 various service providers, such as **google.com** or **apple.com**

   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   - **SECURED WEB**—Traffic is categorized by security protocols, that is **HTTP** and **HTTPS**, HTTPS is added to show the encrypted data. By default, the doughnut chart displays the list of all the service pro-viders. You can click HTTP or HTTPS from the table to view the list of corresponding service providers.

   See "Analyzing Traffic by Category" on page 83.

7. Subtabs—Provide detailed information about individual content categories or subscriber segments. 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 93.

   - 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 inform-ation 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 71 and "Inter-
preting Usage Statistics" on page 117.

- On the **Comparison** subtab, traffic patterns over time are tracked in a
  time-series line chart for three of the segments in box **5**. See "Com-
  paring Network Entities" on page 109.

For further information about the relationship between the parts of the main
pane, see "Performing In-Depth Data Analysis" on page 131.

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 driv-
ing 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 per-
formance for users of other applications.

In the following figure, the doughnut chart in the upper left quadrant of the **Sub-
scriber** tab reports traffic distribution across all subscriber segments. The table to
its right highlights the current demand for **badoo.com** as the service provide
because the **badoo.com** row is selected, the **Device** subtab in the lower half of the
tab reports the most popular devices accessing data through service provider,
badoo.com
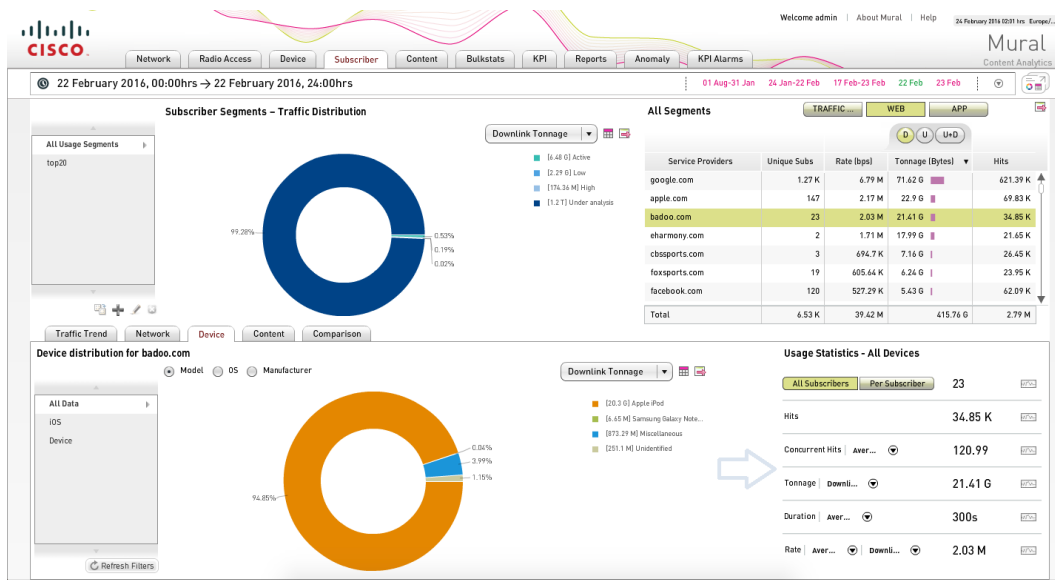
Subscribers with service providers as **badoo.com** using Apple iPod generated the most downlink traffic. When you click on the wedge for the Apple iPod to pop it outward from the doughnut, the **Usage Statistics** table reports values only for subscribers using the Apple iPod.
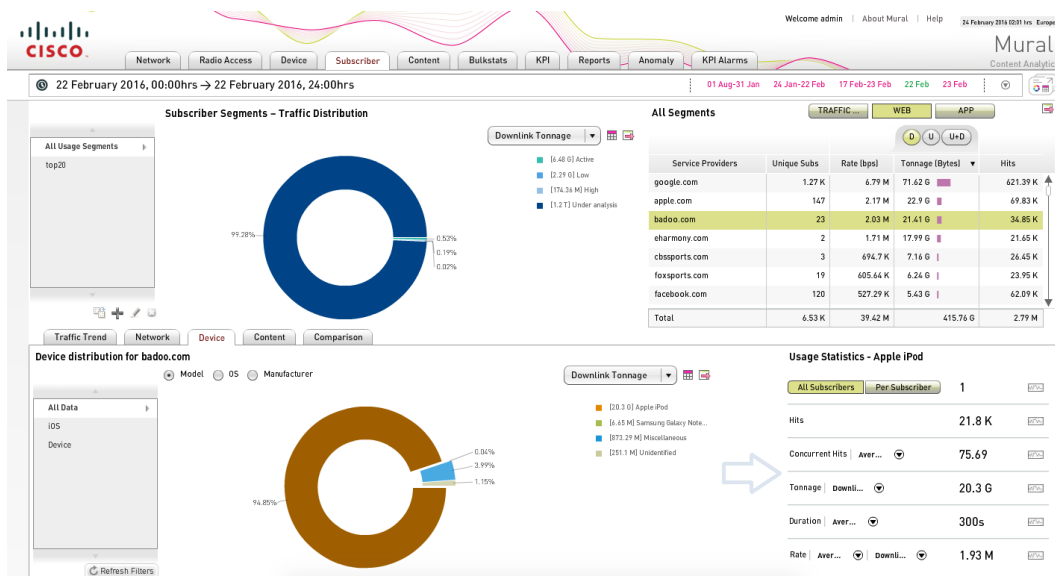
## Analyzing Traffic Distribution Across Types of Content

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 service providers are contributing the most in traffic?

- 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 service provider 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.
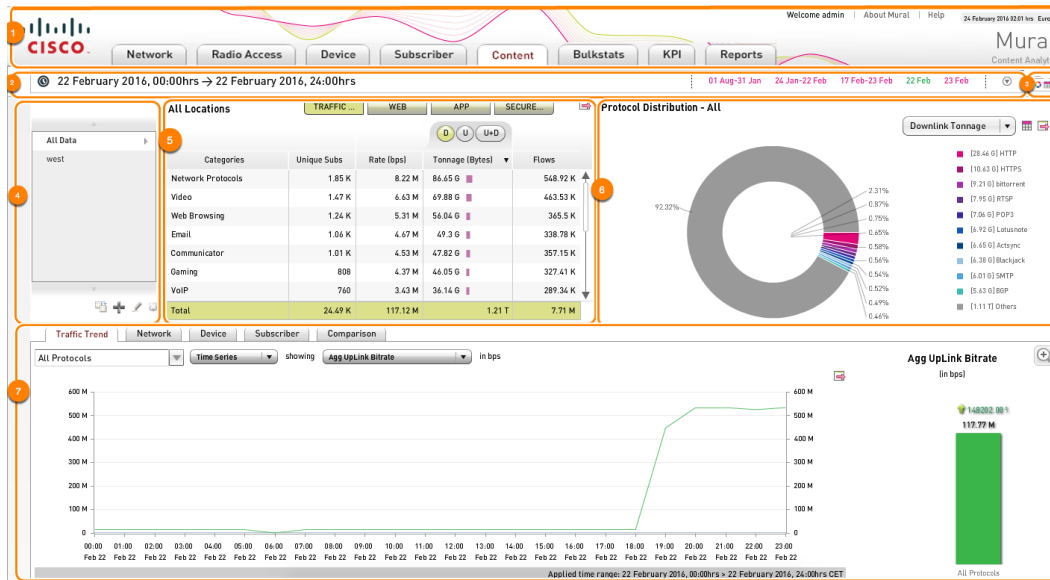
The panes in the numbered boxes provide the following functionality:

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 35.

2. Time range selector—Use this panel to set the period of time for which data is reported on the tab. By default, previous day's data is displayed. See"Setting the Time Range for Displayed Data" on page 39.

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 141.

4. Filter panel—Use this panel to define and apply filters that limit the data

inboxes **5** and **6** (and by implication on the subtabs in box **7**) to include only the devices that match the filter criteriaservices or devices that match the filter criteriasubscribers who generate the most traffic. When no filter is applied, the data includes all devices.See "Using Filters to Fine-Tune the Reported Data" on page 51.

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

   - **TRAFFIC TYPE**—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 various service providers, such as **google.com** or **apple.com**

   - **APP**—Traffic is categorized by type of application used to request and deliver the content, such as **Browser** or **Social Networking**

   - **SECURED WEB**—Traffic is categorized by security protocols, that is **HTTP** and **HTTPS**, HTTPS is added to show the encrypted data. By default, the doughnut chart displays the list of all the service providers. You can click HTTP or HTTPS from the table to view the list of corresponding service providers.

   See "Analyzing Traffic by Category" on page 83.

6. Traffic distribution— 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 71.

7. Subtabs—Provide detailed information about either traffic types, content providers, or applications. 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 entities in box **6**. See "Analyzing Traffic Trend Data" on page 93.

- 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 entities in box **6**, or for a single selected entity. See "Analyzing Traffic Distribution" on page 71 and "Interpreting Usage Statistics" on page 117.

- On the **Comparison** subtab, traffic patterns over time are tracked in a time-series line chart for three of the categories in box **5**. See "Comparing Network Entities" on page 109.

For further information about the relationship between the parts of the main pane, see "Performing In-Depth Data Analysis" on page 131.

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 protocol distribution for **facebook.com**. The doughnut chart to its right reports the proportion of news content provided by various websites. The wedge for **facebook.com** is selected (popped outward from the doughnut), so the **Network** subtab reports the distribution of traffic for **facebook.com** across the gateways in the network. The **Usage Statistics** table reports values for all gateways distrbution for all protocols.
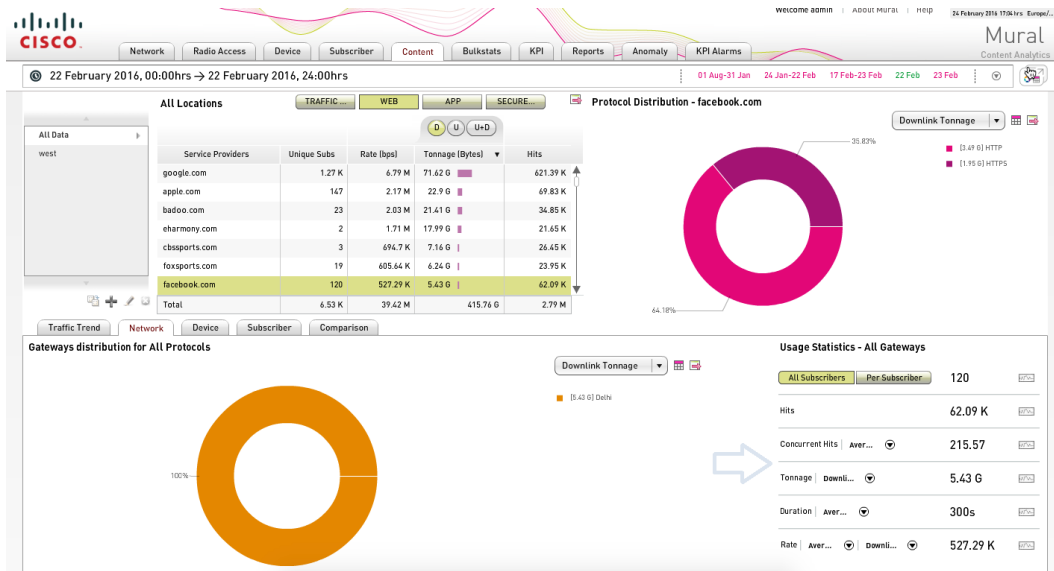
Accessing the Main Tabs and Controlling the Session

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 HTTP Errors** tab.

Note: The figures in this topic depict the stand-alone configuration of MURAL. Some elements might be different in the landing-page configuration, as detailed in the following sections.
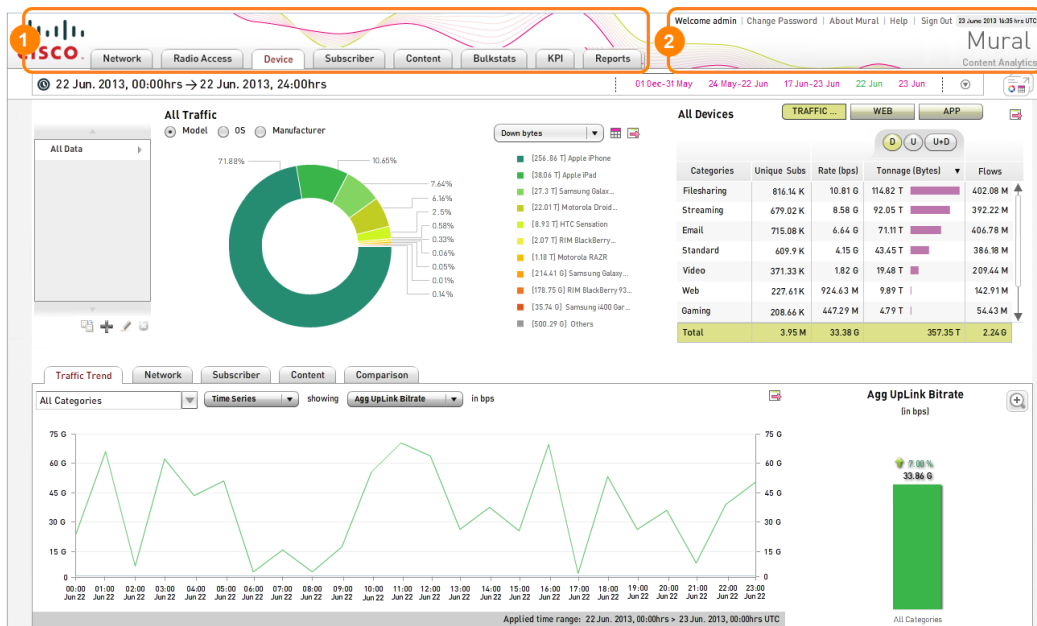

The elements in the numbered panes provide the following functionality:

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 the interface for displaying help topics. In the stand-alone configuration of MURAL, there are also interfaces for changing your password and closing the session. In the landing-page configuration, these interfaces might be on the landing page instead. See "Controlling the MURAL Session" on page 37.

Accessing the MURAL Tabs

The pane enclosed in box **2** in the following figure displays the specialized inform-
ation available on each tab in MURAL(in the figure, 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).
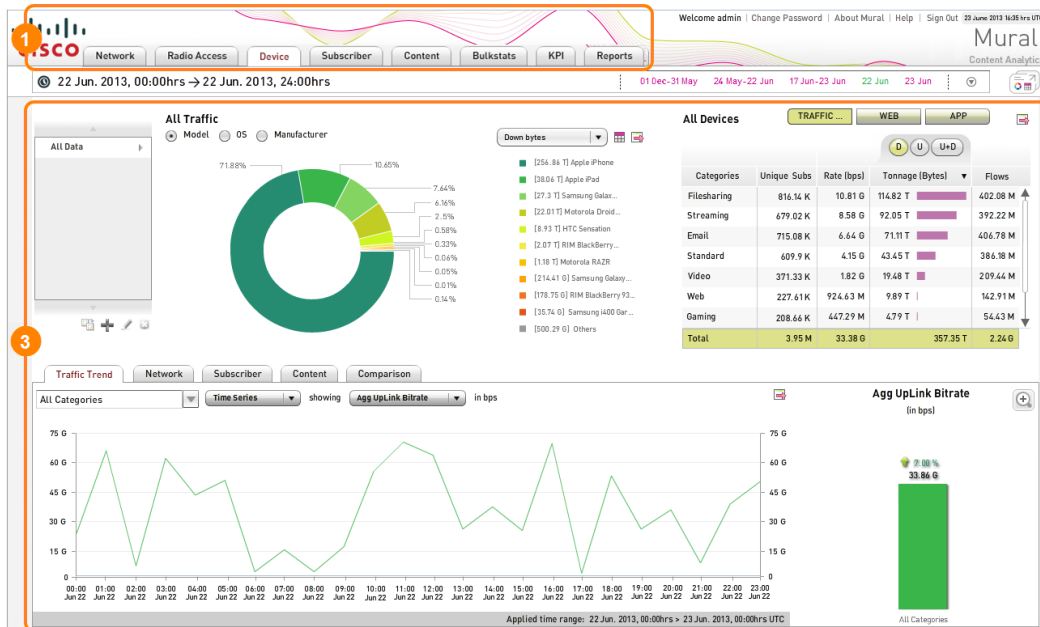
For details about the information featured on each tab, see the indicated topics:

- **Network**—Analysis of traffic distribution across the gateways in your net-
  work. See "Analyzing Traffic Distribution Across Network Sites" on page 5.

- **Radio Access**—Analysis of traffic distribution across radio access types
  (RATs) used by your subscribers. See "Analyzing Traffic Distribution Across
  Radio Access Types" on page 11.

- **Device**—Analysis of traffic distribution across the mobile devices (such as
  smart phones and tablet computers) that subscribers used to access the
  network. See "Analyzing Traffic Distribution Across Mobile Devices" on
  page 17.

- **Subscriber**—Analysis of traffic distribution across subscriber segments. See

"Analyzing Traffic Distribution Across Subscriber Segments" on page 23.

- **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 29.

- **Bulkstats**—Summaries of performance statistics for the Cisco ASR. See"Interpreting Performance Statistics for the ASR" on page 147.

- **KPI**—Summaries of key performance indicators (KPIs) for the Cisco ASR. See"Interpreting Key Performance Indicators from the ASR" on page 165.

- **Reports**—Summaries of traffic analysis for different periods of time (days, weeks, months). See "Scheduling and Interpreting Statistical Reports" on page 187.

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.
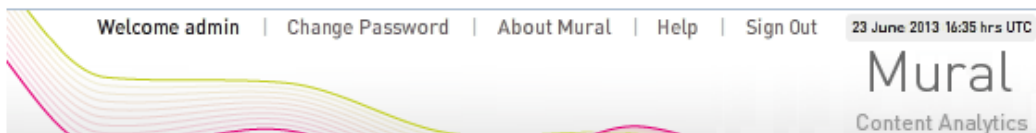
- **Welcome *username***—Names the user logged in to this MURAL session. In the figure, it is **admin**.

- **Change Password**—Opens the pop-up window for changing the password of the current user. See "Changing Your Password" in "Administering User Accounts" on page 1.

  The **Change Password** field appears in this pane in the stand-alone configuration of MURAL. In the landing-page configuration, it might appear on the landing page instead.

- **AboutMural**—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 **Sign Out** field appears in this pane in the stand-alone configuration of MURAL. In the landing-page configuration, it might appear on the landing page instead.

- **TIME ZONE**—Reports 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 the MURAL application. In the figure, Greenwich Mean Time (GMT).

The right-most 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 the MURAL application. In the figure, it is Coordinated Universal Time (UTC).

Setting the Time Range for Displayed Data

The information displayed on the **Network**, **Radio Access**, **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.
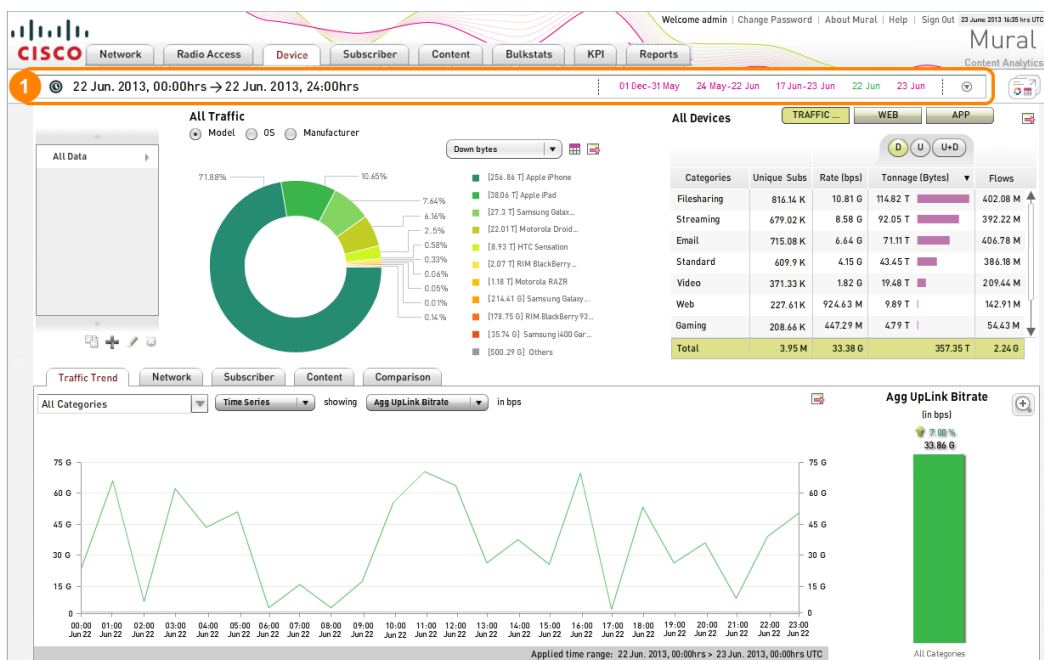
MURAL uses the 24-hour clock to represent times; for example, 00:00 hours is midnight and 18:00 hours is 6 PM.

The following figure depicts the time range selector from the **Network**, **Radio Access, 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 setting the time range. By default, data for the previous day is displayed.

The quick time ranges 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 standard duration, click a date or date range in the right portion of the time range selector. The term in green is the currently selected time range (22 Jun in the following example).

If none of the quick time range terms is 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.

All quick time ranges start at 00:00 hours on the first (or only) day in the range. The following table summarizes the start day and end day and time, relative to the current day (which for the examples is 23 June).

Range	Example	Start	End
Previous 6 months	01 Dec - 31 May	First day of month 7 months prior to current month	00:00 hours on first day of current month
Past 30 days	24 May - 22 Jun	30 days ago	00:00 hours on current day
Past week	17 Jun - 23 Jun	6 days ago	Latest interval on current day for which analyzed data is available
Yesterday	22 Jun	Previous day	00:00 hours on current day
Today	23 Jun	Current day	Latest interval on current day for which analyzed data is available

On the **Bulkstats and KPI** tabs, the ranges are the previous 30 days, 7 days, 24 hours, 12 hours, and 6 hours.

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 collection time and the last hourly interval for which data is available on the current day). The **Selected Time Range** field specifies the start and end times.

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 customize the start and end times.

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 45

Accessing and Interpreting the Custom Time Range Selector

To access the custom time range interface, click the triangle icon (⊙) at the right end of the time range selector.
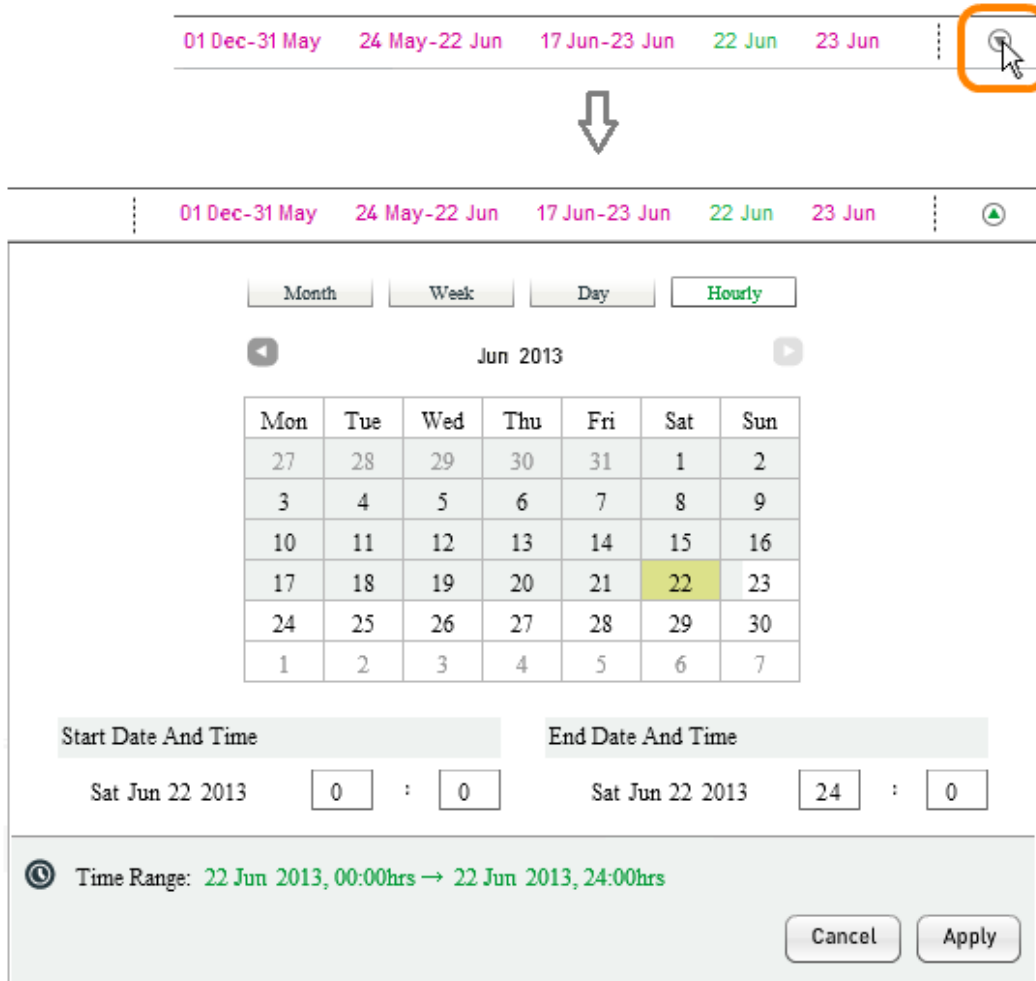
The custom time range interface opens with a calendar that depicts the time range currently selected for the tab. In the figure, it is the previous day.

There are four modes for depicting and setting a span of time, which are selected and indicated by the icons above the calendar: **Month**, **Week**, **Day**, and **Hourly**. The selected mode is in green type. In **Month** mode, there are twelve cells for

the months in the current year. In **Week**, **Day**, and **Hourly** mode, there is a cell for each day in the current month.

The time range in effect when the calendar opens determines which of the four modes is selected by default. If a custom time range is in effect, the mode is the one used to set that range. If a quick time range is in effect, the mode depends on which one.

As illustrated in the following figures, selected months or days are shaded gold. Gray shading indicates that data is available for the shaded part of the month or day. In **Week**, **Day**, and **Hourly** modes the days in the current month are in black print, and days in adjacent months are in gray print. The **Time Range** field below the calendar also reports the time range.

If the quick time range corresponding to the previous six months is selected when the calendar interface opens, **Month** mode is selected as in the following figure.
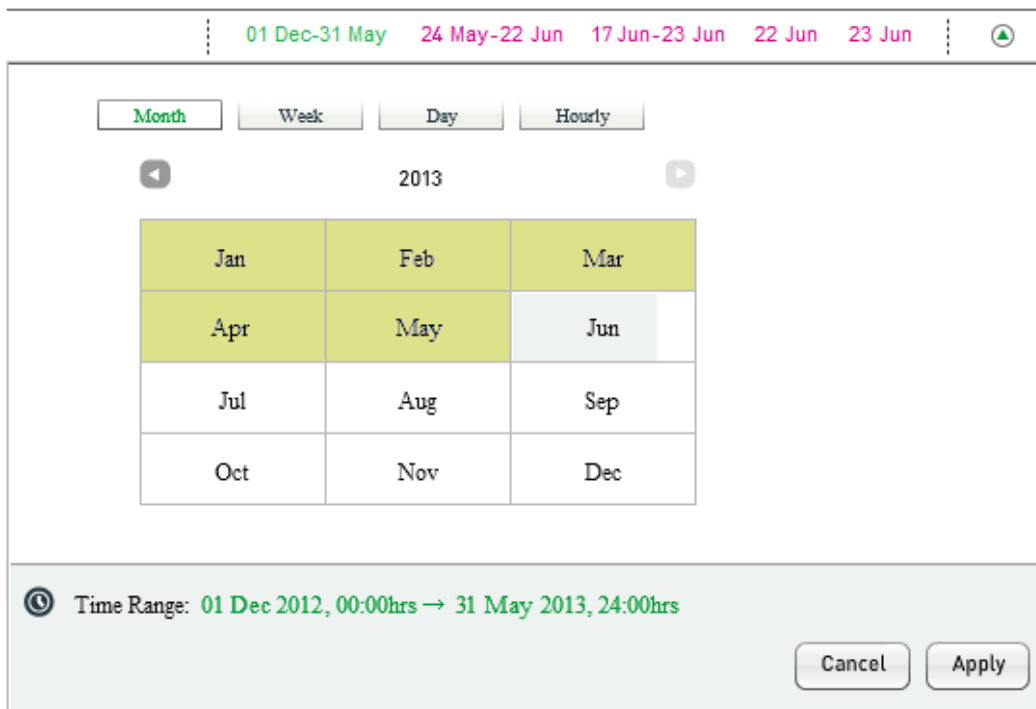
If the quick time range corresponding to the past 30 days is selected when the calendar interface opens, **Day** mode is selected.
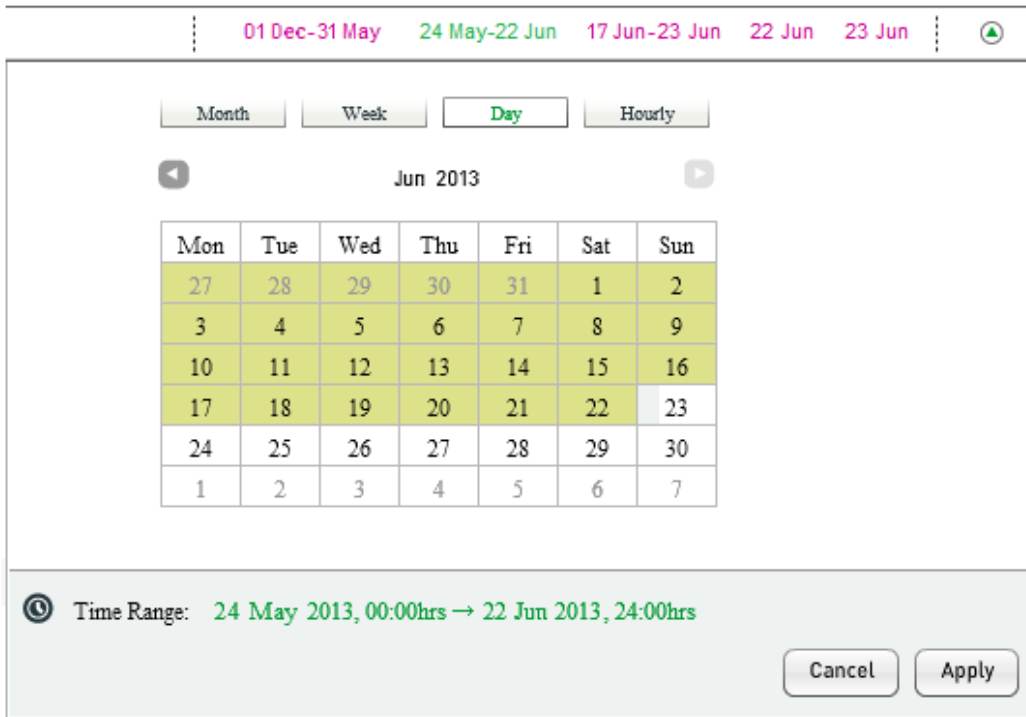
If the quick time range corresponding to the past 7 days, the previous day, or the current day is selected when the calendar interface opens, **Hourly** mode is selected. The following example is for the past 7 days. The diagonal gold lines in the cell for 23 June cover the part of the current day for which data is not yet available.

There is no quick time range for which **Week** mode is the default. For information about setting a range in **Week** mode, see "Setting a Custom Time Range" below.

Setting a Custom Time Range

To set the time range to a custom value, perform the following steps:

1. If the time range calendar interface is not expanded, click the triangle icon (⊙) at the right end of the time range selector.

---

2. Click the **Month**, **Week**, **Day**, or **Hourly** icon above the calendar to select the mode appropriate for the time range you want to set. The mode selected by default depends on the time range in effect when the calendar interface opens, as detailed in "Accessing and Interpreting the Custom Time Range Selector" on page 42.

    - **Month** for one or more complete calendar months.

    - **Week** for one or more complete weeks (Monday through Sunday).

    - **Day** for one or more complete days, with a day defined as the 24-hour period starting at midnight (00:00 hours).

    - **Hourly** to include less than the full 24 hours of the starting day,

ending day, or both. MURAL stores hourly data for a defined period
that immediately precedes the current day. The length of the period
depends on several factors including the amount of storage space
available, but it is commonly one to two weeks. For days further in
the past than the defined period, daily data is available.

3. Navigate to the single cell you want to select, or the cell that corresponds to
the start of a multicell time range. To navigate to a past or future year (in
Month mode) or month (in **Week**, **Day**, or **Hourly** mode), click the icons
above the calendar ( ). A light gray background for the icon indicates
that it is nonoperational because data is not available for the previous or
subsequent period.

4. Select the single or starting month, week, or day:

- In **Month**, **Day**, and **Hourly** mode, click the cell for the desired
  month or day, which must be fully-shaded gray. When you mouse
  over a cell that cannot be selected, its outline turns red.

- In **Week** mode, click any day in the week or the number to the left of
  the row, which indicates the week's count in the 52 weeks of the
  year. Only weeks with all seven days shaded can be selected—when
  you mouse over any of the days in an ineligible week, all days and
  the counter are outlined in red, as in the following figure. (Note that
  the reported time range in the figure remains the same as when the
  calendar interface opened in Step 1, because a valid week has not

actually been selected at this point.)

5. If setting a time range that includes multiple cells, press the **Shift** key and click the final month, week, or day in the range.

   The shading of all cells in the range becomes gold and the newly set time range appears in the **Time Range** field in the lower part of the window. In the following figure, 16 June is being selected.

6. If setting a time range in **Hourly** mode, you can set the start time, end time, or both to a value other than 00:00 hours.

   a. Click the hours (left-hand) box under the **Start Date and Time** header, remove the zero (**0**) and type in the desired hours.

   b. Repeat the previous step in the hours box under the **End Date and Time** header.

   The value in the **Time Range** field is updated, the selected hours are shaded solid gold and slanting gold lines cover the unselected hours. In the following figure, the selected time range is 14:00 hours to 20:00 hours on 16 June.

| Month | Week | Day | Hourly |

Jun 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
1	2	3	4	5	6	7

Start Date And Time

Sun Jun 16 2013   14 : 0

End Date And Time

Sun Jun 16 2013   20 : 0

Time Range: 16 Jun 2013, 14:00hrs → 16 Jun 2013, 20:00hrs

Cancel   Apply

7. To refresh the tab to display data for the new time range, click the **Apply** icon in the lower right corner of the window. The time range selector interface closes.

   To close the time range selector interface without applying your changes, click the **Cancel** icon in the lower right corner or the triangle icon (⏶) in the upper right corner of the window.

Using Filters to Fine-Tune the Reported Data

By default, the data on the **Network**, **Radio Access**, **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**.
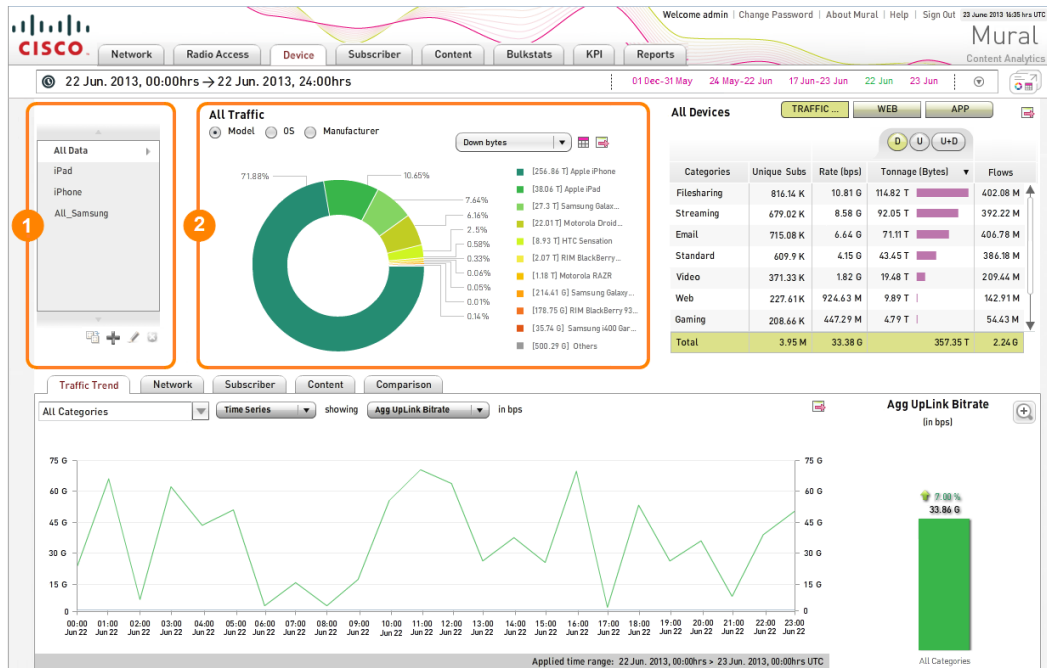
The filters interface consists of the elements shown in the following figure and described in the table.
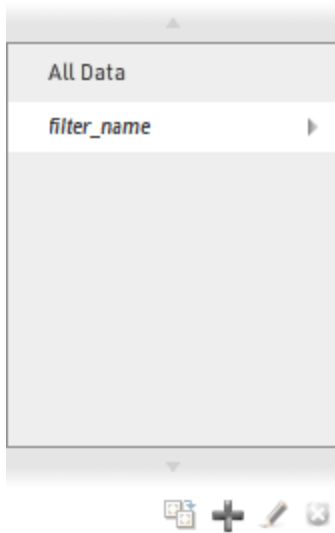
Element	Function
▲ ▼	Scrolls the list, exposing the previous filter at the top of the list or the next filter at the bottom of the list.
filter_name ▷	Indicates the currently selected filter.
▤	Clones the selected filter. See "Cloning or Editing an Existing Filter" on page 66.
✚	Creates a new filter. See "Creating a New Filter" on page 64.
✏	Edits the selected filter. See "Cloning or Editing an Existing Filter" on page 66.
✕	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 54

- "Selecting Filter Criteria from a Drop-Down Menu" on page 63

- "Creating a New Filter" on page 64

- "Cloning or Editing an Existing Filter" on page 66

- "Displaying Filter Terms" on page 67

- "Using the Filters on Subtabs" on page 68

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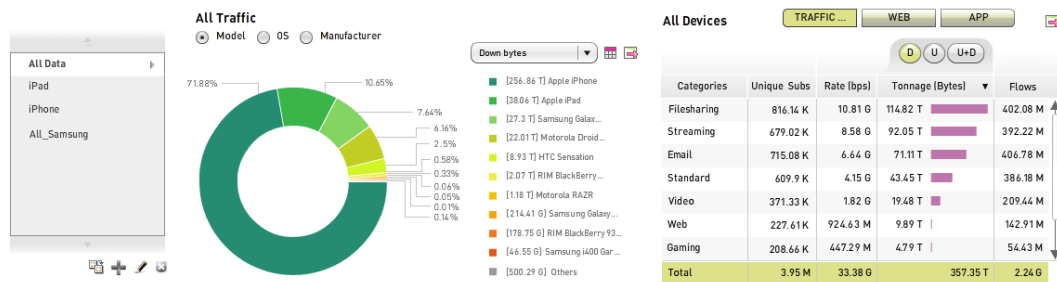
To apply a filter, click its name in the filter list. The background color for its row changes from gray to white and an arrow appears at the right end of the row. In the following figure, the **iPhone** filter is applied. As a consequence, the entire doughnut chart corresponds to the one device model.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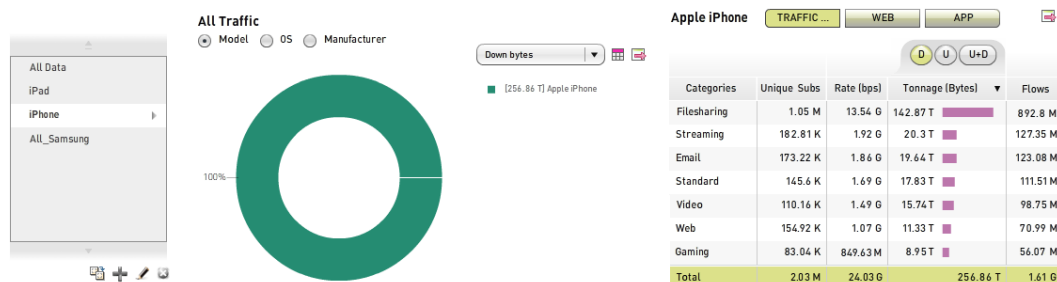
To clear a filter and display all data again, click **All Data** in the filter list.

To remove a filter from the list, click its name and then the remove icon (⊗).
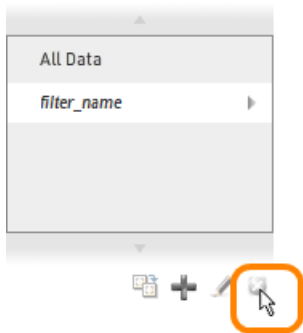
Selecting Criteria for a Filter

The procedures for creating, editing, or cloning a filter are described in "Creating a New Filter" on page 64 and "Cloning or Editing an Existing Filter" on page 66. 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 Radio Access Tab" on page 57

- "Selecting Filter Criteria on the Device Tab" on page 59

- "Selecting Filter Criteria on the Subscriber Tab" on page 61

- "Selecting Filter Criteria on the Content Tab" on page 62

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 that your system administrator has defined as belonging to the **California** region.

- **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)

For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" on page 63.

Selecting Filter Criteria on the Radio Access Tab

On the **Radio Access** 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 that your system administrator has defined as belonging to the **California** region.

- **RadioType**—Click the check box to select radio access types such as GSM and CDMA. The list of criteria is configured by your system administrator during initial MURAL configuration.

For instructions on selecting criteria from a drop-down menu, see "Selecting Filter Criteria from a Drop-Down Menu" on page 63.

Copyright © 2016, Cisco Systems, Inc.

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.

- **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 that your system administrator has defined as belonging to the **California** region.

For instructions on selecting criteria from a category, see "Selecting Filter Criteria from a Drop-Down Menu" on page 63.

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 that your system administrator has defined as belonging 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 let-ters, 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 that your system administrator has defined as belonging 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.
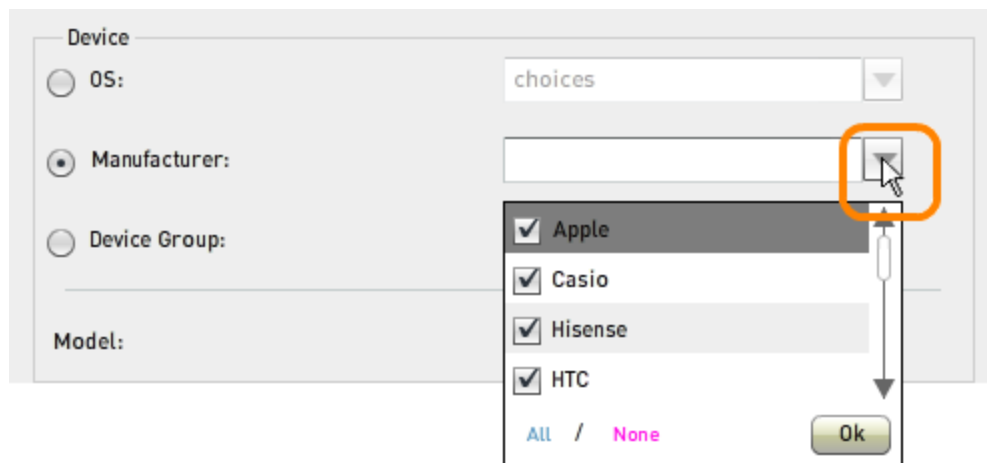
When the menu drops down, all values are checked, which selects them for inclusion in the filter.

- 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.

---
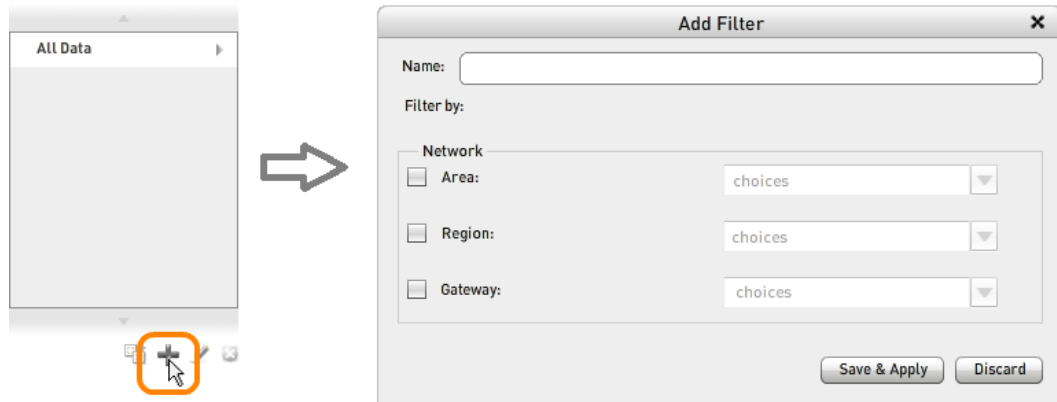
2. Specify the filter name and select criteria as described in "Selecting Criteria for a Filter" on page 54.

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.

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 54.

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 its name in the filter list. 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 and the **iOS** criterion selected in it; to further refine the results, 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).
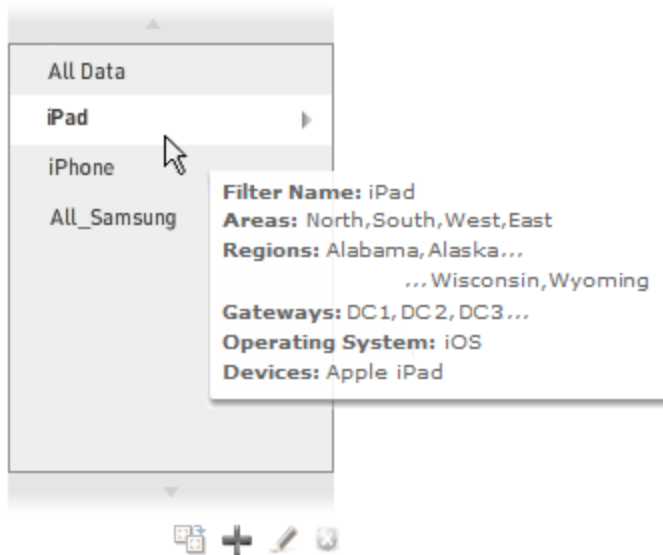
Using the Filters on Subtabs

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 facing 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 top-level **Device** tab (on the left) are duplicated on the **Device** subtab of the **Network** tab (on the right).
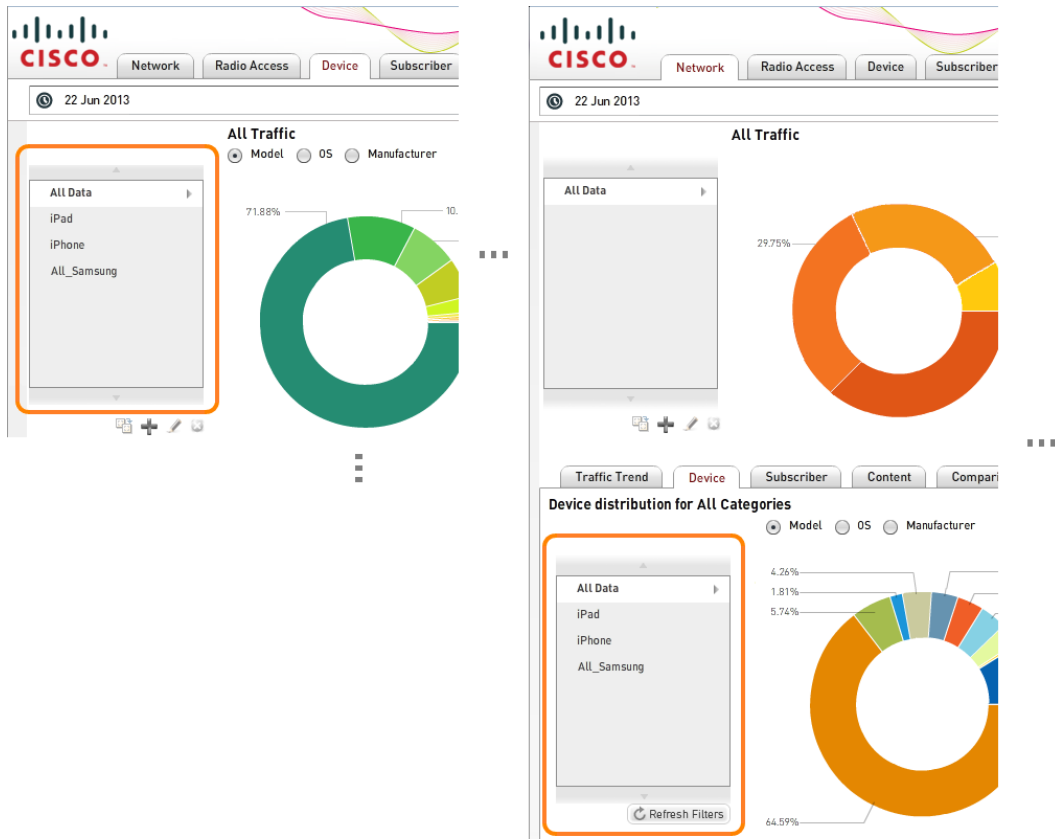
You cannot edit the filter list on a subtab directly; it is always derived from the filter list on the corresponding top-level tab. Therefore, the icons for cloning, adding, editing, and removing filters are not available on subtabs.

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:

- **WEB**—The orange boxes in the following sample figure highlight how the three filters on the **Content** subtab (lower left area of the figure) correspond to the radio buttons on the doughnut chart of distribution data on the top-level **Content** tab (upper right area).

  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.
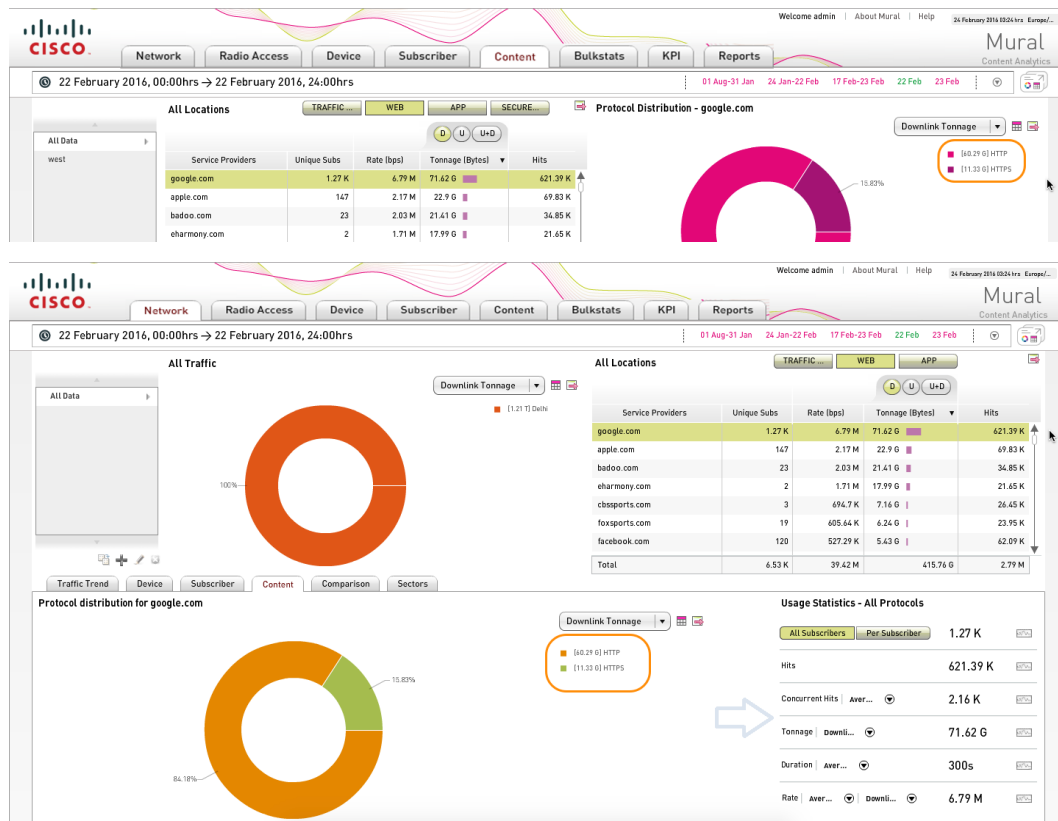
- **TRAFFIC** or **APP**—No filters are available on the **Content** subtab.

Analyzing Traffic Distribution

The main pane on the **Network**, **Radio Access**, **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.
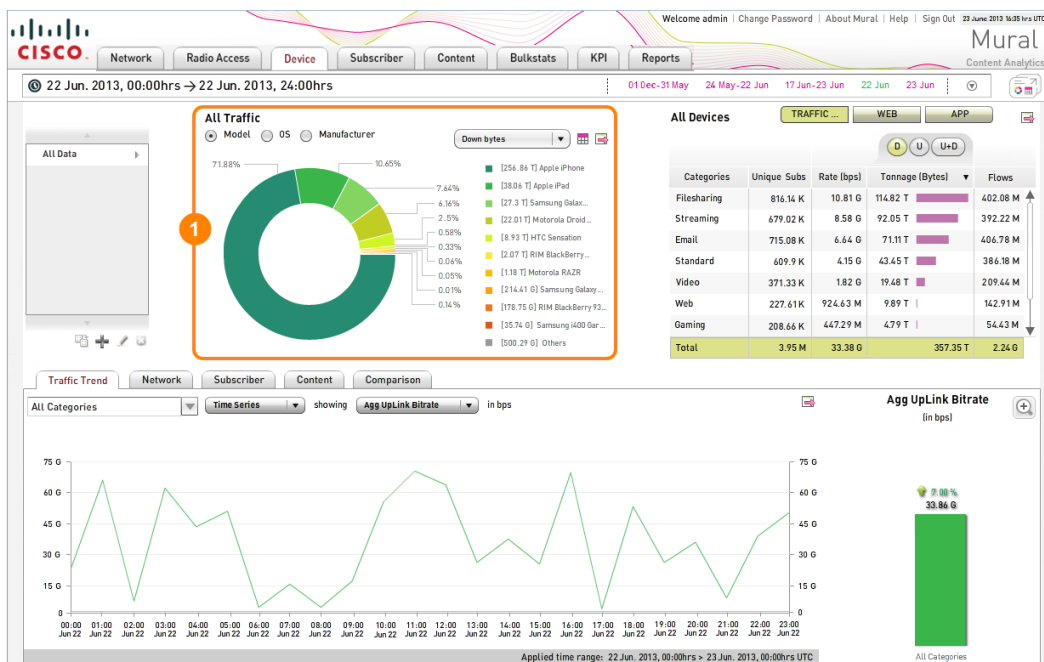
For information about the related filter interface, which appears to the left of box **1**, see "Using Filters to Fine-Tune the Reported Data" on page 51.

For information about the categories table, which appears to the right of box **1**, see "Analyzing Traffic by Category" on page 83.

This topic describes the following tasks:

- "Navigating the Traffic Distribution Display" on the next page

- "Interpreting Doughnut Charts" on page 75

- "Interpreting Distribution Tables" on page 79

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.

- **Radio Access**—Radio access types used by subscribers to connect to the network.

- **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 six classes based on the average daily volume of traffic they generated in the previous month. Following are default values for each segment; consult your system administrator to determine if they were changed during configuration of MURAL at your site.

    - Extreme—More than 600 megabytes (MB)

    - High—300 to 600 MB

    - Active—150 to 300 MB

    - Regular—60 to 150 MB

    - Mild—30 to 60 MB

    - Low—Less than 30 MB

    The **Under analysis** segment represents currently active subscribers that were not active during the entire previous month and so have not been assigned to one of the six classes.

- **Content**—Network protocols (when the **TRAFFIC** traffic type is chosen for the adjacent categories table), content provider websites (when **WEB** is
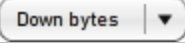
chosen), or applications (when **APP** is chosen). For information about the categories table, see "Analyzing Traffic by Category" on page 83.

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.
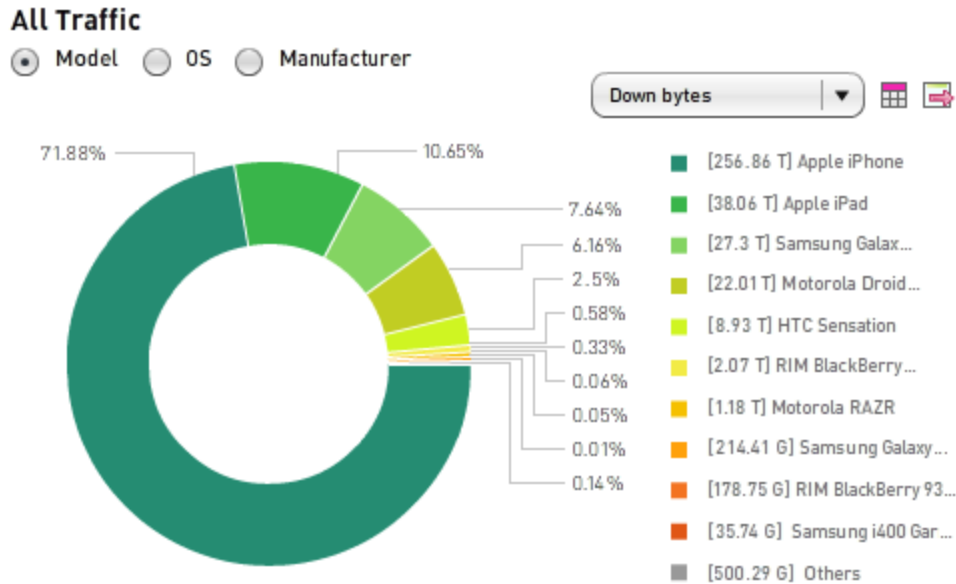

The following table describes the elements in the doughnut chart display area.

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**).

Element	Description
Down bytes ▼	Indicates and sets the statistic reported in the dough-nut chart. See "Selecting the Statistic Reported in a Doughnut Chart" on page 77.
	Changes display format from doughnut chart to table. See "Interpreting Distribution Tables" on page 79.
	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 135.

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 the **Radio Access** tab radio access types, on the **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.
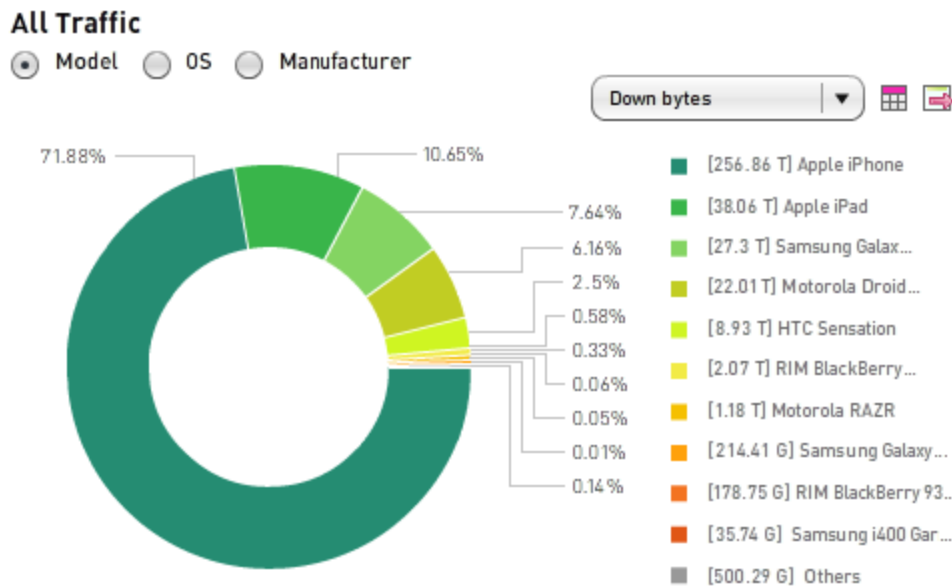
The legend to the right of the chart lists the entities, marking them with the color of the corresponding wedge in the chart. They are listed in order from largest to smallest value (matching the decreasing size of the wedges). A quantified measurement of the traffic precedes the entity name. The letter 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	–
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	–
Q	–	–	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" below.
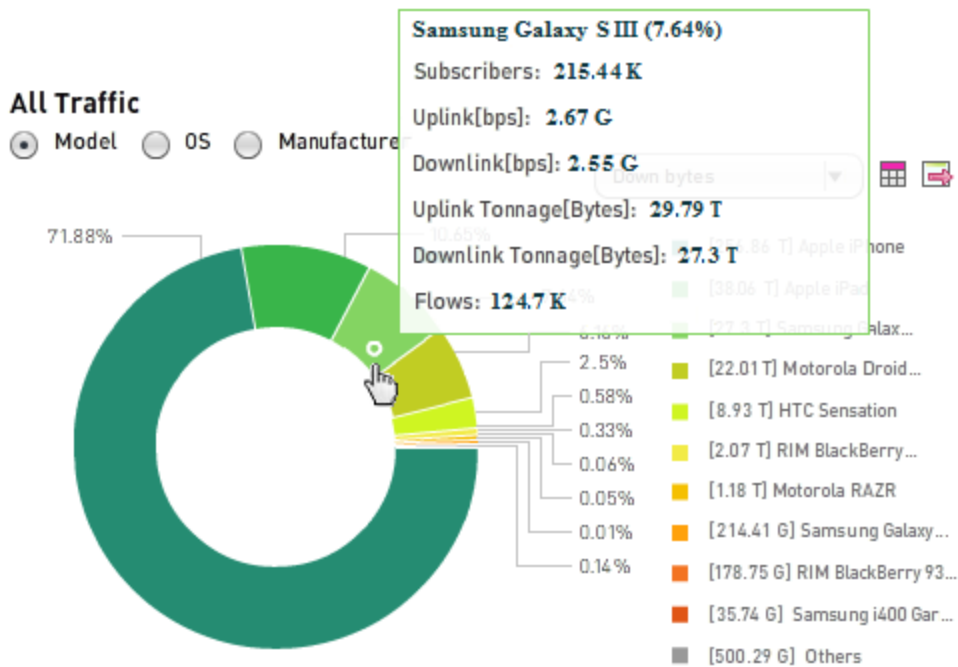
Selecting the Statistic Reported in a Doughnut Chart

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**.
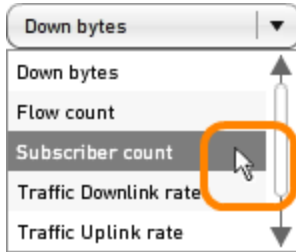
The text in the menu bar changes to indicate the new statistic, and the chart is redrawn. The statistics are defined as follows:

- **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 access for the first time during a MURAL session a tab or subtab that reports traffic distribution, the data appears in a doughnut chart. To display the data in a table, click the table icon (⊞) in the upper right corner of the display area. Table format is useful in that all statistics are visible simultaneously, and that data is reported for all entities, even those that do not account for enough traffic to appear in the doughnut chart.
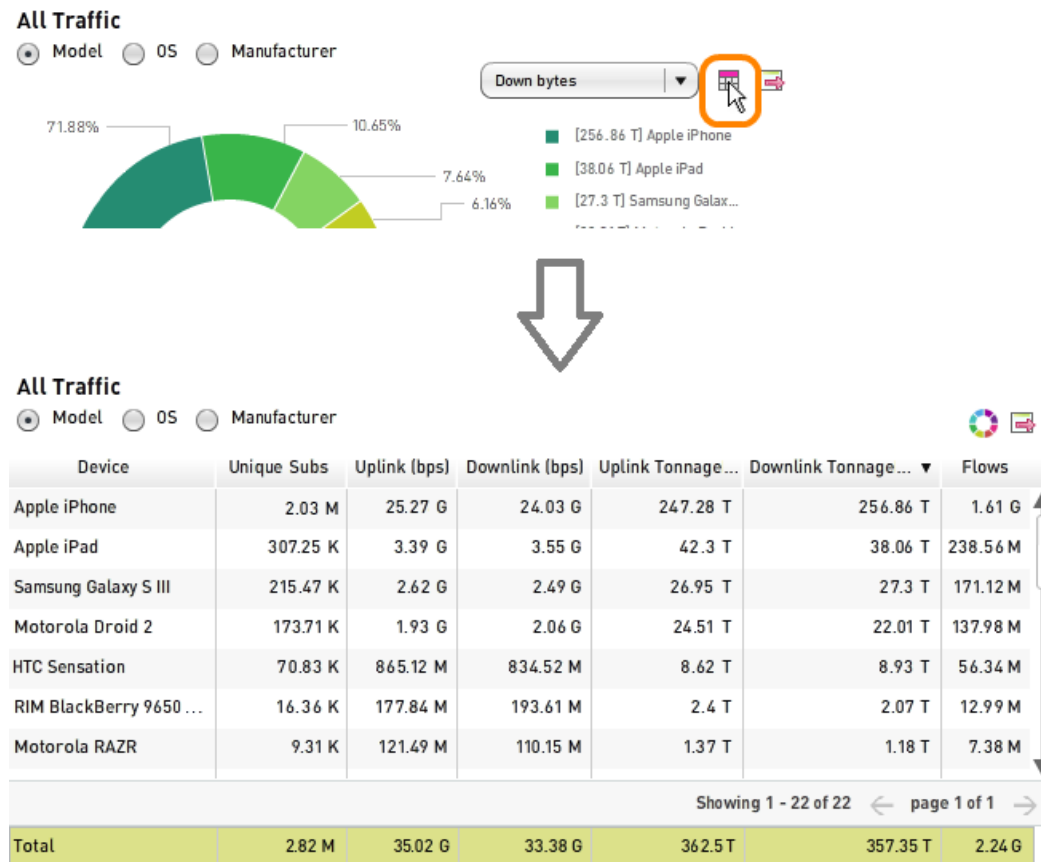
The following table describes the elements in the table (not all elements appear on every tab).

Element	Description
All Traffic	Indicates that traffic of all protocol types is included in the chart.

Element	Description
◉ 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 the **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 75.
◼	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 135.
▼ ▲	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 82.
Showing 1 - *xx* of *total*	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 *x* ➡	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 column 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 83.

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 select a column, click in its 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, Radio Access, Device, Subscriber**, and **Content** tabs—for example, you can sort by uplink traffic rate on the **Network** tab and at the same time by number of hits on the **Device** tab. MURAL maintains the sort basis on a tab for the duration of a session.

Analyzing Traffic by Category

The table in the main pane of the **Network**, **Radio Access**, **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 TYPE**—Categories of protocol type, such as **VOIP** (voice over IP) or **Web**, referring to Hypertext Transfer Protocol (HTTP)

- **WEB**—Categories of various service providers, such as **google.com** and **facebook.com**.

- **APP**—Categories of application type used to request and deliver the content, such as **Browser** or **Social Networking**.

- **SECURED WEB:** —Traffic is categorized by security protocols, that is **HTTP** and**HTTPS**, HTTPS is added to show the encrypted data. By default, the doughnut chart displays the list of all the service providers. You can click HTTP or HTTPS from the table to view the list of corresponding service providers.

This topic describes the following tasks:

- "Interpreting the Content Categories Table" on the next page

- "Categorizing Traffic by Type" on page 87

- "Changing the Sort Order in the Categories Table" on page 90

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**, **Radio Access**, and **Subscriber** tabs; on the **Content** tab, the positions of the table and the adjacent doughnut chart are reversed.
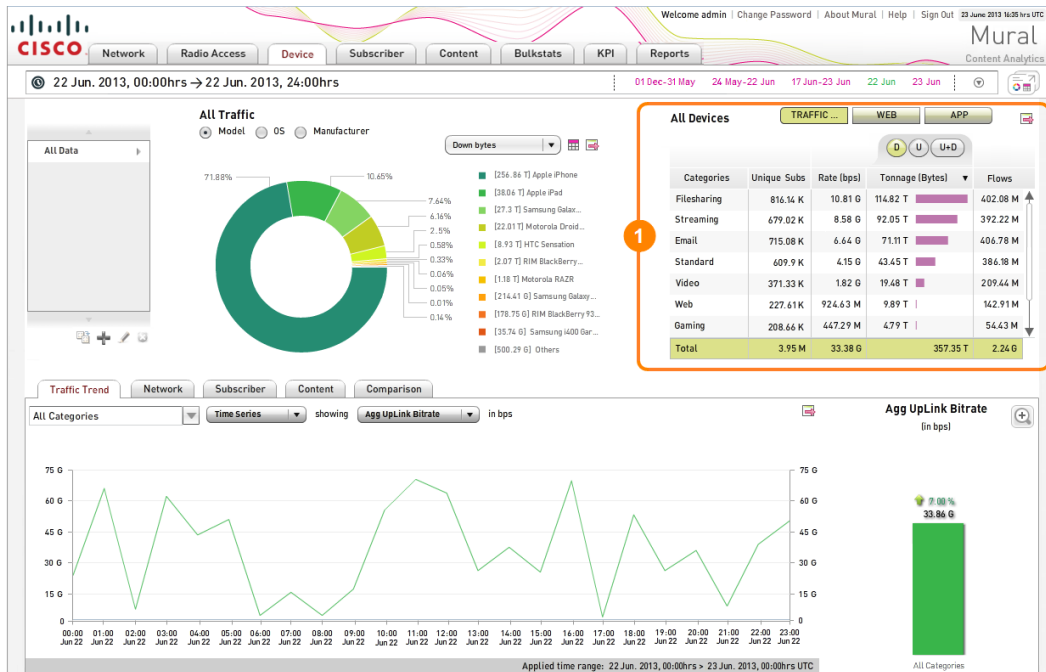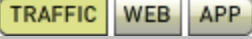
The following figure shows what the table looks like when you first access a tab during a MURAL session. The **TRAFFIC** traffic type is selected, as indicated by the solid gold color of that icon, and the table displays values for the associated service providers, which are named in the **Service Providers** column. Service providers 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.
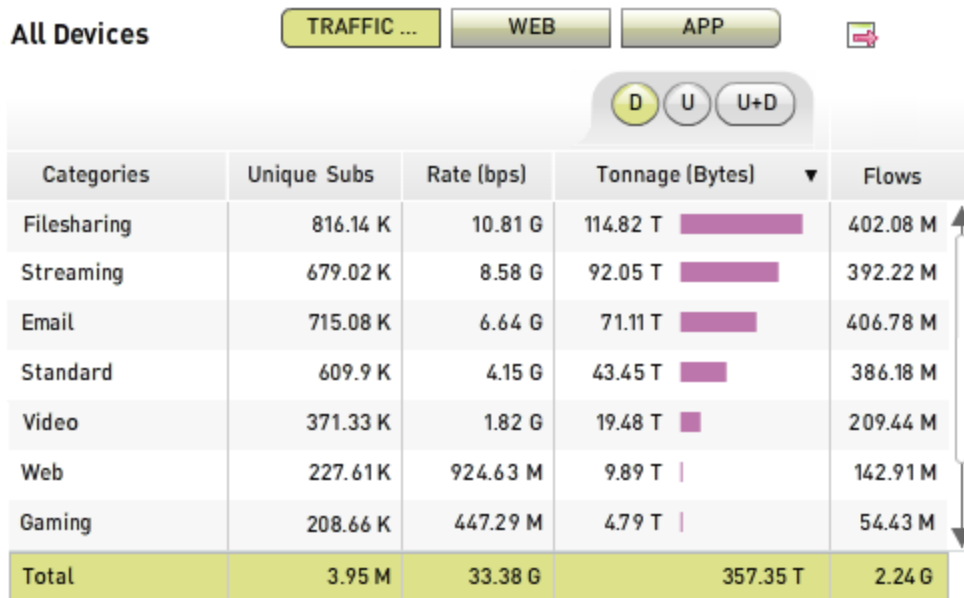
The following table describes the elements in the table display area.

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 131.

Element	Description
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 the facing page.
	Copies the data in the table to a file or the palette. See "Exporting Data to a File or the Palette" on page 135.
D U U+D	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 90.
	Indicates that the category (row) is selected, as a result of which the information on the **Traffic Trend**, **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 131.

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 cal-culated 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 repor-ted 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	–
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	–
Q	–	–	quadrillions (10^{15})

Categorizing Traffic by Type

When you first access a tab during a MURAL session, the **TRAFFIC** icon above the table is solid gold, 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)

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 web-site that is providing content, based on categorization guidelines from the Inter-active 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 **mobile-appcategorynotfound**.

Changing the Sort Order in the Categories Table

When you access the **Network**, **Radio Access**,**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 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	227.61K	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 select a column, click in its 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.

The basis for sorting is independent on the **Network, Radio Access, Device, Subscriber**, and **Content** tabs—for example, you can sort by uplink traffic rate on the **Network** tab and at the same time 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**, **Radio Access**, **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 categories table on the top-level tab. You can also compare multiple categories in a single chart.

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 97

- "Displaying the Exact Value for an Hourly Interval" on page 103

- "Setting the Statistic Reported in a Traffic Trend Chart" on page 103

- "Interpreting the Summary Bar Chart" on page 105

- "Displaying Data from Multiple Categories" on page 106

- "Comparing Two Charts" on page 107

Interpreting the Traffic Trend Subtab

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

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.

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 the **Network**, **Device**, **Subscriber**, and **Content** tabs 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 105.
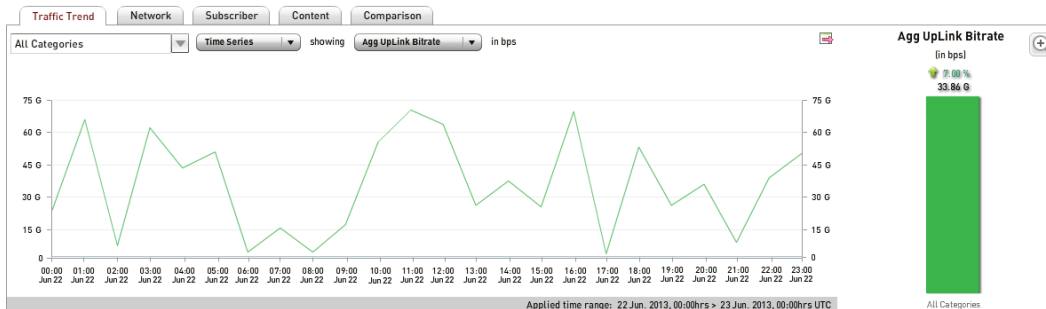
As on the other top-level tabs, on the **Radio Access** tab the **Traffic Trend** subtab (box **2** in the following figure) tracks average traffic rate on the uplink at hourly increments for the selected category in box **1** (by default, **Total**). But it further represents the distribution of traffic across the radio access types in the dough-nut chart (box **3**) in stacked bands of the same colors as in the doughnut chart. The bar chart to the right of the line chart reports the same statistic for the entire selected time range, for the radio access types (up to four) that account for the most traffic.
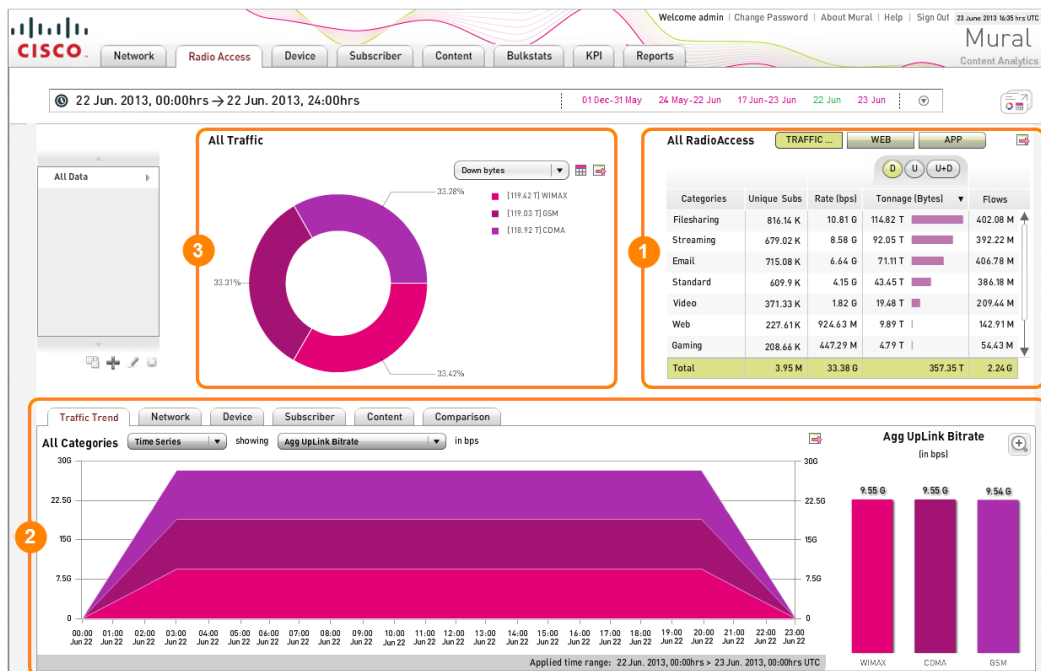
The following table describes the elements on the **Traffic Trend** subtab.

Element	Description
Category_name ▼	(**Network**, **Device**, **Subscriber**, and **Content** tabs) Names the categories (up to three) for which data is presented on the subtab. See "Displaying Data from Multiple Categories" on page 106.
Category_name	(**Radio Access** tab) Names the category from the categories table for which data is presented on the subtab. By default it reads **All Categories** to correspond to the **Total** row.

Element	Description
Time Series ▼	Indicates and sets the type of chart displayed. See "Displaying Traffic Trend Data in Line or Bar Charts" below.
Agg UpLink Bitrate ▼	Indicates and sets the statistic reported in the chart. See "Setting the Statistic Reported in a Traffic Trend Chart" on page 103.
(icon)	Copies the data in the table to a file or the palette. See "Exporting Data to a File or the Palette" on page 135.
⊕ ⊖	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 107.

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	–
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	–
Q	–	–	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.

The formats are described in the following sections:

- "Interpreting Time-Series Charts" below

- "Interpreting Hourly Bar Charts" on the facing page

- "Interpreting Busy-Hour Bar Charts" on page 101

Interpreting Time-Series Charts

On the **Network**, **Device**, **Subscriber**, and **Content** tabs, when you select **Time Series** from the drop-down menu, the line in the 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.
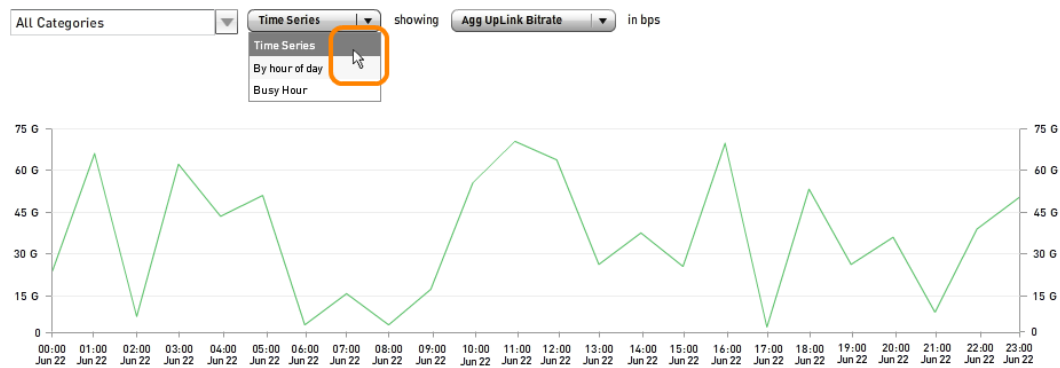
On the **Radio Access** tab, when you select **Time Series** from the drop-down menu, the top outline of the bar for each radio access type connects data points which each represent a defined collection period. In the following figure, the chart presents hourly time points for a one-day period.
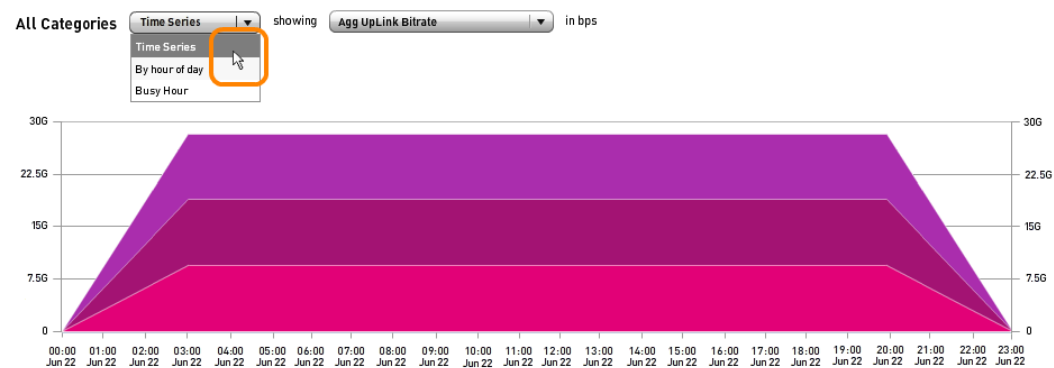
For data to appear in the line chart, you must set the time range to a minimum of 2 hours.

Interpreting Hourly Bar Charts

On the **Network**, **Device**, **Subscriber**, and **Content** tabs, 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.
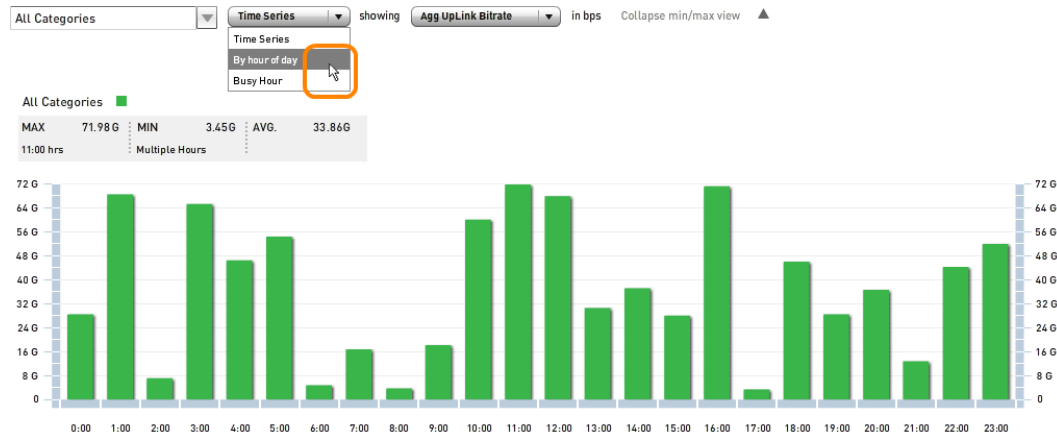
On the **Radio Access** tab, when you select **By hour of day** from the drop-down menu, for each of the 24 hourly collection periods from 00:00 hours through 23:00 hours, the chart includes a bar for each radio access type.

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 set in **Hourly** mode that does not begin at 00:00 hours on the first day and end at 24:00 hours on the last day

The maximum time range for which data can appear in the chart is seven cal-endar days, which implies that data is not displayed for the quick time ranges cor-responding to the previous 6 months or past 30 days, or for custom time ranges of more than 7 days.

For details about the time range selector, see "Setting the Time Range for Displayed Data" on page 39.

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 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 **Hourly** 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**.
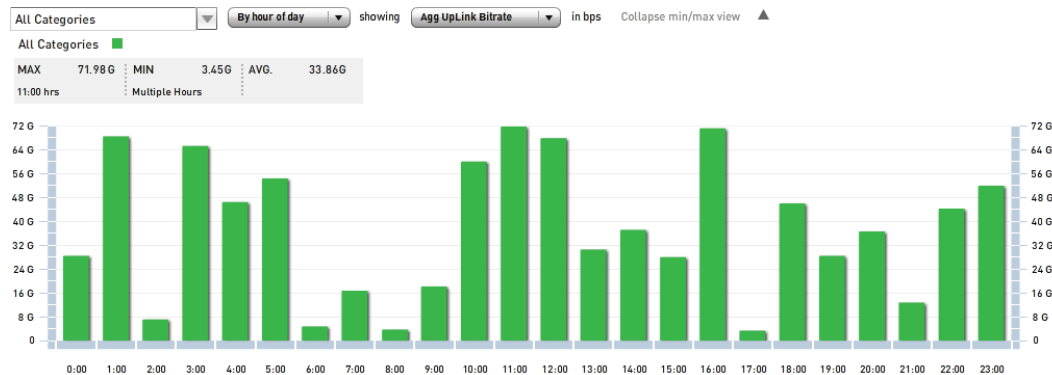
Copyright © 2016, Cisco Systems, Inc.

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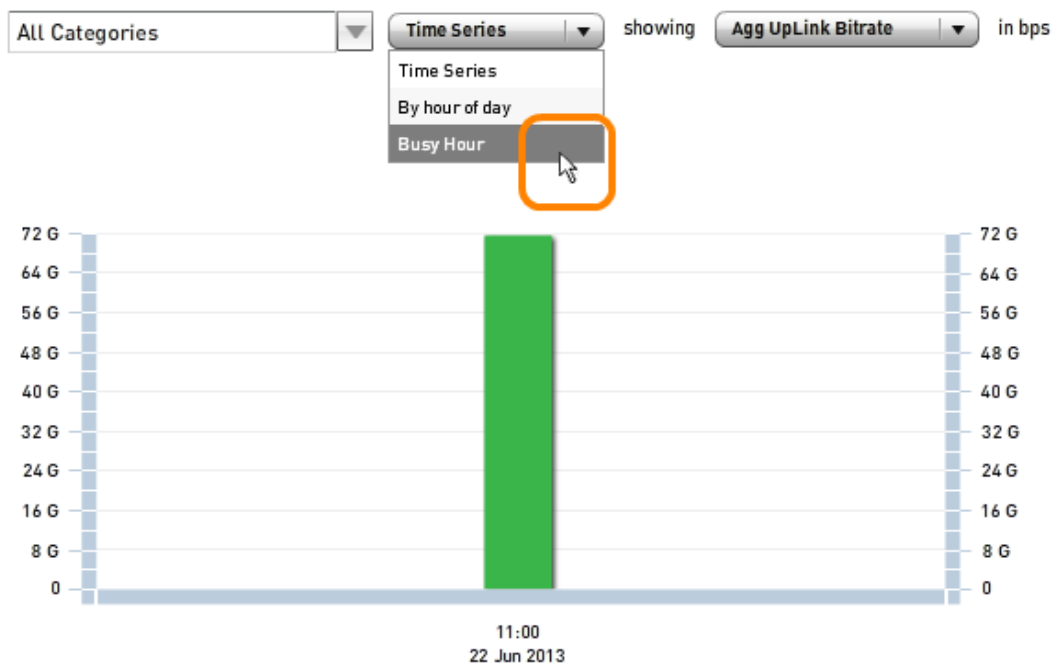
For data to appear in the chart, you must set a time range that covers at least one full calendar day. This implies that data is not displayed for the following time ranges:

- The quick time range corresponding to the current day

- A custom time range set in **Hourly** mode that does not begin at 00:00 hours on the first day and end at 24:00 hours on the last day

The maximum time range for which data can appear in the chart is seven cal-
endar days, which implies that data is not displayed for the quick time ranges cor-
responding to the previous 6 months or past 30 days, or for custom time ranges
of more than 7 days.

For details about the time range selector, see "Setting the Time Range for Dis-
played Data" on page 39.

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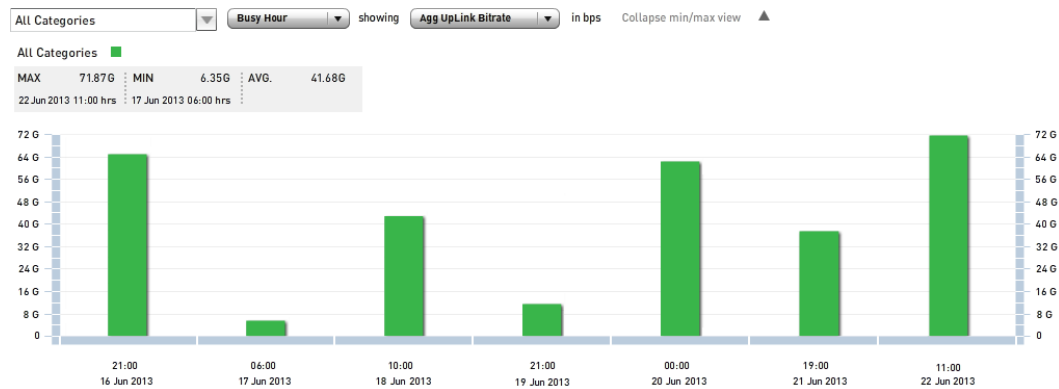
To collapse the legend, click the triangle icon (▲) labeled Collapse min/max view.
To expose the legend when it is hidden, click the triangle icon (▼) labeled
Expand to view min/max.

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.
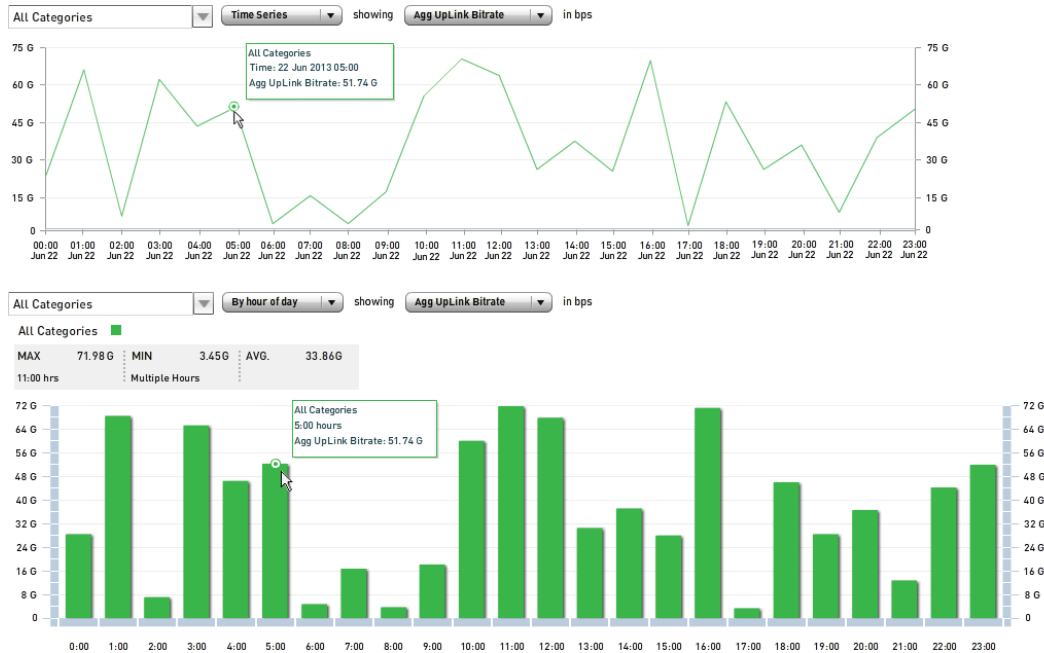
Setting the Statistic Reported in a Traffic Trend Chart

When you first access the **Network**, **Radio Access**, **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 statistics and units. The statistics 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**).
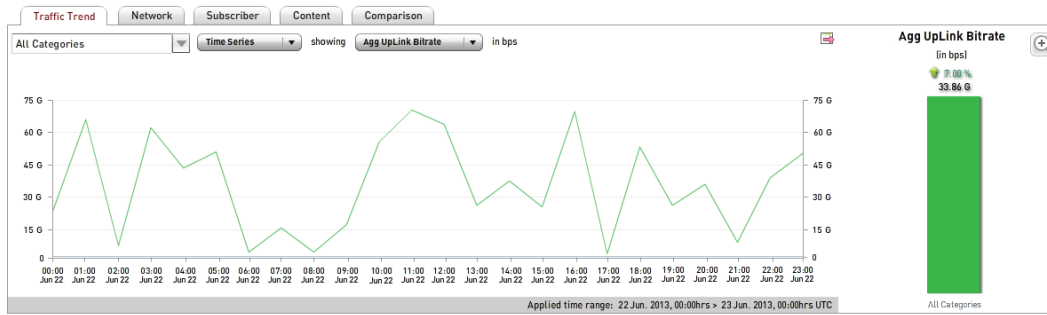
The percentage value above the measurement indicates the percentage change in its value compared to the period of the same duration as the current time range that immediately preceded it. For example, if the current time range is 12 hours, the comparison period is the 12 hours that ended at the start of 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 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

On the **Network**, **Device**, **Subscriber**, and **Content** tabs, you can select up to three categories to display simultaneously on the **Traffic Trend** subtab. (On the **Radio Access** tab, only one category can be displayed at a time, but values for all radio acess types are reported.) 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 on the **Traffic Trend** subtab. Click the row of the table for the category you want to display or compare in the 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 97.
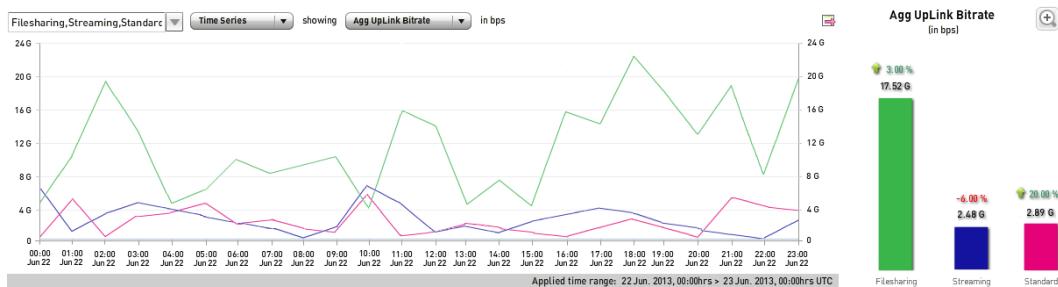
The meaning and available operations on a chart with multiple categories are the same as on a single-category chart.

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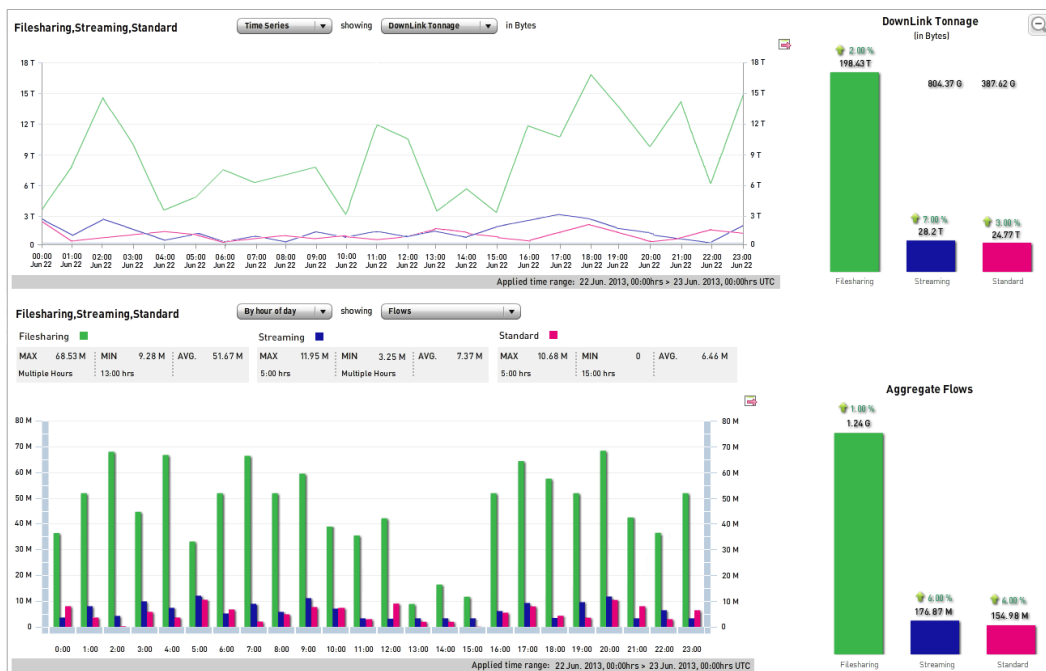
To collapse the subtab back to its normal size, click the collapse-pane icon (⊖).

Comparing Network Entities

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

This topic describes the following tasks:

- "Interpreting the Comparison Subtab" below

- "Displaying Traffic Trend Data as a Line or Bar Chart" on page 111

- "Displaying the Precise Value for an Hourly Interval" on page 112

- "Setting the Statistic Reported in Comparison Charts" on page 112

- "Interpreting Usage Statistics" on page 115

Interpreting the Comparison Subtab

On the **Network**, **Radio Access**, **Device**, and **Subscriber** tabs, you select three entities from the doughnut chart of distribution data (box **1** in the following sample **Device** tab) to compare on the **Comparison** subtab (box **2**).
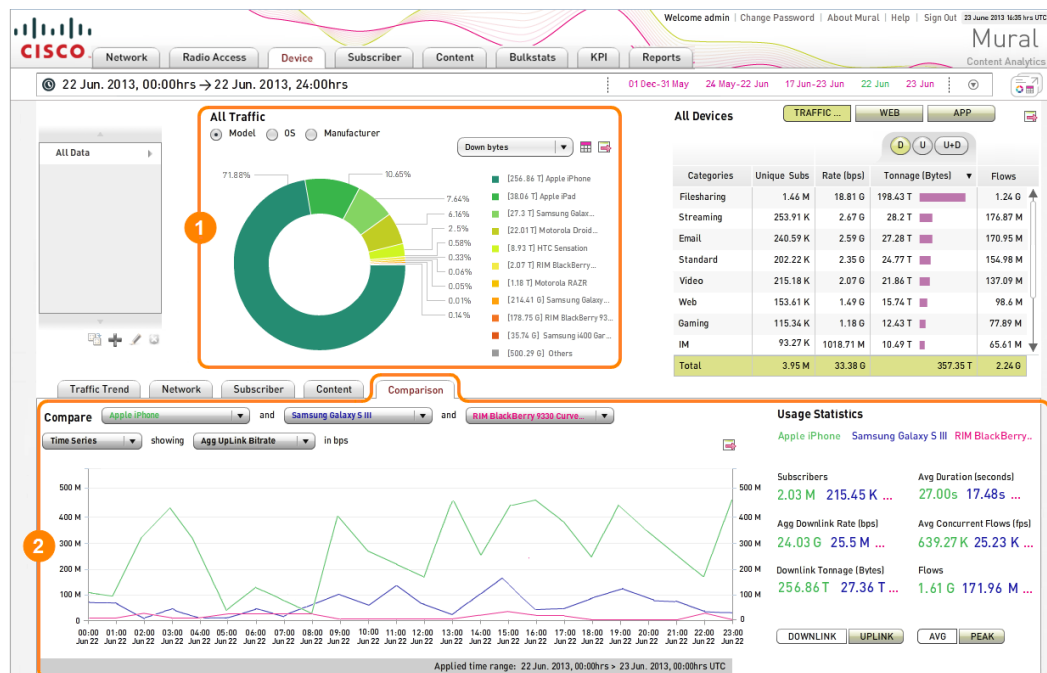
On the **Content** tab, you select three categoriesfrom the table in box **1** to compare on the **Comparison** subtab (box **2**).
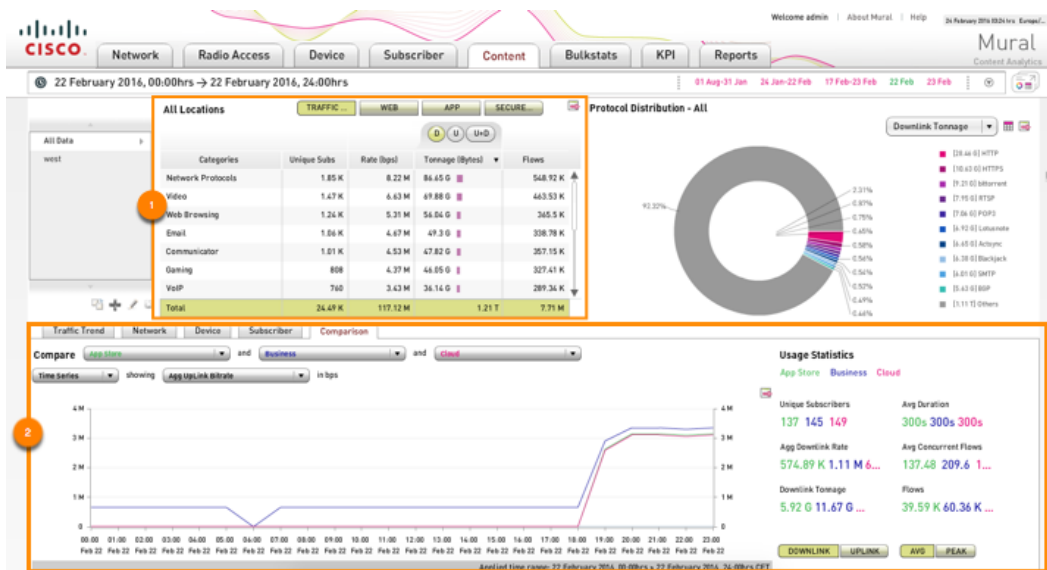
When you first access the **Comparison** subtab on a top-level tab during the MURAL session, the time-series line chart reports the average traffic rate on the uplink at hourly increments for two entities. The **Usage Statistics** table to the right of the line chart provides totals and averages over the selected time range for the statistics available for tracking at hourly intervals in the chart; see "Interpreting Usage Statistics" on page 115.

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

Element	Description
Compare Entity_1 ▼ ··· and Entity_2 ▼ ··· and Entity_3 ▼	Names the three 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 facing page.

Element	Description
Agg UpLink Bitrate ▼	Indicates and sets the type of statistic tracked in the chart. See "Setting the Statistic Reported in Comparison Charts" on the next page.
⬚	Copies the data in the table to a file or the palette. See "Exporting Data to a File or the Palette" on page 135.

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
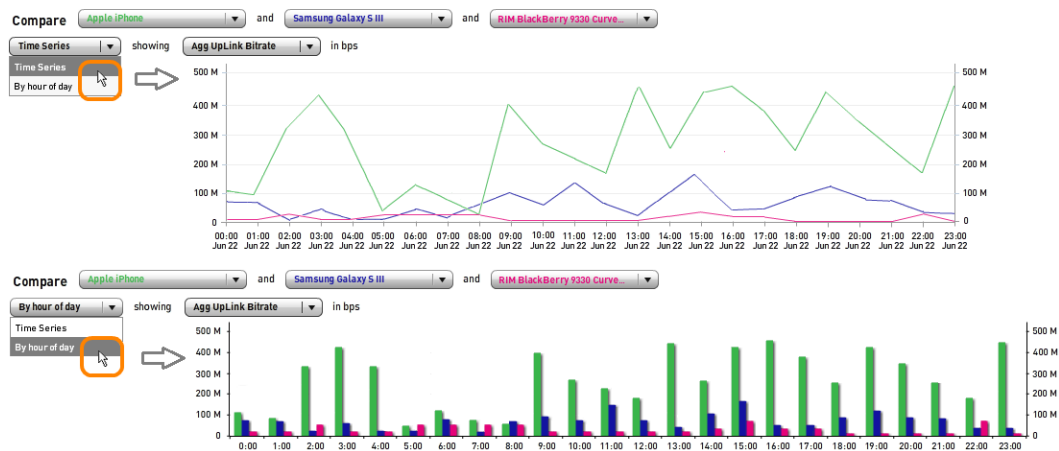
Displaying the Precise Value for an Hourly Interval

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 entity at a time unless the lines for the entities are very close to one another at the time point, in which case the pop-up windows for each of them appear together.) The following figure shows the result for 07:00 hours on the two types of chart.
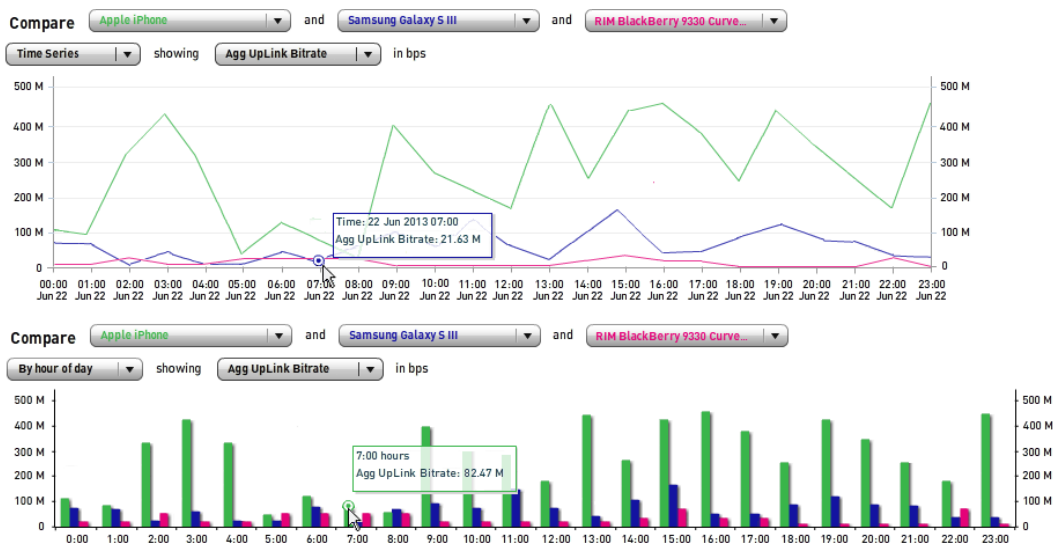
Setting the Statistic Reported in Comparison Charts

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 (from mobile devices to the network), 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 statistic.
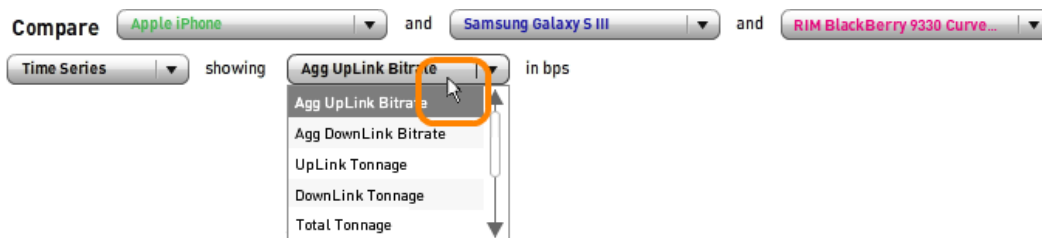
The text on the menu button and in the field to its right change to indicate the new statistic. The statistics are defined as follows for each hourly increment. Statistics related to flows are available on the **Network** and **Subscriber** tabs, and on the **Radio Access**, **Device**, and **Content** tabs when the **TRAFFIC** traffic type is selected for the categories table. Statistics related to hits are available on the **Radio Access, Device, and Content** tabs 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.

- **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 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.

- **Total Tonnage**—Sum of **DownLink Tonnage** and **UpLink Tonnage**.

- **Unique Subscribers**—Number of active subscribers.

- **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**, **Total 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	–
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	–
Q	–	–	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 123.

Usage Statistics

Apple iPhone   Samsung Galaxy S III   RIM BlackBerry..

Subscribers	Avg Duration (seconds)
2.03 M 215.45 K ...	27.00s 17.48s ...

Agg Downlink Rate (bps)	Avg Concurrent Flows (fps)
24.03 G 25.5 M ...	639.27 K 25.23 K ...

Downlink Tonnage (Bytes)	Flows
256.86 T 27.36 T ...	1.61 G 171.96 M ...

DOWNLINK | UPLINK   AVG | PEAK

Interpreting Usage Statistics

On the **Network**, **Radio Access**, **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.

Note: This topic describes the **Usage Statistics** table on the **Network**, **Device**, **Subscriber**, and **Content** tabs. The table functions somewhat differently on the **Radio Access** tab; see "Analyzing Traffic Distribution on Subtabs of the Radio Access Tab" on page 13.

This topic describes the following tasks:

- "Interpreting the Usage Statistics Table" below

- "Interpreting Statistics on the Network, Device, Subscriber, and Content Subtabs" on page 121

- "Interpreting Statistics on the Comparison Subtab" on page 123

- "Generating Traffic Trend Charts from the Usage Statistics Table" on page 126

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 Network, Device, Subscriber, and Content Subtabs" on page 121.

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).
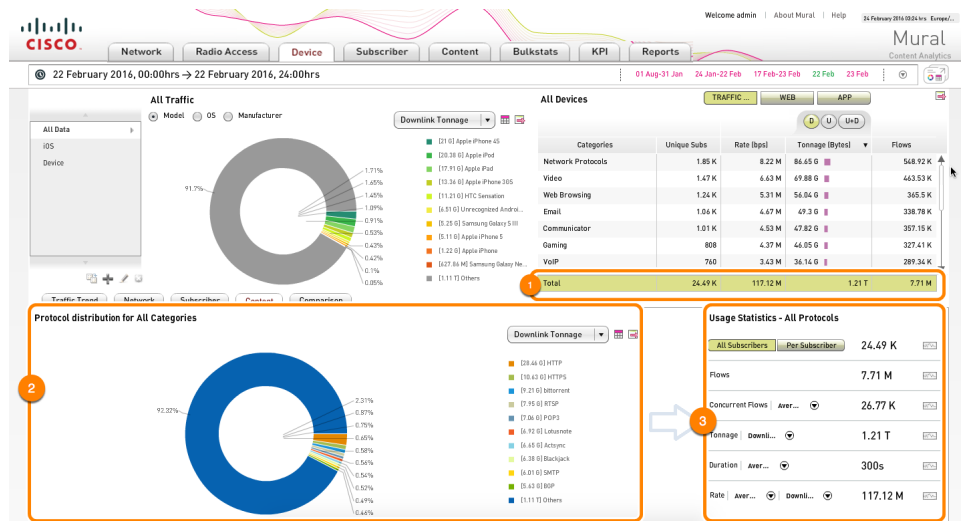
- On the **Comparison** subtab, the left pane (enclosed in box **2** in the following figure) displays statistics collected at hourly increments for two entities from box **1**. The **Usage Statistics** table in box **3** reports statistics summed or averaged across the entire selected time range, depending 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 123.

In the following sample **Device** tab and **Comparison** subtab, the
Usage Statistics table reports statistics for the three mobile devices in the
line chart in box **2** the Apple iPhone in green, the Samsung Galaxy S III
in blue, and the RIM Blackberry 9330 Curve 2 Refresh in pink).
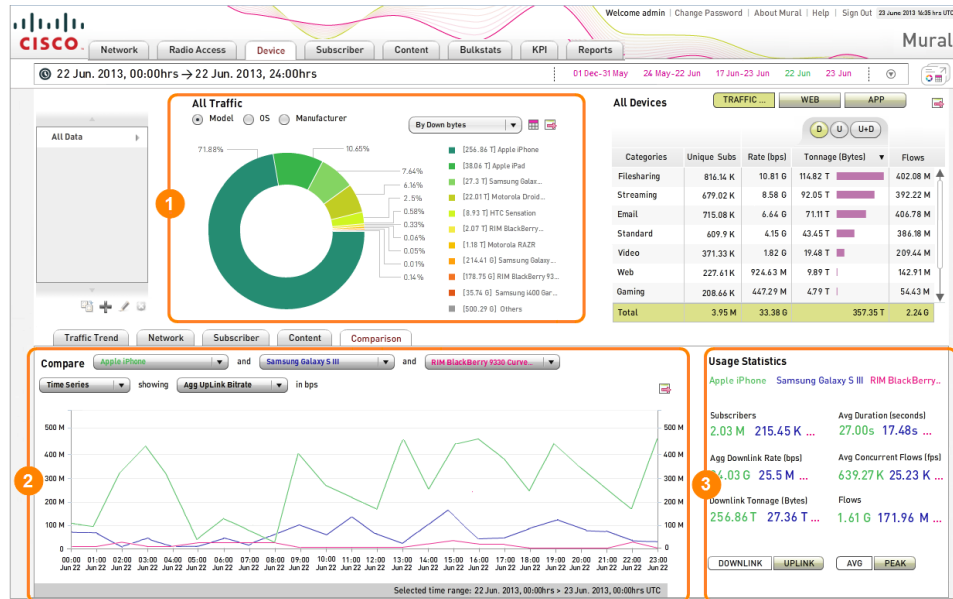
In general, the **Usage Statistics** table presents the same types of statistics that you
can select on the drop-down menu of statistic types in box **2**. On the left side of
the following figure is a sample **Usage Statistics** table for the **Network**, **Device**, **Sub-
scriber**, and **Content** subtabs, and on the right a sample **Usage Statistics** table for
the **Comparison** subtab.
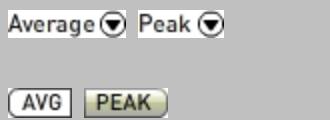
The following table summarizes how the buttons and drop-down menus in the **Usage Statistics** table change the type or format of a statistic in the row.

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 Network, Device, Subscriber, and Content Subtabs

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

Usage Statistics - HTTP

All Subscribers | Per Subscriber	153.61 K		
Hits	98.6 M		
Concurrent Hits | Average ⊙	832.79 K		
Tonnage (Bytes) | Downlink ⊙	15.74 T		
Duration (seconds) | Average ⊙	207s		
Rate (bps) | Average ⊙ | Downlink ⊙	1.49 G		

- **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 des-tination 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	–
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	–
Q	–	–	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**, **Radio Access**, **Device**, and **Subscriber** tabs, and of the top-level **Content** tab when the **TRAFFIC** traffic type is selected.

Usage Statistics

Apple iPhone   Samsung Galaxy S III   RIM BlackBerry..

Subscribers	Avg Duration (seconds)
2.03 M 215.45 K ...	27.00s 17.48s ...

Agg Downlink Rate (bps)	Avg Concurrent Flows (fps)
24.03 G 25.5 M ...	639.27 K 25.23 K ...

Downlink Tonnage (Bytes)	Flows
256.86 T 27.36 T ...	1.61 G 171.96 M ...

[DOWNLINK | UPLINK]   [AVG | PEAK]
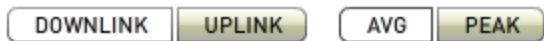
- **Agg Downlink Rate**—Average number of bits per second (bps) that traveled from the network toward mobile users.It is calculated by dividing the total number of bytes by the number of seconds in the selected time range, then multiplying by eight to convert bytes to bits.

- **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	–

	Rate Statistics	Volume Statistics	Count Statistics
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})
P	petabits per second (Pbps)	petabytes	–
Q	–	–	quadrillions (10^{15})

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**.
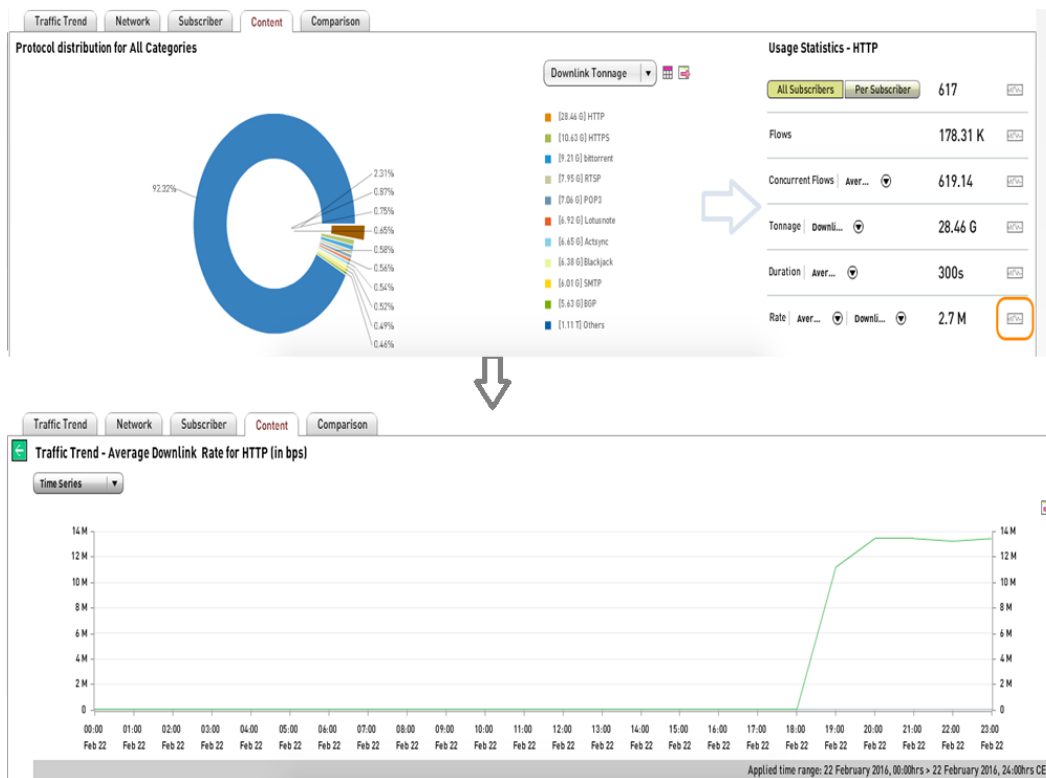
To close the chart and return to the previous view of the subtab, click the page-back icon ( ) in the upper left corner. For information about traffic-trend charts, see "Analyzing Traffic Trend Data" on page 93.

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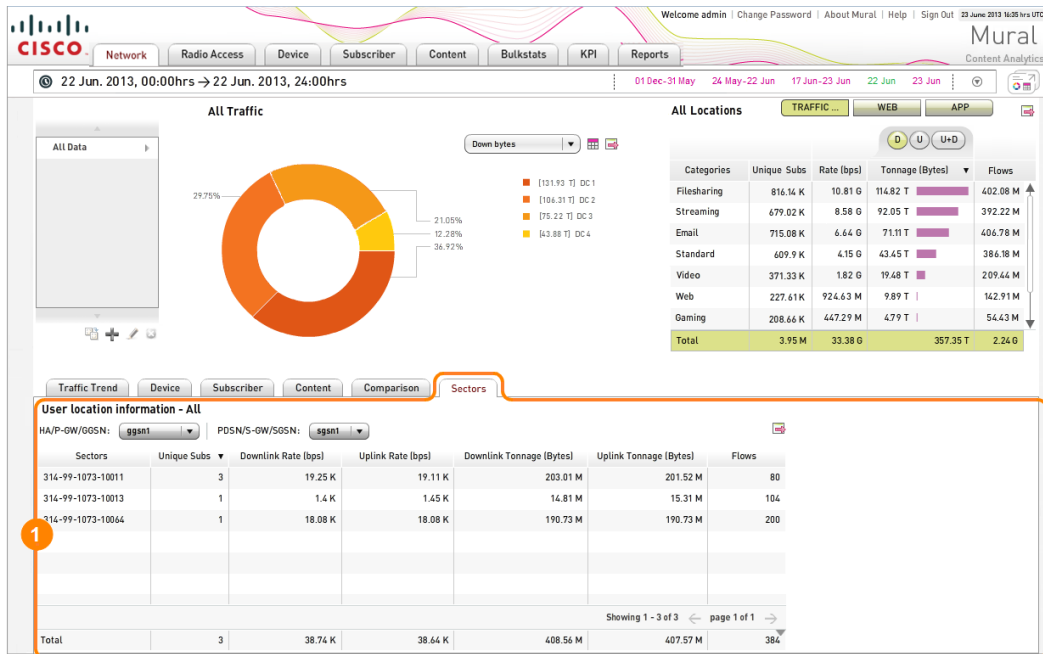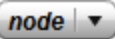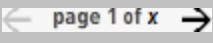
To specify the set of sectors to display, click the drop-down menus above the table and select a node from each of them. The list of sectors is determined only by the two nodes; selecting an individual wedge in the doughnut chart or row in the categories table in the upper half of the tab has no effect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

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 135.
▼ ▲	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 130.
Showing 1 - *xx* of *total*	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 *x* →	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.

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	–
B	–	–	billions (10^9)
T	terabits per second (Tbps)	terabytes	trillions (10^{12})

	Rate Statistics	Volume Statistics	Count Statistics
P	petabits per second (Pbps)	petabytes	–
Q	–	–	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.

Performing In-Depth Data Analysis

The main pane on the **Network**, **Radio Access**, **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.
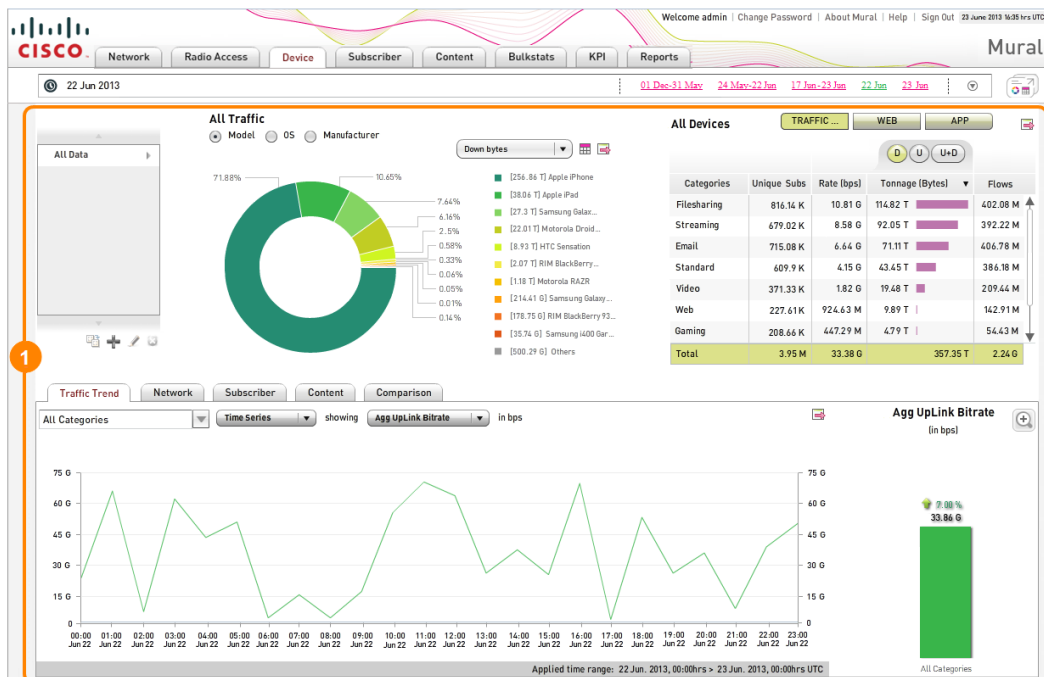
The "flow" from high-level summary data to detailed data in the MURAL main pane creates a Z shape, starting at the filter interface in the upper left corner, proceeding through the charts and tables to its right, then moving down to the charts and graphs on the subtabs in the lower left corner, and ending 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 Service Providerstable and the **Content** subtab opened in the lower half of the tab.
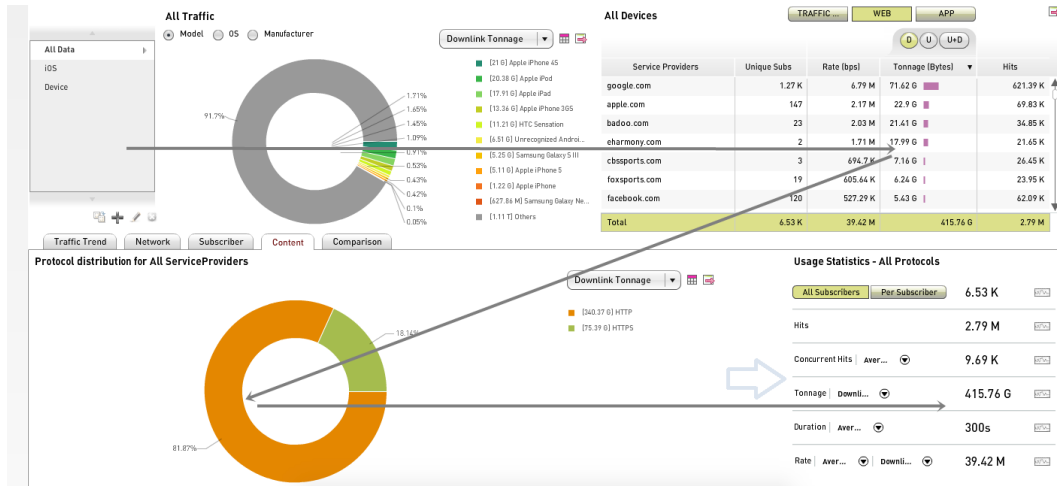
By means of an example, this topic describes how to obtain detailed information about a very specific portion of the traffic on your network.

To view data in the Service Provider table for just one of the devices in the dough-nut 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 service provider has been clicked and selected—**google.com**, accounting for the largest number of bytes on the downlink.
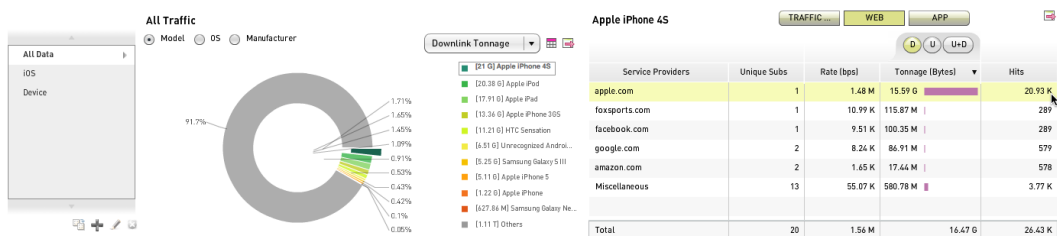
(To switch back to viewing data for all entities in the doughnut chart, click the popped-out wedge.)

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 **google.com** as the service provider.
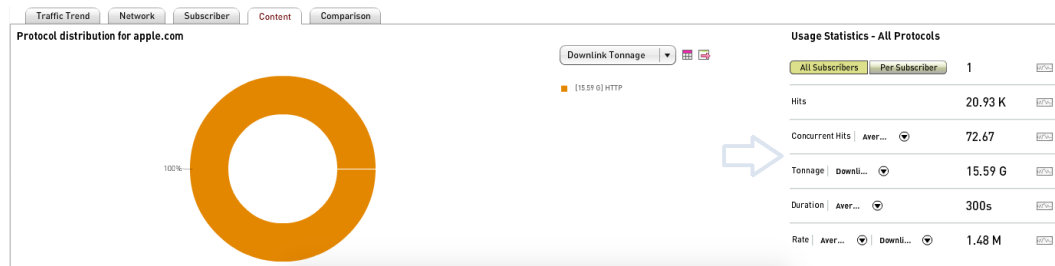
For more information about filters, see "Using Filters to Fine-Tune the Reported Data" on page 51.

For more information about doughnut charts and tables of distribution data, see "Analyzing Traffic Distribution" on page 71.

For more information about the **Usage Statistics** table, see "Interpreting Usage Statistics" on page 117.

Exporting Data to a File or the Palette

On the **Network**, **Radio Access**, **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 CSV" below

- "Exporting an Image to a File" on page 138

- "Exporting an Image to the Palette" on page 139

Exporting Data to a File as CSV

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.
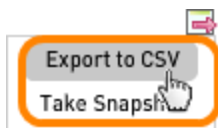
A new window pops up to display the CSV-formatted text. The example is from the traffic distribution pane on the **Device** tab.
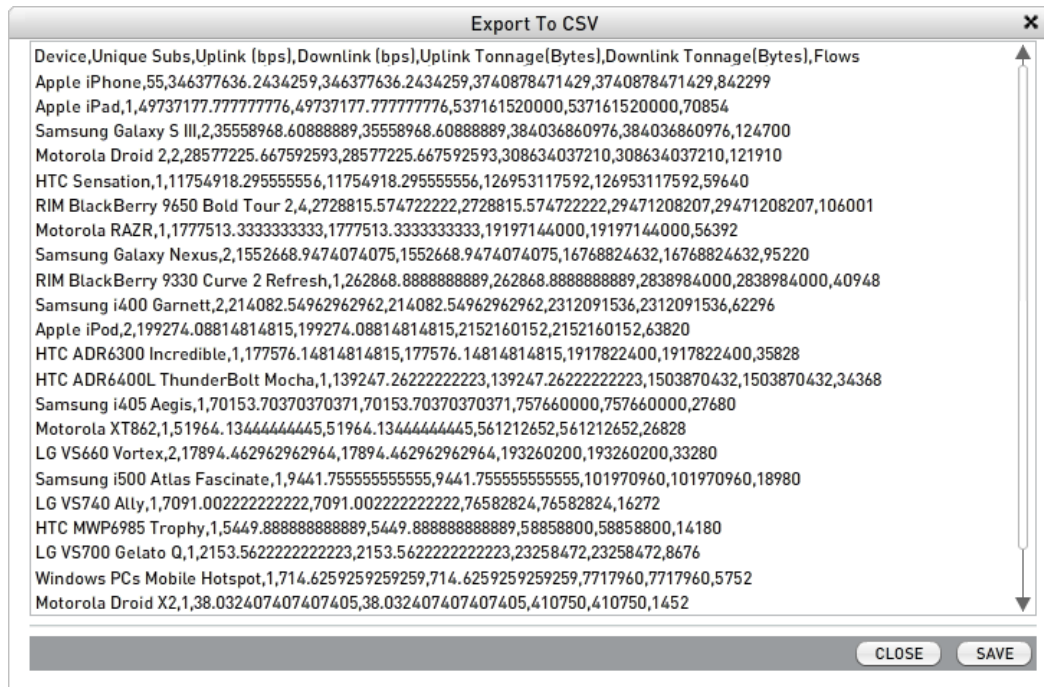
There are three points to note:

- 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.

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

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). Information such as entity type, entity name, tab or subtab name,
   bit-rate, traffic direction, IP version, and time range is added above
   the chart, along with the current settings of any drop-down menus and
   selector boxes in the display.
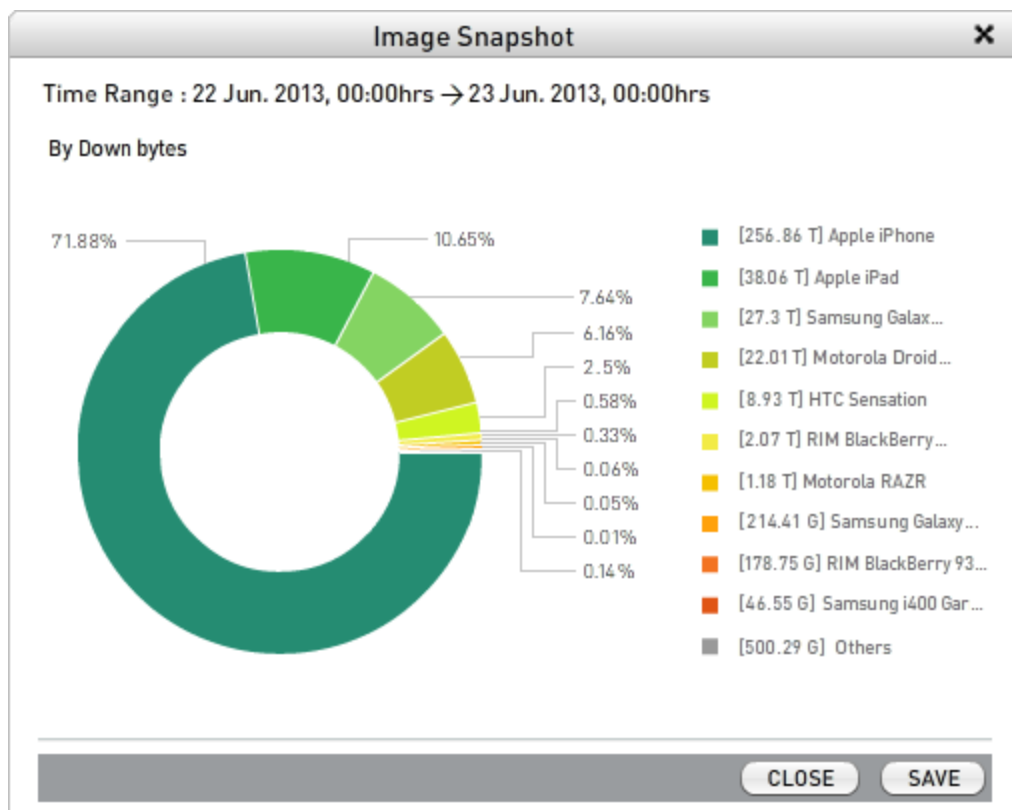
Note: If you save a table as an image, the image includes only the rows that are visible on the tab. If you want to capture all of the data used to generate the table, follow the procedure in "Exporting Data to a File as CSV" on page 135.

3. To save the image to a file, click the **SAVE** icon. 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** icon or the close-window icon (✖) on the title bar.

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 MURALsession.

"Comparing Images on 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.

The screen is added to palatte. It can be viewed by clicking the**"click to open palatte window"**icon given at the top right.

A separate palatte window is displayed that shows the various items added as palatte.

The following image displays a palatte window with various analysis items added.
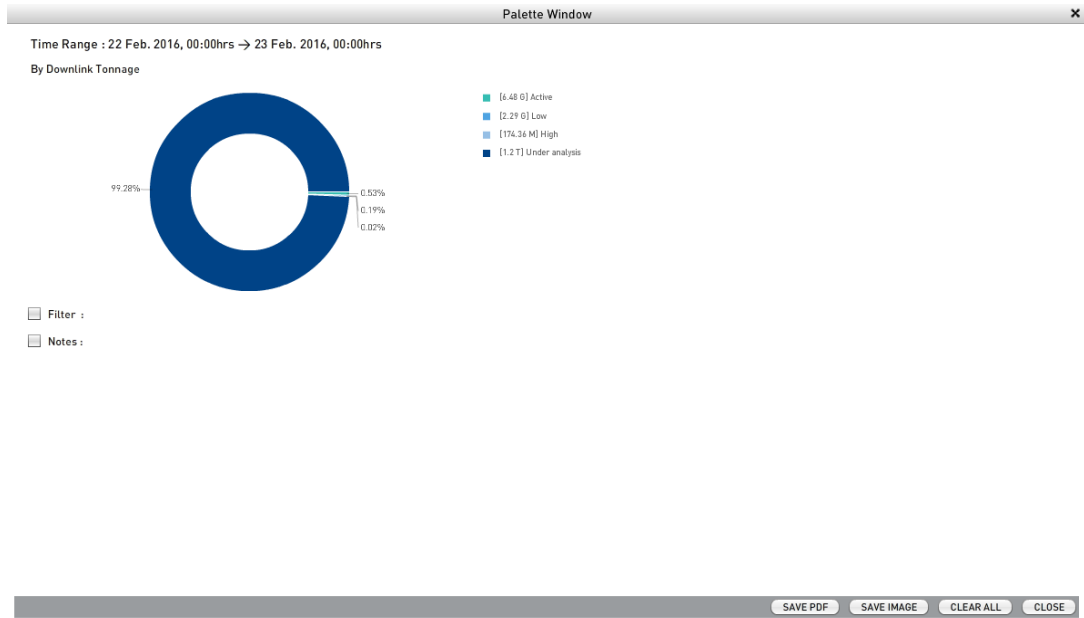
You can perform the following functions from the palatte window.

- **Save PDF**- Save the palatte window as PDF.
- **Save Image**- Save the palatte window as an Image.
- **Clear All**- Clear the contents of the palatte window. If you want to delete a particular item, click the icon at the top right of the selected item.
- **Close**- Close the palatte window.

You can also add notes for a particular item in the palatte window by checking the**Notes**checkbox.

Comparing Images on the Palette

On the **Network**, **Radio Access**, **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 143

- "Clearing Images from the Palette" on page 144

- "Saving the Contents of the Palette to a File" on page 145

- "Closing the Palette Window" on page 146

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.
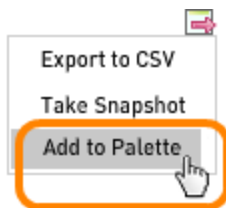
A small version of the image appears and floats quickly across the screen
to the palette icon, which is enclosed in the orange box in the following fig-
ure.
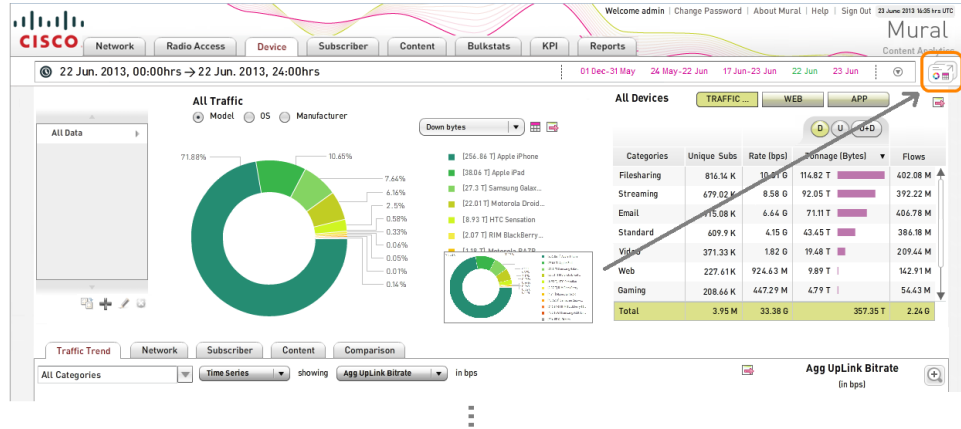
Accessing the Palette and Comparing Images

To open the palette window, click on the palette icon, which is in the upper right
corner of the tab.
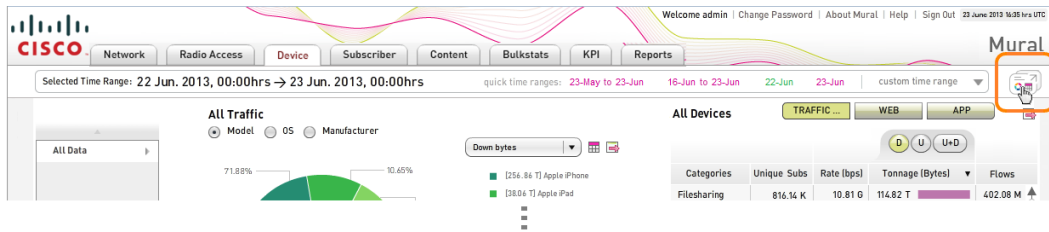
The palette window pops up. If there are no images on the palette, a set of
instructions appears in the window.

Copyright © 2016, Cisco Systems, Inc.

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.
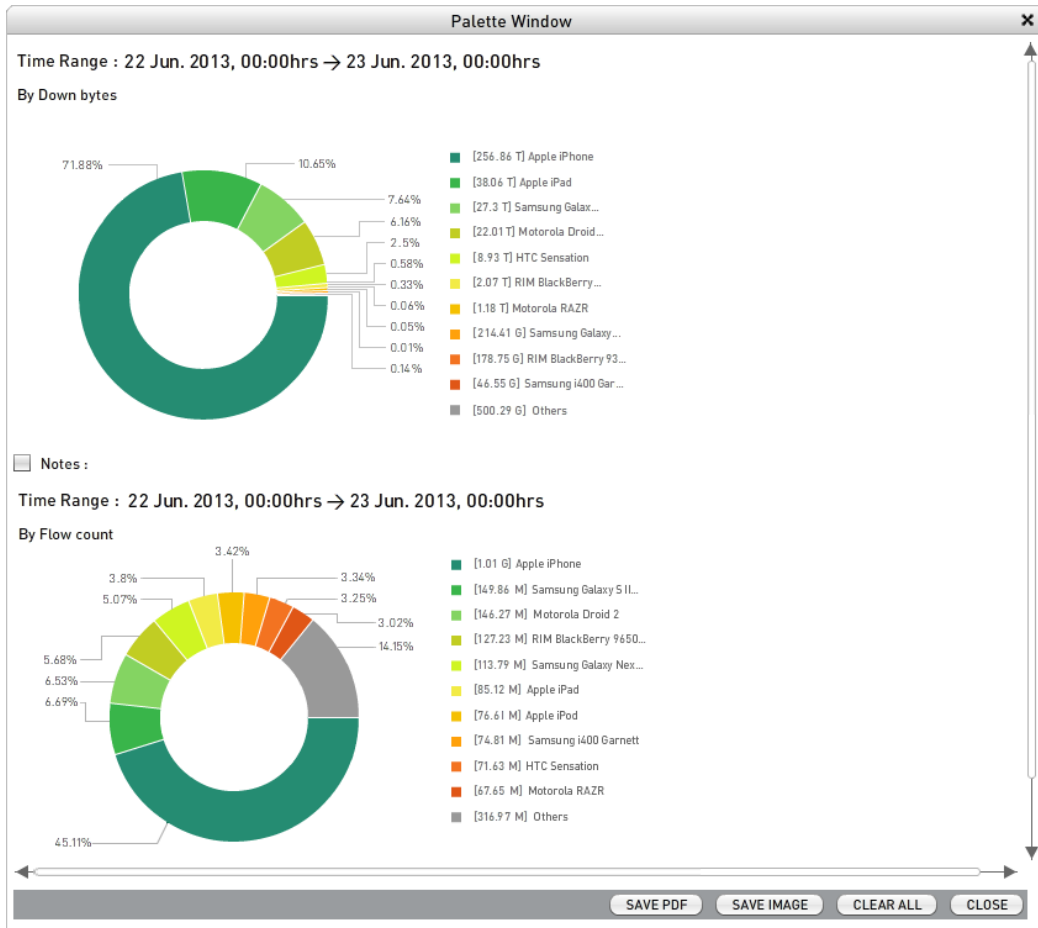
Attaching an Annotation to an Image

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.

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.
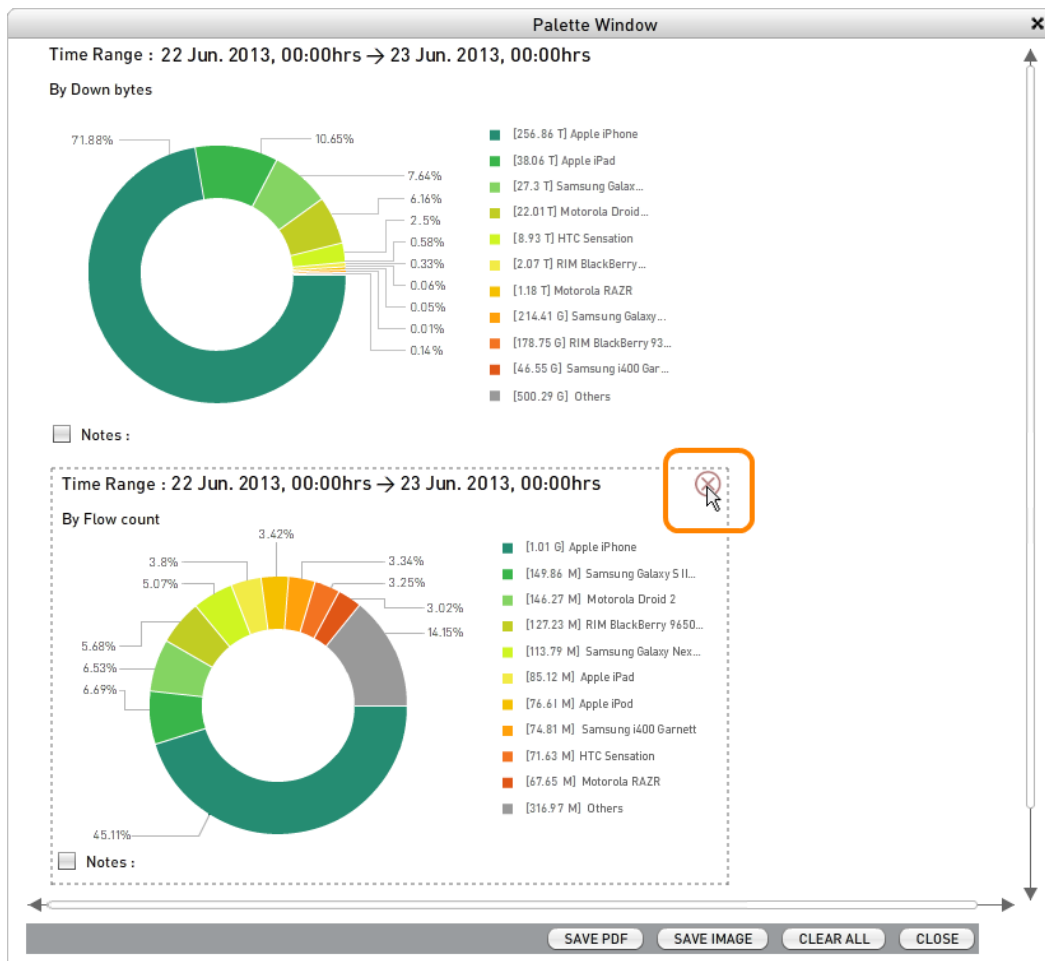
Saving the Contents of the Palette to a File

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.

Interpreting Performance Statistics for the ASR

The **Bulkstats** tab in Mobility Unified Reporting and Analytics (MURAL) reports performance statistics for a specified Cisco ASR 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 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.
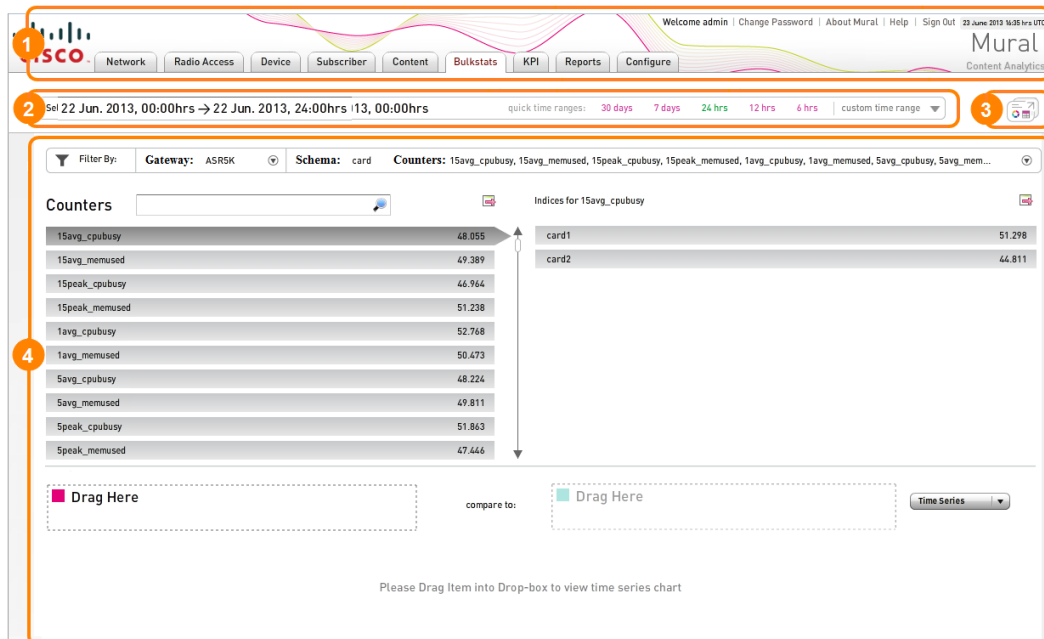
The panes in the numbered boxes provide the following functionality:

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 35.

2. Time range selector—Use this panel to set the period of time for which data is reported on the tab. By default, previous day's data is displayed. See"Setting the Time Range for Displayed Data" on page 39.

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 141.

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 Bulkstats Display" below

   - "Displaying the List of Counters" on page 151

   - "Comparing Two Counters" on page 152

   - "Selecting the Gateway" on page 157

   - "Selecting the Schema" on page 159

   - "Displaying a Subset of Counters" on page 161

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

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 152.

The following table describes the elements in the pane.

Element	Description
Gateway: gateway_name	Names and sets the ASR for which counters are displayed. See "Selecting the Gateway" on page 157.
Schema: schema_name Counters: counters...	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 159 and "Displaying a Subset of Counters" on page 161.
Counters	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 162.

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 135.
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.
counter_name value *counter_name* value	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.
index_name value	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.
Drag Here compare to: ··· ··· Drag Here	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 152.
⊗	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 152.
Time Series ▾	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 152.

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.

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 161, 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.
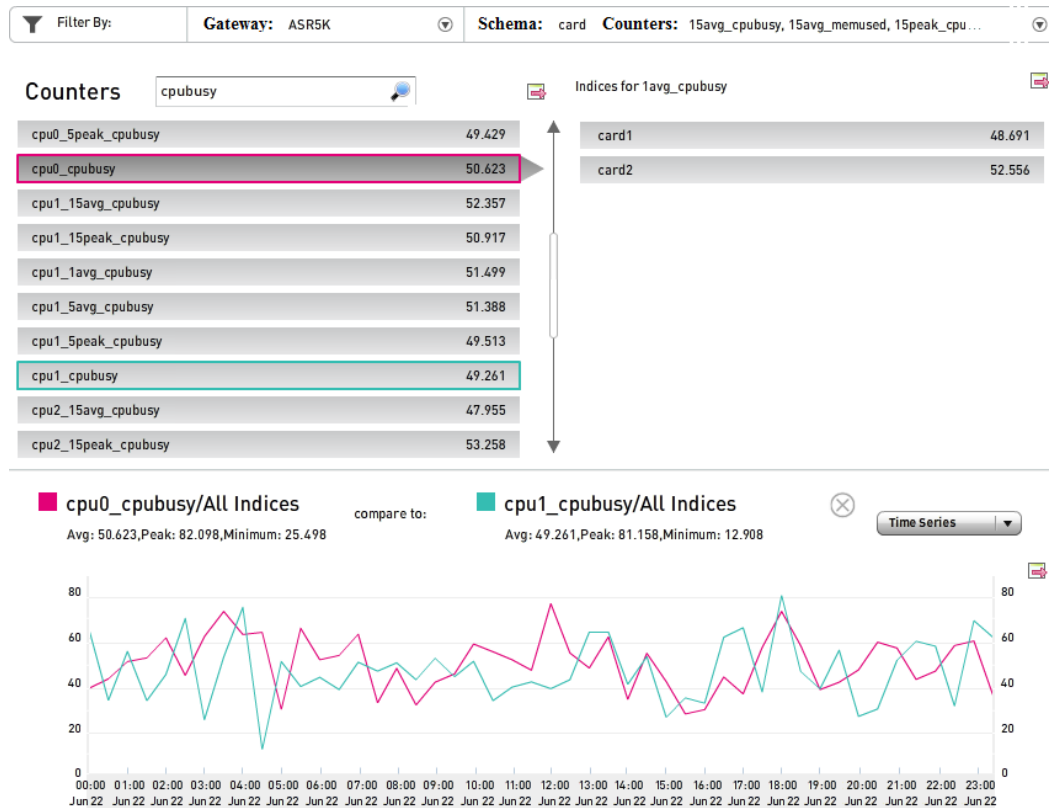
The names of the counters appear in two locations:

- 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.

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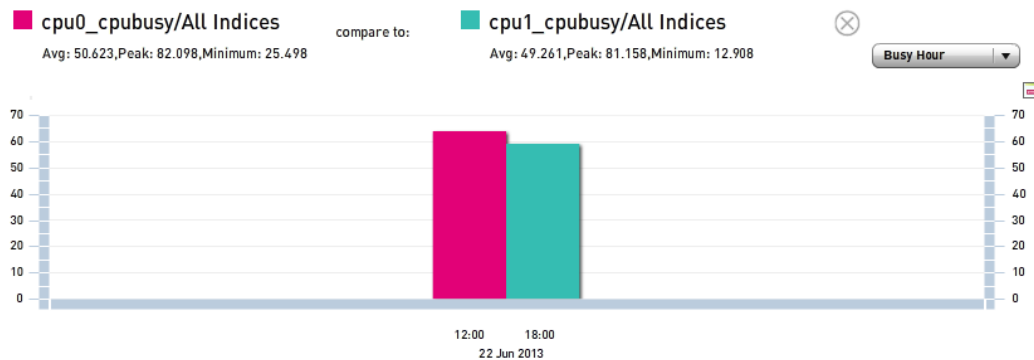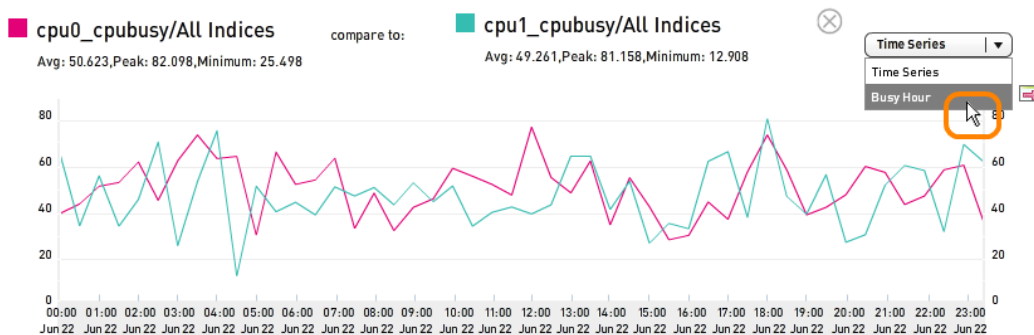
You can compare any two counters from the left and right halves of the pane (the left-hand values being aggregates and the right-hand values being individual entities to which the schema applies). In the following example, the aggregated value of the **1avg_cpubusy** counter (selected in the left column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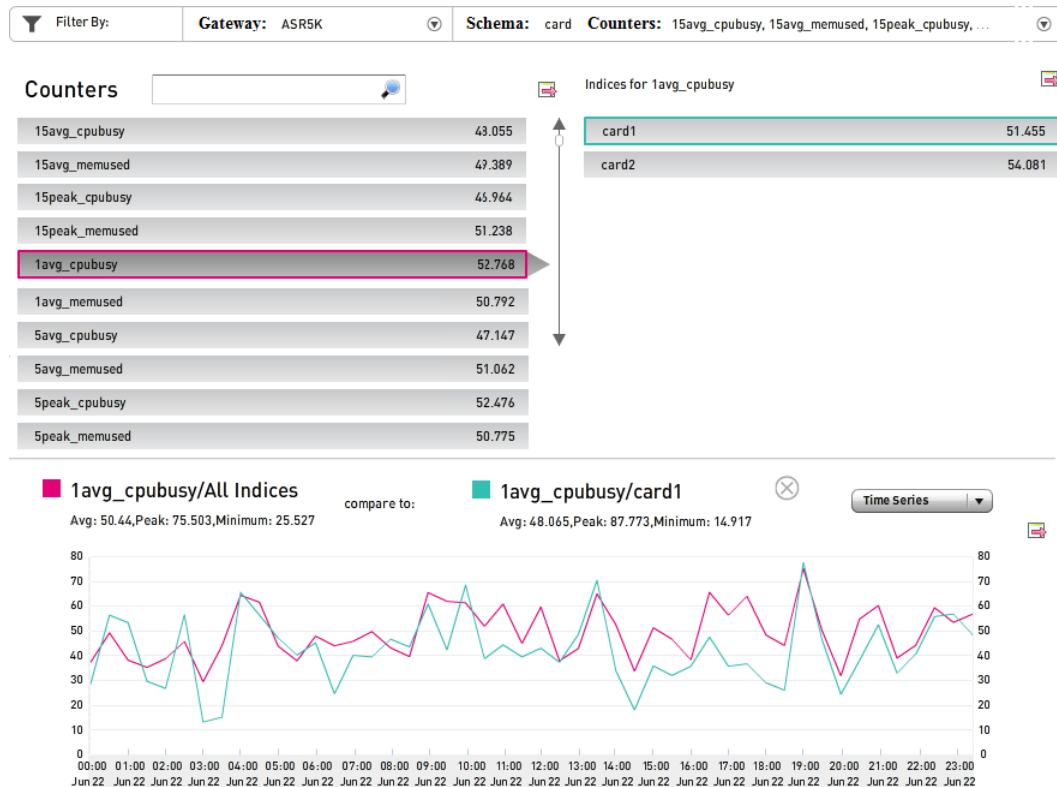
To specify the two counters to compare, perform the following steps.

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.

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.
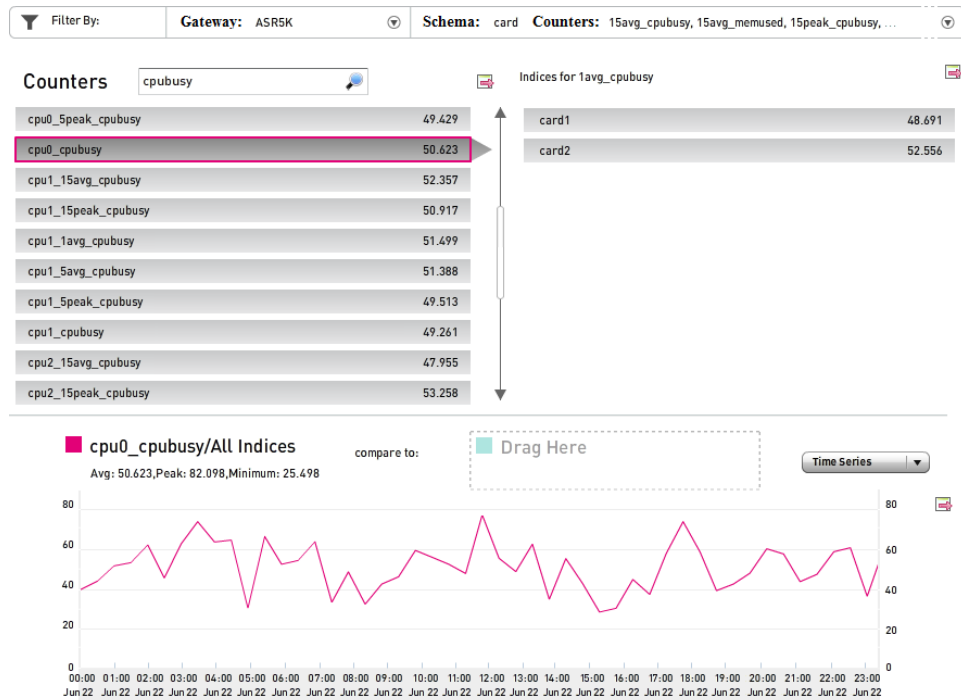
3. Repeat Steps 1 and 2 for the second counter, dragging it into the box labeled **Drag Here** with the turquoise square (▣) in the lower right pane.

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.

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.
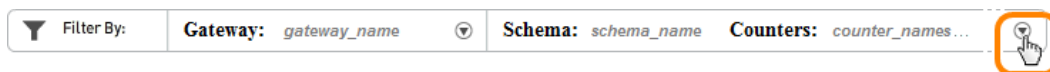
The **Select Counter** window pops up to report the currently selected schema and the first few counters from the schema that are currently selected for inclusion in the pane, as in the following example for the **card** schema.
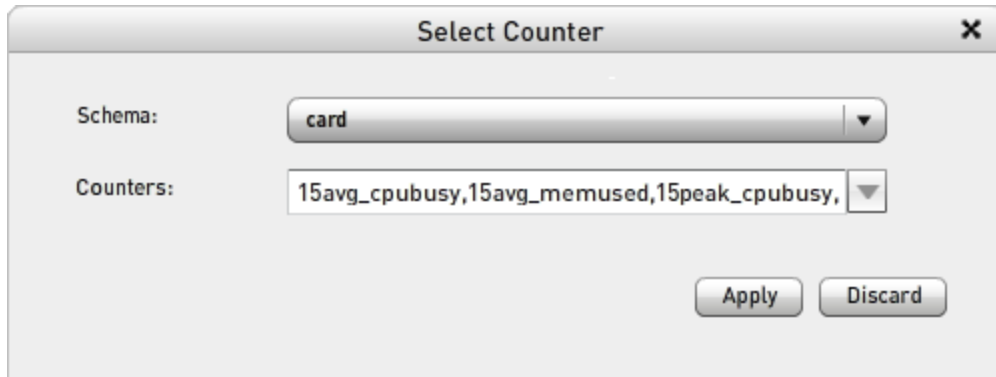
To select a different schema, click the **Schema** menu button and then your choice in the menu that drops down. Several dozen schemata are usually available; to navigate to the one you want, you can type a letter to jump down to the first counter whose name begins with it, use the scroll bar, or both. In the following example, the **gprs** schema is being selected.
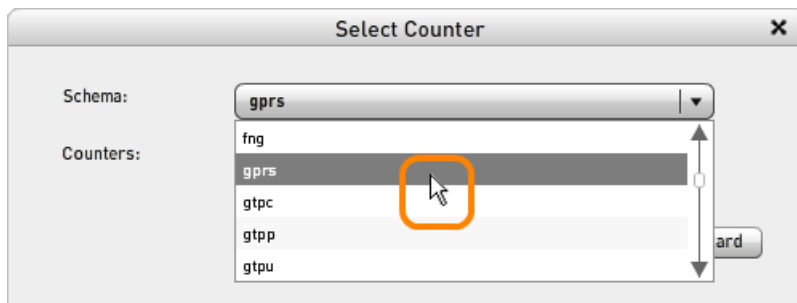
After selecting the new schema, you can optionally select a subset of counters to display; for instructions, see "Specifying a Subset of Counters During Schema Selection" on the facing page.

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 next 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.
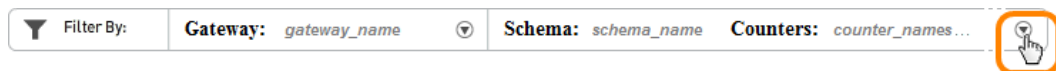
2. In the **Select Counter** window, click the open-menu icon (▼) on the **Counters** drop-down menu box to expose the list of counters. (Counter names that begin with numerals appear first, followed by names in alphabetical order.)
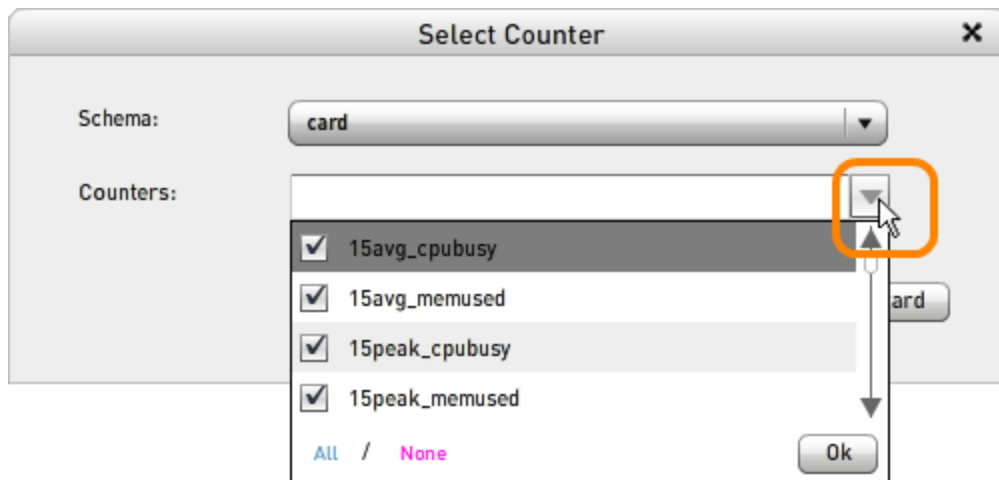
When the menu drops down, all values are checked, which selects them for inclusion in the display.

- 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.
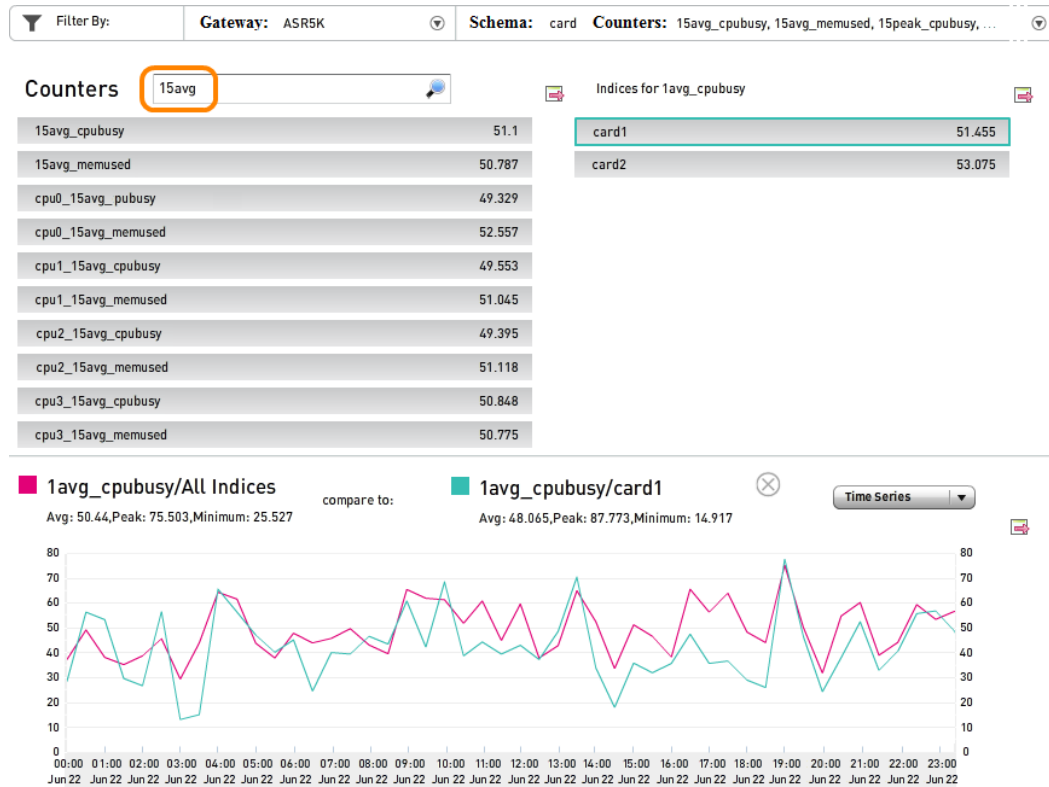
The figure illustrates how limiting the list to matching counter names does not change other aspects of the display pane, which is taken from the second example in "Comparing Two Counters" on page 152. The counter that was selected before the search (**1avg_cpubusy**) is still selected; it does not appear 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**.

Interpreting Key Performance Indicators from the ASR

The **KPI** tab in Mobility Unified Reporting and Analytics (MURAL) reports key performance indicators (KPIs) from the Cisco ASR.

KPIs are formulas that operate on the statistics generated by the ASR (which are reported individually on the **Bulkstats** tab as described in "Interpreting Performance Statistics for the ASR" on page 147). 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 35.

2. Time range selector—Use this panel to set the period of time for which data is reported on the tab. By default, previous day's data is displayed. See"Setting the Time Range for Displayed Data" on page 39.

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 141.

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 170

   - "Comparing Hourly Values for Two KPIs or Counters" on page 171

   - "Selecting the Gateway" on page 174

   - "Selecting the Schema" on page 176

   - "Displaying a Subset of KPIs" on page 177

   - "Defining New KPIs" on page 180

   - "Cloning and Editing KPIs" on page 185

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 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 **ASR** gateway and **sgsn** schema. The KPI called **2G Subscriber PDP De-act Success Rate (%)** is selected and its aggregated value for gateway **ASR** 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**

---
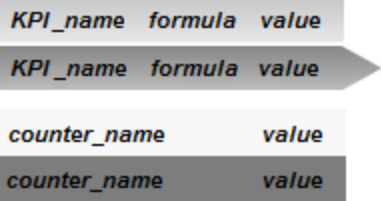
schema applies (**mcc1_rac1_mnc1_vpnname1_lac1_servname1** through **mcc6_rac6_mnc6_vpnname6_lac6_servname6**).
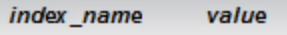
The lower half of the pane is an interface for visually comparing the values of two KPIs or counters on an hourly basis as they change over the course of the selected time range. For instructions on its use, see "Comparing Hourly Values for Two KPIs or Counters" on page 171.
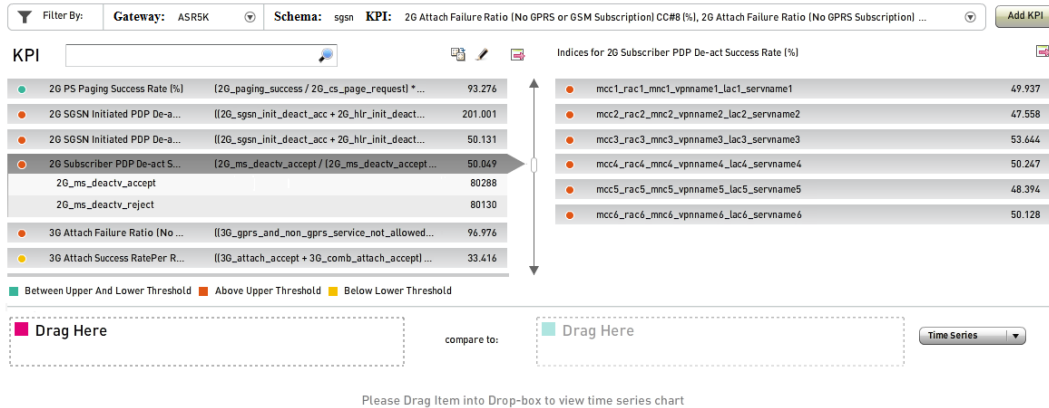

The following table describes the elements in the pane.

Element	Description
Gateway: *gateway_name* ▼	Names and sets the ASR for which KPIs are displayed. See "Selecting the Gateway" on page 174.
Schema: *schema_name* **KPI:** *KPIs …* ▼	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 176 and "Specifying a Subset of KPIs During Schema Selection" on page 177.
Add KPI	Opens the interface for creating new KPIs. See "Defining New KPIs" on page 180.

Element	Description
KPI	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 179.
	Clones or edits the selected KPI. See "Cloning and Editing KPIs" on page 185.
	Copies the data in the pane to a file or the palette. See "Exporting Data to a File or the Palette" on page 135.
Indices for *KPI-or-counter_name*	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 No Indices for *KPI-or-counter_name* and the words No data available 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.
KPI_name formula value *KPI_name formula value* *counter_name value* *counter_name value*	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).

Element	Description
index_name　　*value*	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 **Indices for** *KPI-or-counter_name* header.
■ **Drag Here** compare to: ⋯　⋯ ■Drag Here	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 171.
⊗	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 page 171.
Time Series ▼	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 page 171.

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.
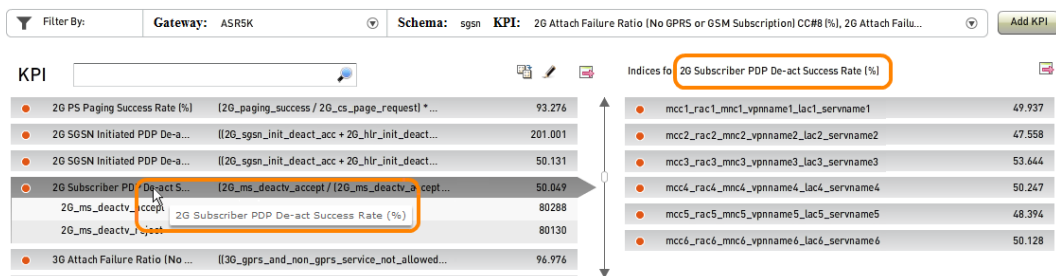
Similarly, formulas are usually too long to appear in full in the list of KPIs. To display the full formula for a KPI, mouse over its name in the list, as shown in the following figure for the **2G Subscriber PDP De-act Success Rate (%)** KPI. For information about the notation used in formulas, see "Defining New KPIs" on page 180.

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 177, 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.

- 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.
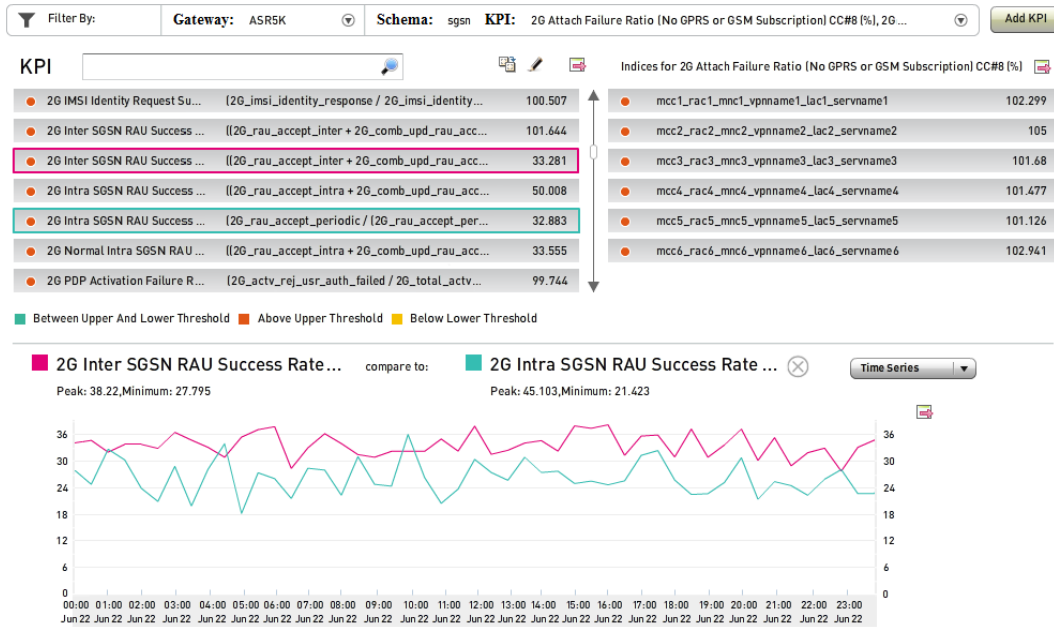
To display the hour in which the highest value occurred for both counters during the selected time range, click on the **Time Series** drop-down menu button and select **Busy Hour** on the menu that drops down. In the following example, the highest average value occurred between 13:00 and 14:00 hours for **2G Inter SGSN RAU Rate per RA (%)** and between 07:00 and 08:00 hours for **2G Intra SGSN RAU Rate per RA (%)**.
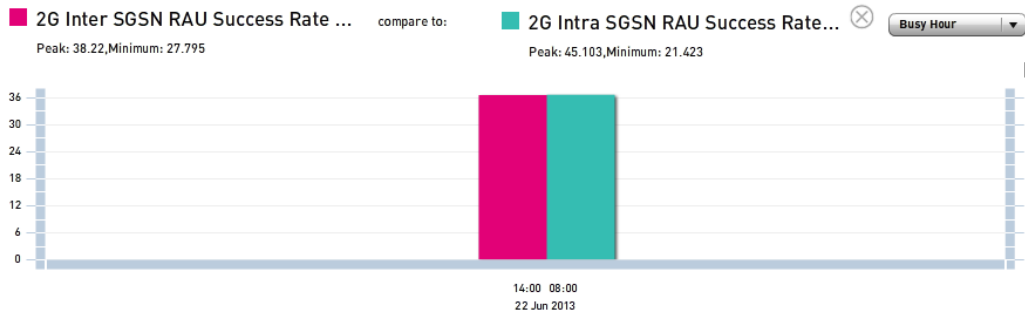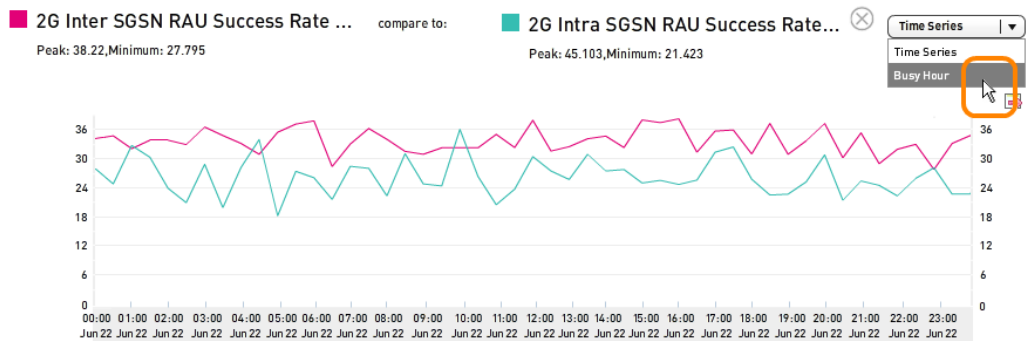
You can compare any two KPIs or counters from the left and right halves of the pane. To specify the two entities to compare, perform the following steps.

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

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.
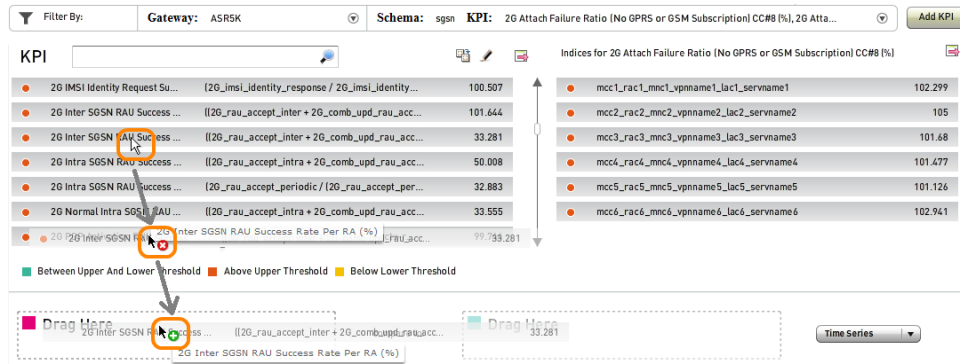
A time-series line chart appears with hourly values for the first KPI.
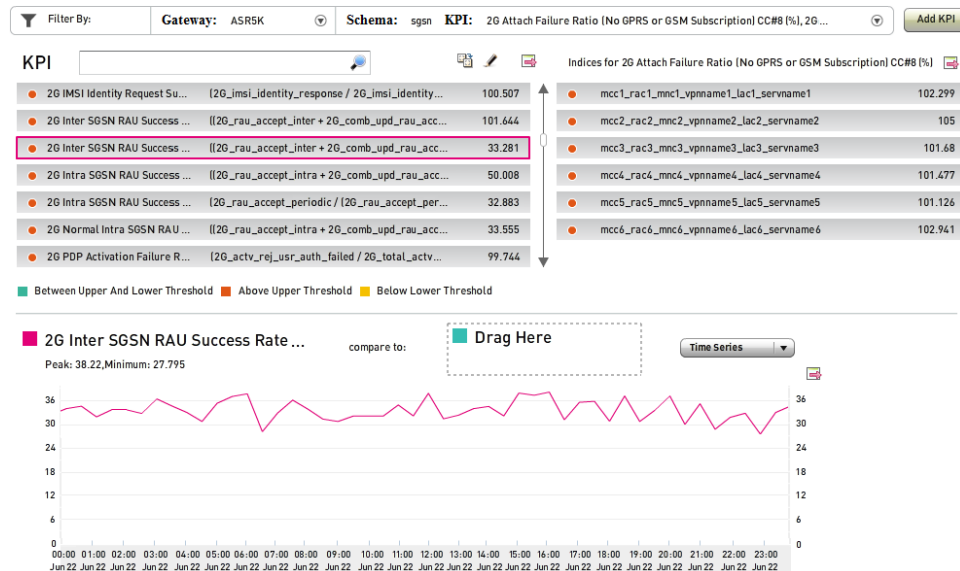
3. Repeat Steps 1 and 2 for the second counter or entity, dragging it into the box labeled **Drag Here** with the turquoise square (■) in the lower right pane.

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 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 option-ally display only a subset of KPIs, click the open-window icon (⊙) at the right end of the **Schema** field.
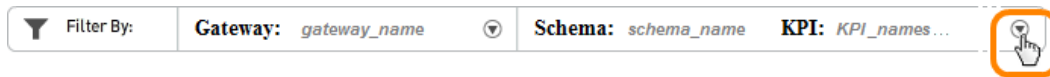
The **Select Counter** window pops up to report the currently selected schema and the first few KPIs from the schema that are currently selected for inclusion in the pane, as in the following example for the **sgsn** schema.
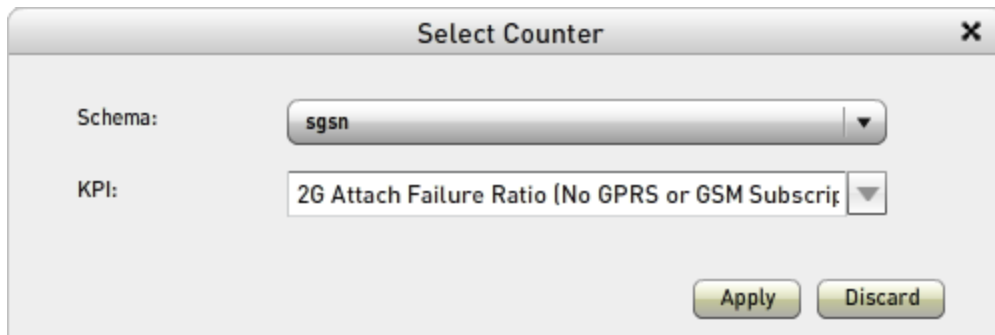
To select a different schema, click on the menu button and then on your choice in the drop-down menu. In the following example, the **gtpc** schema is being selected.
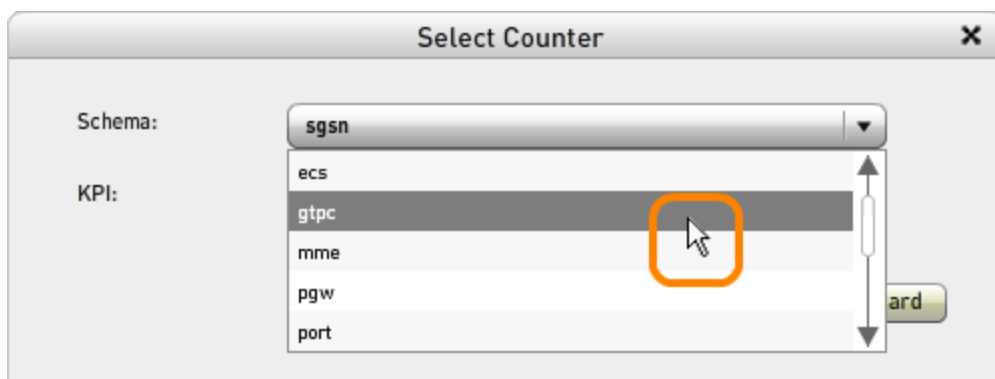
After selecting the new schema, you can optionally select a subset of KPIs to dis-play; for instructions, see "Specifying a Subset of KPIs During Schema Selection" on the facing page.

Copyright © 2016, Cisco Systems, Inc.

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 page 179

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.
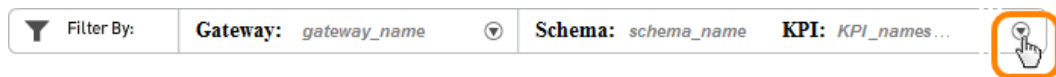
2. On the **Select Counter** window, click the open menu icon (▼) on the **KPI** drop-down menu box to expose the list of KPIs. (KPI names that begin with numerals appear first, followed by names in alphabetical order.)
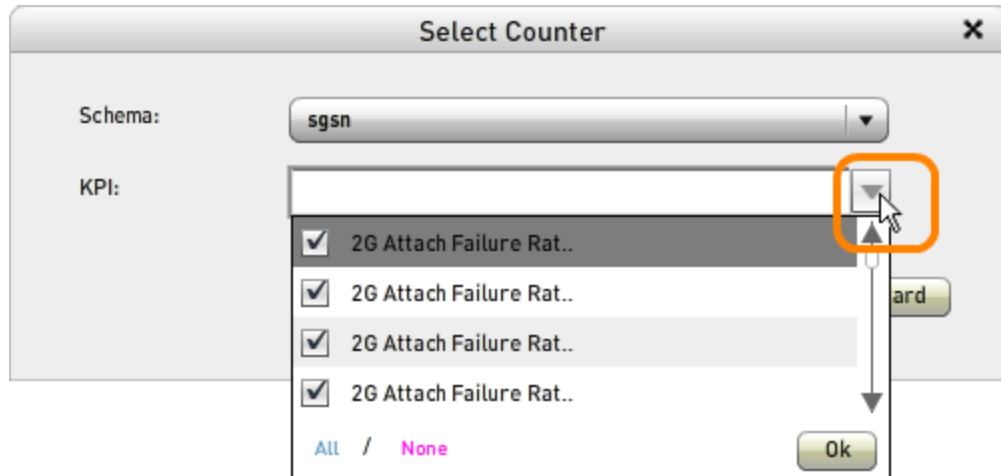
When the menu drops down, all values are checked, which selects them for inclusion in the display.

- 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).

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.
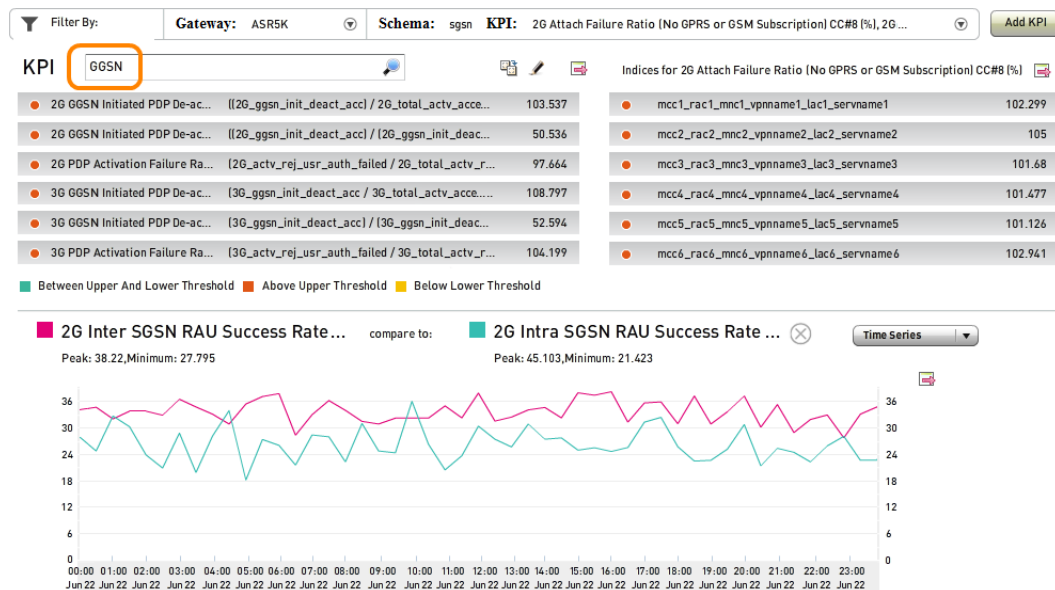
The example illustrates how limiting the list to matching KPI names does not change other aspects of the display pane, which is taken from the example in "Comparing Hourly Values for Two KPIs or Counters" on page 171. The KPI that was selected before the search (**2G Subscriber PDP De-act Success Rate (%)**) 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 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 ().

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.
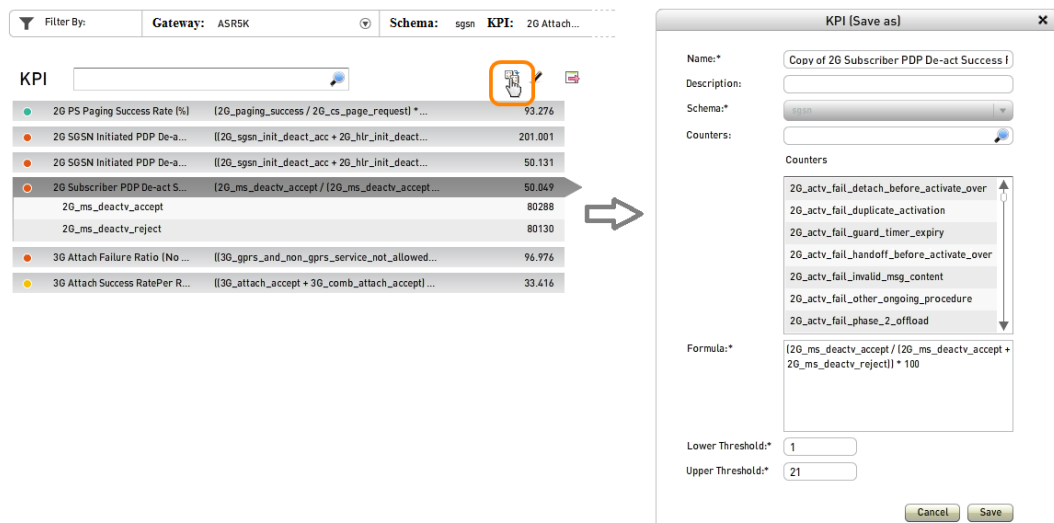
Cloning and Editing KPIs

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 180.

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.

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 180.

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   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 **Undelivered 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 **Undelivered 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 inform-
   ation on each tab. On the right side, reports status information about the
   current MURALsession andprovides access to interfaces for changing your
   password. See"Accessing the Main Tabs and Controlling the Session" on
   page 35.

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 191.

- In the **Undelivered Reports** window, reports that are scheduled to be generated in the next day, week, or month. See "Administering Scheduled Reports" on page 198.

4. Filter—(**Available Reports** and **Undelivered 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 200.

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 197).

- **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 191).

- **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 193).

- **REQUESTED BY**—MURAL user ID of the user who scheduled the report.

- **NOTES/FILTERS**—Icons for opening pop-up windows that display inform-
  ation 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 "Review-
    ing and Submitting the Report Request" on page 197).

  - 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
    "" on page 197).

- **REPORT LINKS**—Icon for saving the report as a PDF (**.pdf**) 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** icon.

    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 (🗑).

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 200.

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" below

- "Specifying the Covered Period of Time" on page 193

- "" on page 197

- "Reviewing and Submitting the Report Request" on page 197

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

Until you submit the finalized report request, you can change the selections on any of the screens by clicking the **BACK** icon to go back one screen at a time. You can also click the **STARTOVER** icon 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 report to create, then click the **CONTINUE** icon.

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:

- Top Customers Report—Customers who generated the most traffic, either on the entire network or at specified points of presence (PoPs)

- Top Prospects Report—Prospective customers who generated the most traffic, either on the entire network or at specified PoPs

- Peer Interactions Report—Traffic exchange between your network and all peers

- Customer Overview Report—Traffic generated by one specified customer

- Customer Detail Report—Traffic generated by one specified customer with detailed analysis for every interface

- Prospect Detail Report—Traffic generated by one specified prospective customer

- Peer Overview Report—Traffic generated by one specified peer

- Peer Detail Report—Traffic generated by one specified peer with detailed analysis for every interface

- Prospect Deal Sheet Report - Traffic Summary and Traffic Trends over the selected reporting time interval.

- Gateway Traffic —Gateways (sites where network equipment is located)

- Subscriber Activity—Subscribers that account for the greatest amount of traffic

- Device Usage—Mobile devices 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 use a calendar interface to specify the period of time—months, weeks, or days—for which to include data in the report:

- "Scheduling a Single Report" below

- "Scheduling a Recurring Report" on the next page

Scheduling a Single Report

By default, the calendar is in **Day** mode and the previous day is selected, as indicated by the gold background color.

In **Week** mode, the calendar depicts the current month, with a number to the left of each week indicating its count in the 52 weeks of the year. No week is selected by default.

In **Month** mode, the calendar depicts the twelve months of the current year. No month is selected by default.

The interface uses the same conventions as the time range selector described in "Setting the Time Range for Displayed Data" on page 39:

- The selected mode is indicated by green print on the icon. To select a mode, click the icon.

- To navigate to earlier or later months (or years in **Month** mode), click the

arrow icons above the calendar ().

- Cells that can be selected are shaded gray. Ineligible cells have a white background, and when you mouse over them their outline turns red. (In **Month** mode, the first and last months in the available range might be partially gray, but only full months can be selected.)

- To select a single day or month, click its cell. To select a single week, click any cell in the row or the count number to the left of the row.

- The precise start and end times of the currently selected period appear in the **Time Range** field below the calendar.

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. The figure depicts **Day** mode as an example.

1. Click the initial month, day, or week to select it.

2. Click the **Create Recurring Report** check box. A table opens in the right half of the pane and lists the reports to be generated, two by default. Each report covers the period from 00:00 hours (midnight) on the indicated **START DATE** to 00:00 hours on the indicated **END DATE**.

   In addition, a gray bar appears at the bottom of the pane to report the period for which data is currently available. If a report's **END DATE** is within the availability period, the report is generated the day after the report request is submitted. If the **END DATE** is after the final day of the availability period, the report is generated the day after the **END DATE**.

   In the figure, 9 June was selected as the initial day in Step 1, so the two reports cover 9 June and 10 June. They will be generated the day after the current day, because those dates are within the availability period.

3. Set the number of reports to create, either by typing in the

Number of Instances box or by clicking the up or down arrow to increase or decrease the number by one for each click. The minimum value is **2** and the maximum is **50**. The table to the right updates to list all reports to be generated.

4. Click the **CONTINUE** button. For information about the next screen, proceed to "" on page 197.

For most report types, you specify filter criteria that customers, peers, or prospects must match in order to be included in the report. The available categories of criteria depend on the type of report you selected on the **Select Report Category** screen, as described in "Selecting the Report Type" on page 191. After selecting the filter terms, click the **CONTINUE** button.

- For filter-creation instructions for the **Top Customers** and **Top Prospects** reports, see "Selecting PoPs for Top Customers and Top Prospects Reports" below.

- For filter-creation instructions for *Entity* **Overview** and *Entity* **Detail** reports, see "Selecting Customers, Peers, or Prospects for Overview and Detail Reports" on the next page.

- For the **Peer Interactions** report, you do not define a filter. MURAL moves directly from the **Select Report Period** screen to the **Review and Submit** screen, which is described in "Reviewing and Submitting the Report Request" on page 197.

Selecting PoPs for Top Customers and Top Prospects Reports

When scheduling **Top Customers** and **Top Prospects** reports, you specify the PoPs to include in the report. You must select at least one.

- To include a PoP in the report, click its check box.

- To include all PoPs in the filter, click All. (If you want to include a large number of PoPs but not all of them, it is most efficient to select all of them this way and then click on the check boxes of the ones to exclude.)

- To remove the check from all currently checked boxes, click None.

Selecting Customers, Peers, or Prospects for Overview and Detail Reports

When scheduling **Overview** and **Details** reports, you choose the customer, peer, or prospect to include in the report.

To specify the customer, peer, or prospect, perform the following steps:

1. Search for it using one or more of the following criteria. First check the box in front of the criterion, then type in the box.

   - **Name**—Character string that occurs anywhere in the name of the customer, peer, or prospect. The match is not case sensitive.

   - **AS Number**—Full AS number (unlike values in the **Name** field, partial matches do not yield results).

   - **PoP**—Partial or full PoP name, router name, or both. After specifying a router name, you can additionally specify an interface identifier. Values in these fields are case sensitive.

   AS numbers, PoPs, routers, and interfaces are associated with a customer, peer, or prospect in its entity record. See "Defining Network Entities" on page1.

2. Click the **SEARCH** button.

Reviewing and Submitting the Report Request

The **Review and Submit** screen summarizes the selections you made on the pre-
vious 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 cat-
egories 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** icon to go
back one screen at a time. You can also click the **STARTOVER** icon 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 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** icon to schedule the report.

Administering Scheduled Reports

The **Undelivered Reports** window lists reports that are scheduled to be generated. To access the window, click the **Undelivered** 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 200.

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 the previous page).

- **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 191).

- **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 193).

- **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 inform-
  ation 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 "Review-
    ing and Submitting the Report Request" on page 197).

  - 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
    "" on page 197).

- **CANCEL/DELETE**—Icon () for canceling the generation of a
  pending report.

Filtering a List of Reports

By default the **Available Reports** and **Undelivered 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.
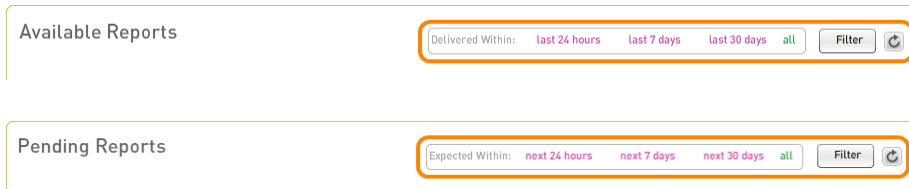
To open the filter interface, click the **Filter** icon. The following figure shows an example for the **Available Reports** window.

To close the filter interface without changing the applied filter (if any), click the **Close Filter** icon. 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** icon and then the **Apply** icon.

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

- "Defining and Applying Filters" on the facing page
- "Saving Filters and Applying Saved Filters" on page 204

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 next page

- "Filtering by Requester ID" on page 203

- "Filtering by Coverage Period" on page 203

- "Filtering by Delivery Status" on page 204

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 **Undelivered 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 **Undelivered Reports** window), click the appropriate name. The currently selected duration appears in green (it is **all** by default).
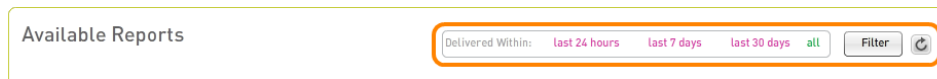
To specify a custom duration, perform the following steps:

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

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 icon 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** icon.
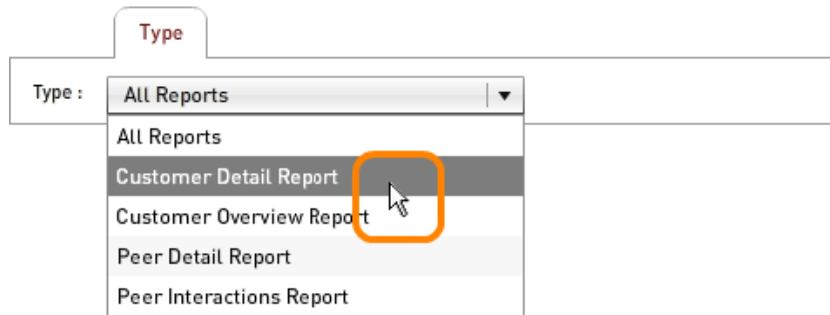
Filtering by Report Name

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** icon.

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** icon.

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.

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

3. Click the **Apply** icon.

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 icon 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** icon.

Filtering by Delivery Status

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

1. Click the **Status** tab.

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

3. Click the **Apply** icon.

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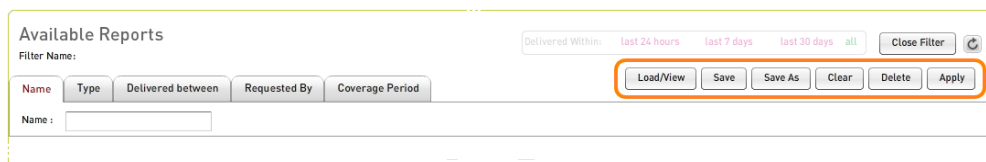
To save a filter that you have defined or is currently applied, click the **Save** icon (or the **Save As** icon to save it under a different name). In the **Save** window that pops up, type a name for the filter in the **Filter name** box and click the **Save** icon.

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

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

Configuring Key Performance Indicator Alarms

You can configure alarms on key performance indicators that are based on the Bulkstat data received from multiple ASR nodes in a network. You can create an alert on a specific schema and instance of a gateway. When the KPI crosses or misses the threshold that you defined, an alarm is raised and displayed on the **KPI Alarms Log** subtab.

You can use the **KPI Alarms** tab in the following ways:

- Click the **Configure** subtab to view a list of KPI alarms for the selected gateway and their details such as schema, index, severity, comparator, threshold value, and status. KPI alarms are displayed in a table and you can sort the values by column. You can also add new KPI alarms and edit or delete the existing KPI alarms.

  Click the Refresh icon ( ) at the top right corner of the page. The page is refreshed with the current status (Cleared or Raised) of the alarms.

  For more information about tasks that can be performed on the **Configure** subtab, see:

    - "Viewing KPI Alarms" below

    - "Adding KPI Alarms" on page 207

    - "Modifying KPI Alarms" on page 208

    - "Deleting KPI Alarms" on page 208

- Click the **KPI Alarms Log** subtab to monitor the alarms (along with their timestamps) raised in the system. Click the Refresh icon ( ) at the top right corner of the page. The logs are refreshed in the page. You can view the time at which a given alarm was raised and when it was cleared. By default, the last 1000 alarms are displayed. For more information, see "Monitoring KPI Alarms" on page 209.

Viewing KPI Alarms

To view KPI alarms for a gateway:

1. Click the **Configure** tab.

2. Perform the following steps to select a gateway that is configured to send Bulkstats data to the MURALsystem:

    a. Click the Filter icon (⊙) next to the **Gateway** field. The Select Gateway pop-up appears.

    b. Select an area, a region, and the gateway for the new KPI alarm.

       By default, the first gateway provisioned in the system is displayed in the available options.

    c. Click **Apply**.

       All the KPI alarms configured for the selected gateway are displayed with the following attributes:

       - **Schema**— Schema of the gateway.

       - **KPI**— KPI on which the alarm is configured.

       - **Index**— Index of the KPI.

       - **Severity**— Severity of the alarm. It can be **Critical**, **Major**, **Minor**, and **Warning**. Severity is illustrated on the UI by using solid colored circles. Hover your mouse over a cirle to display its severity.

         The following table describes the color application in the **Severity** column.

Color	Severity
🔴	Critical
🟠	Major
🟡	Minor
⚫	Warning

       - **Comparator**— Comparator for the threshold value. It can be

Greater than Equal to and **Lesser than Equal to**. The alarm is raised if the value is more or less than the threshold value.

- **ThresholdValue**— Threshold value based on which an alarm is raised.

- **Status**— Current status of the alarms. It can be **Cleared** and **Raised**.

- **Edit/Delete**— Options to edit or delete a KPI alarm. For more information, see "Modifying KPI Alarms" on the next page and "Deleting KPI Alarms" on the next page.

Adding KPI Alarms

You can add a maximum of 100 KPI alarms in the system. You cannot create multiple alarms for the same gateway, schema, index, and threshold value.

To add a KPI alarm, perform the following steps:

1. Click the **KPI Alarms** > **Configure** tabs.

2. Click the **Add KPI Alarm** button at the top right corner of the screen.

3. Perform the following steps in the Add KPI Alarm pop-up that appears:

   a. From the **Gateway** drop-down list, select a gateway.

   b. From the **Schema** drop-down list, select a schema.

   Options in this list are populated based on the gateway that you selected in the step a.

   c. From the **KPI** drop-down list, select a KPI.

   Options in this list are populated based on the schema that you selected in the step b. You can create KPIs for a gateway by using the KPI tab in MURAL. For more information, see "Interpreting Key Performance Indicators from the ASR" on page 165.

   d. From the **Index** drop-down list, select an index.

Options in this list are populated based on the KPI that you selected in the step c.

e. From the **Severity** drop-down list, select a severity for the alarm. The available options are: **Critical**, **Major**, **Minor**, and **Warning**.

f. From the **Comparator** drop-down list, select a comparator. The available options are: **Greater than Equal to** and **Lesser than Equal to**. The alarm is raised if the value is more or less than the threshold value.

g. From the **Report Granularity** drop-down list, select a granularity in minutes at which the KPI is to be calculated. The available options are: 5, 10, 15, and 30.

h. In the **Threshold Value** box, enter an absolute signed double value against which each KPI value for the defined granularity will be compared against.

i. Click **Save** to apply your changes or **Cancel** to discard them. You can also cancel your changes by clicking the **X** in the top-right corner to close the pop-up.

The new KPI alarm is added to the table.

Deleting KPI Alarms

Click the delete icon in the **Edit/Delete** column to delete a KPI alarm. Click **Ok** to confirm the deletion.

Modifying KPI Alarms

1. Click the edit button for the KPI alarm you want to modify. The **Edit Rule** popup window appears showing the current settings.

   Note: Fields which are greyed out cannot be changed. This is because changing these fields would result in the three hours, days, or months learning cycle starting over. Only the Index and the Threshold Value can be modified without causing this reset.

2. Make the necessary modifications.

3. Select **Save** to apply your changes or **Cancel** to discard them. You can also cancel your changes by clicking the **X** in the top-right corner to close the pop-up.

Monitoring KPI Alarms

Click the **KPI Alarms Log** tab to view details of the last 1000 KPI alarms raised in the system. Click the Refresh icon (⟳) at the top right corner of the page to refresh the logs.

KPI alarms are displayed in a table with the following attributes:

- **Time Stamp**—Indicates the day and time that the threshold of the rule was crossed.

- **Gateway**— Gateway for which the alarm is configured.

- **Schema**— Schema of the gateway.

- **KPI**— KPI on which the alarm is configured.

- **Index**— Index of the KPI.

- **Severity**— Severity of the alarm. It can be **Critical**, **Major**, **Minor**, and **Warning**. Severity is illustrated on the UI by using solid colored circles. Hover your mouse over a cirle to display its severity.

  The following table describes the color application in the **Severity** column.

Color	Severity
🔴	Critical
🟠	Major
🟡	Minor
⚫	Warning

- **Value**— Actual value of the measured data.

- **Status**— Status of the alarms. It can be **Cleared** and **Raised**. You can

view history of an alarm on the **KPI Alarms Log** subtab by looking at the timestamp when an alarm was raised and when it was cleared.