



Tridium Graphics Standards Guide

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1.0 Overview and Objectives

Tridium's Niagara Framework® (Niagara) is a powerful platform to develop and implement an easy to use, efficient graphical user interface (GUI) to monitor, control and manage Integrated Automation Systems (IAS). Niagara provides a software infrastructure to integrate disparate systems and devices, regardless of manufacturer or communication protocol, into a unified platform that can be easily managed in real time over the Internet or Private Wide Area Network using a standard web browser.

Sufficient planning, development, coordination, specification and verification are required to maximize the performance of the GUI. The Niagara Framework provides a high degree of flexibility, similar to the development of a website. There are a wide variety of options for gathering and presenting real time and historical data to facilitate control, monitoring and analysis of an IAS. Therefore, the functionality and operation of the GUI should be thoroughly defined by the development team, which can vary from simple to complex. The development team will define navigation, system details, alarming, trending, graphical displays, color selection, etc., enabling complete flexibility for a user experience that meets or exceeds the expectations of the owner.

The design of the GUI will impact functionality, efficiency, operation and cost. Therefore, it is important to obtain and document input from key stakeholders. The GUI development team should consist of the owner, IAS design engineers, the owner's IT department, and key stakeholders within the owner's organization that will operate (facility engineers), support (IT personnel) or utilize (executive management) the IAS.

The development begins with an analysis of owner requirements and expectations. These requirements form the basis of an implementation plan and ultimately the design documents that can be competitively bid on the open market. **It is important for the IAS engineer to thoroughly define the requirements for the operation of the GUI within the design drawings and specifications.** IAS design documents must detail the components required to provide the expected results. Detailed design and specification are required to clarify the options, detail the operation and define the system performance. The design documents provide the basis for contract negotiations, construction administration, performance verification and commissioning. The use of performance specifications with minimal design is not recommended. A low bid contractor should not determine the design, operation and functionality of the GUI. Thorough definition of the GUI requirements facilitates realization of the expected system performance and creates a platform for fair evaluation of the bidders.

The Tridium Graphics Standards Guide provides an overview of the level of detail that the IAS engineer should specify to define the operation of the Graphical User Interface for the Integrated Automation System. The operation of the GUI should be tightly coordinated with the Division 25 specifications and the IAS design drawings to provide a complete set of design documents for the IAS. The IAS engineer should specify that all the graphics requirements defined herein shall be implemented by the IAS Contractor. Substitutions must be submitted by the IAS Contractor for approval by the Owner and the IAS Design Engineer before implementation.

Graphic standards also utilized to provide consistency for clients with multiple facilities. User interfaces that are consistent from site to site allow facility engineers and building operators to apply what they have learned on one site to all sites within the client's portfolio, reducing training time and increasing efficiency. Tridium's Graphics Standards Guide and demonstration site illustrate how to maintain consistency across a portfolio of facilities.

Implementation of the concepts presented within the Tridium Graphics Standards Guide accomplishes the following objectives:

1. Facilitates ease of operation by setting standards for graphics development that shall be implemented by all IAS Contractors.
2. Enables fair and open evaluation of bidders.
3. Provide a standard that is professional, neat, and distinctive.
4. Increase the effectiveness of all system users by providing a consistent user interface.

The standards provided in this document have been coordinated with a demonstration site that Tridium created to illustrate the functionality of the system. It is recommended that the IAS Design Engineer log into publicly available demonstration sites provided by vendors and integrators, become familiar with the operation of the system and compare the concepts in this Guide to the operation of various demonstration websites.

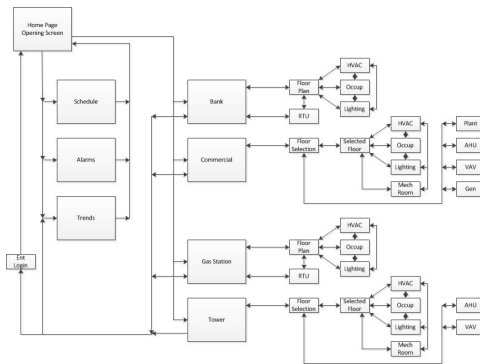
This document can be copied in part, or in whole, to streamline the designer's development of project specific GUI specifications and provide an example of the expected appearance and operation. The IAS design specifications should require the system integrator to submit GUI samples that demonstrate their ability to meet the requirements of the specification. During the Construction Administration and Commissioning phases of the project, the design engineer should verify that the GUI meets all the design requirements, including appearance and operation.

2.0 Graphic Standards

Graphic standards define the required functionality and operation of the GUI. The design documents should clearly define the requirements for the GUI. The descriptions provided in this guide demonstrate the level of detail that should be included within the design documents. The following operations are key components of the user interface.

A. Navigation

Navigation defines the progression through the user interface screens. A Site Map is utilized to illustrate how the user will access individual pages, progress through the GUI, and return to previous pages. Development of a Site Map is important to define expectations, maximize efficiency, and identify any potential bottlenecks.



B. Opening Screen

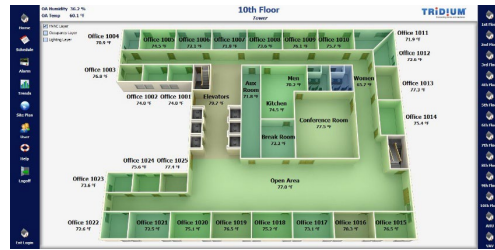
The opening screen is the most viewed page, and therefore should present a professional first impression of the facility, company, and Integrated Automation System. The opening screen must also be functional, enabling the users to quickly access the data that is important to them.



C. Floor Plans

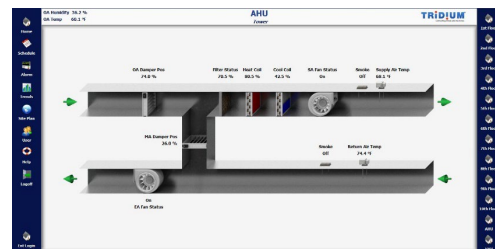
The utilization of floor plans to identify the location and status of equipment provides the user with a visual interface that will enable them to quickly determine the operating condition of an entire floor and/or troubleshoot issues. The ability for Tridium Niagara to display thermographs (graphical color changes based on

the numeric value of an input) enables the user to quickly analyze current conditions and identify the extent of any issues.



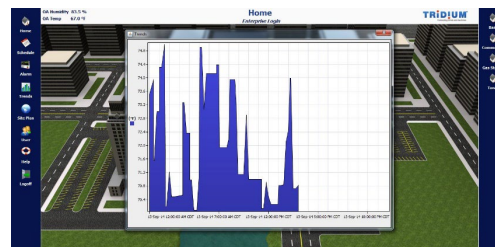
D. Equipment Details

Equipment detail screens enable the user to analyze all the points related to a specific piece of equipment. The number of points required for each piece of equipment will vary based on the equipment type (e.g. VAV box, Air Handling Unit).



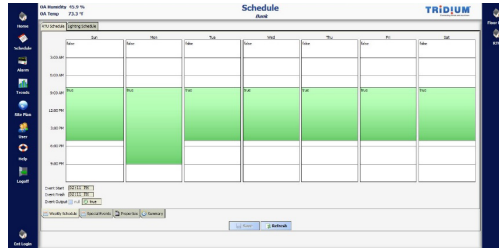
E. Trends

Trends provide a graphical representation of the historical values for a specific data point or multiple data points. Trends are useful for evaluating the performance of a specific piece of equipment over time.



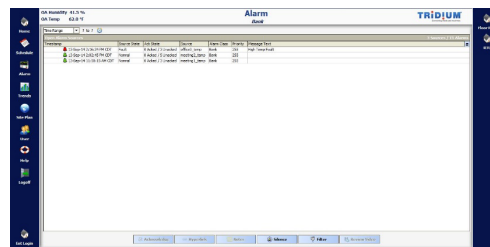
F. Scheduling

Schedules are utilized to define the occupied and unoccupied time parameters. The devices are programmed to respond to the schedules.



G. Alarming

Alarms are programmed to provide messages to the operator when the device conditions have exceeded the defined operating range.



2.1 Navigation

The design of the user interface begins with development of the site map. The site map defines how the user will navigate through the interface screens and defines the basic operation of the IAS. The complexity of the map is dependent on a number of variables including the number of facilities, buildings, pieces of equipment, etc.

The diagram illustrated below represents the site map for a typical site. IAS Design Engineers can familiarize themselves with the functionality of a site map by logging onto various Niagara based demonstration sites and reviewing the map while navigating through the site.

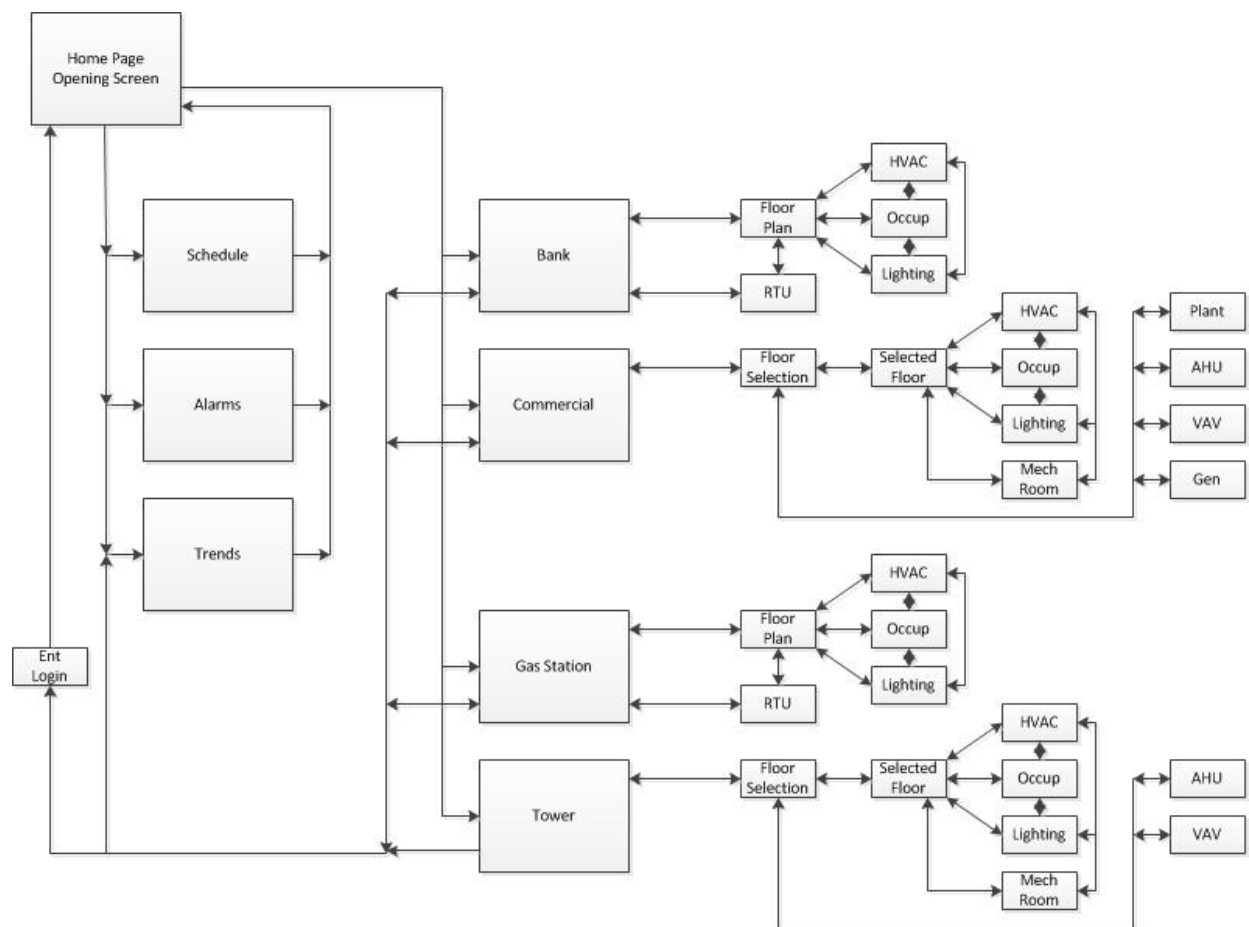


Figure 1: Site Map

2.2 Opening Screen or Home Page

The Opening Screen or Home Page should present an attractive interface that provides the users with quick and logical access to the information they need. The needs of all users should be considered within the design of the opening screen. The information that is important to Facility Occupants, Facility Engineer, On-site Manager, and Executive Management varies significantly. The opening screen presents a professional first impression of the facility, company, and IAS. It enables each user to quickly access the information they need to perform their job functions, while restricting them from the functionality that they are not authorized to access (e.g. System Overrides and Schedule adjustments). The designer has complete flexibility to use any combination of graphics and colors to represent the desired first impression or “look and feel” of the opening screen. It is important to illustrate expectations.

The opening screen shown below in Figure 2 illustrates a method to create easy access to pertinent information. The icons on the left side of the screen provide quick links to primary functions, while the icons on the right side of the page provide quick links to all the facilities within the owner’s portfolio including Bank, Commercial, Gas Station and Tower. The facilities can also be selected by clicking on the graphical image of each facility. The opening page should provide a professional appearance and enable quick access to pertinent data.



Figure 2: Opening Screen/Home Page

The header displays key information common to all facilities (e.g. Outside Air Temperature and Humidity) along with the company logo.



Figure 3: Header Graphics

The footer contains contractor contact information along with the date and time. It is important to display the date and time throughout the GUI to timestamp screen captures.

Defining the type, color, quality, size, and shape of the graphics utilized throughout the GUI creates a baseline for expectations, facilitates effective use of the user interface, enables enforcement of the desired level of quality and creates a fair, competitive market for IAS Contractors.

2.3 Primary Operations

The graphic icons shown along the left side of the opening screen are quick links primary operations including “Home”, “Schedule”, “Alarm”, “Trends”, “Site Plan”, “User”, “Help” and “Logoff”. These icons can be any color or shape and should be selected to enable quick identification of the intended purpose.

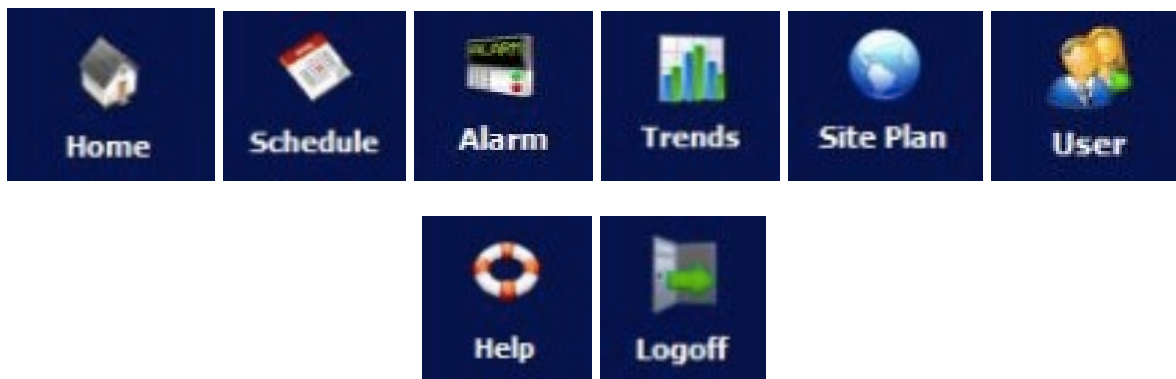


Figure 4: Graphic Icons for Primary Operation

2.4 Facility Selection

The graphical navigation for the user interface utilizes a computer-generated aerial view of an urban area, including the four buildings that comprise the owner's facilities. The opening page provides quick access to the control systems within each facility. The facility portfolio consists of four facilities including "Bank", "Commercial", "Gas Station" and "Tower".

The quick links on the right side of the opening screen provide access to specific facilities, as does the image itself. The details for the operation and control of each specific facility can be accessed by clicking on the icon, or on the graphical image of the selected facility. The text associated with each facility icon can be customized to meet the needs of the application.

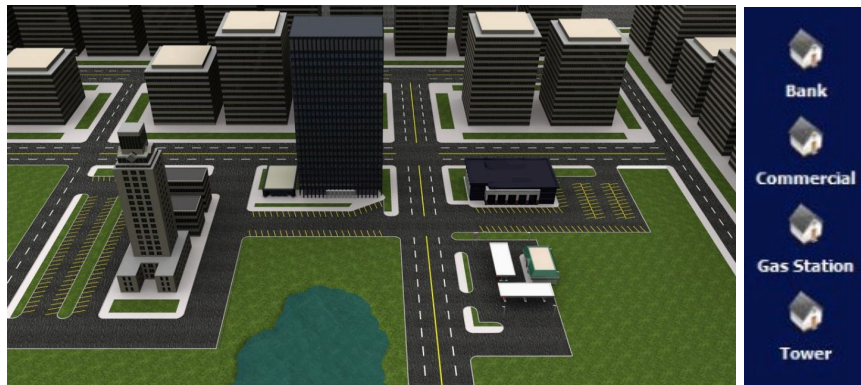


Figure 5: Facility Selection Screen

It is important to specify all aspects of each user interface screen including background colors, font colors, font sizes, font types, and graphics (renderings, photographs, drawings, shapes, etc.).

2.5 Facility Operation

Once the facility is selected, the status of the equipment within that facility can be accessed from the Facility Main Screen. The images shown below are renderings of each facility (Bank, Commercial, Gas station, Tower). The appearance of each facility within a specific portfolio should be similar. The renderings for the larger facilities (e.g. Commercial and Tower) are active, meaning the user can directly access subsystem data on specific floors by rolling the mouse cursor over the image of the building.

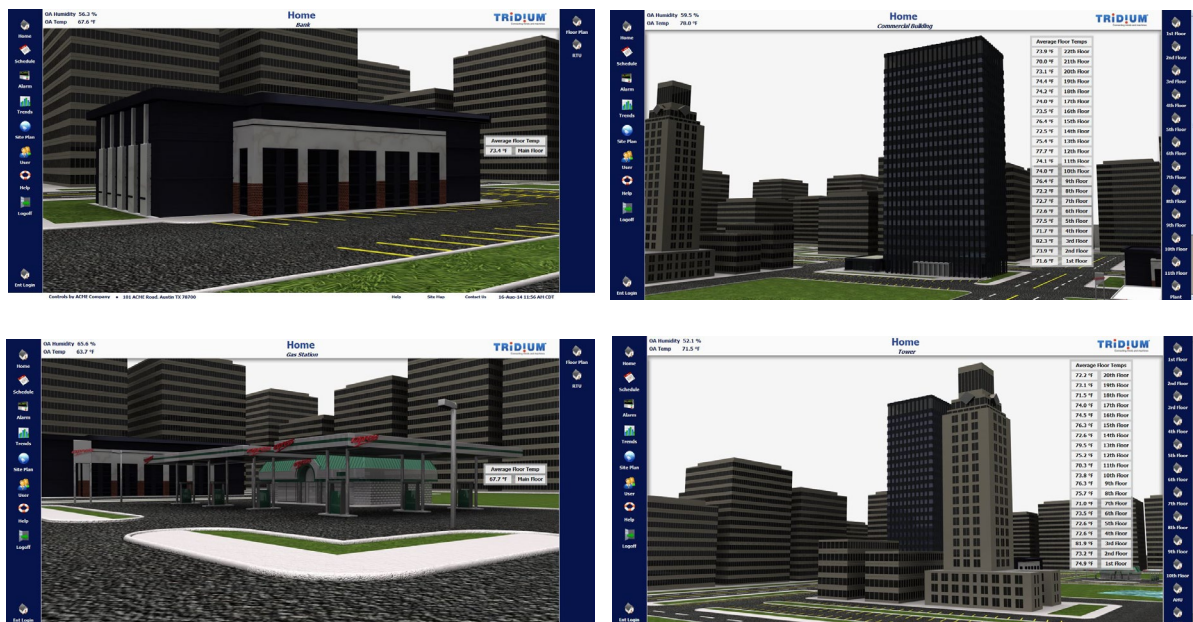


Figure 6: Facility Main Screens

The icons on the right represent the subsystems that can be accessed for each facility, including specific floors or pieces of equipment (RTU, AHU, VAV, Generator, Central Plant). Note how the icons for the primary operations on the left remain accessible on all screens. This enable users to quickly access functions that are common for all facilities.

The header also remains visible on all screens providing quick access to pertinent common data. Navigation requirements like those shown above should be evaluated, designed and specified by the development team and included in the design documents.

Maintaining basic screen functionality and consistency for the background colors, font colors, font sizes, font types, and graphics throughout the user interface facilitates ease of use, reduces training time, and increases efficiency.

2.6 Subsystem Selection – Equipment

The quantity and types of subsystems within a facility will vary based on the type of facility and the extent of the control system installed within the facility. The equipment detail screens shown below illustrate the equipment subsystems for specific pieces of equipment including RTU (Bank, Gas Station), AHU (Commercial, Tower), VAV (Commercial, Tower), Central Plant (Commercial, Tower), and Generator (Commercial).

The subsystem detail screen is displayed by clicking on the desired subsystem. The graphics shown below illustrates the detail for control and monitoring each piece of equipment.

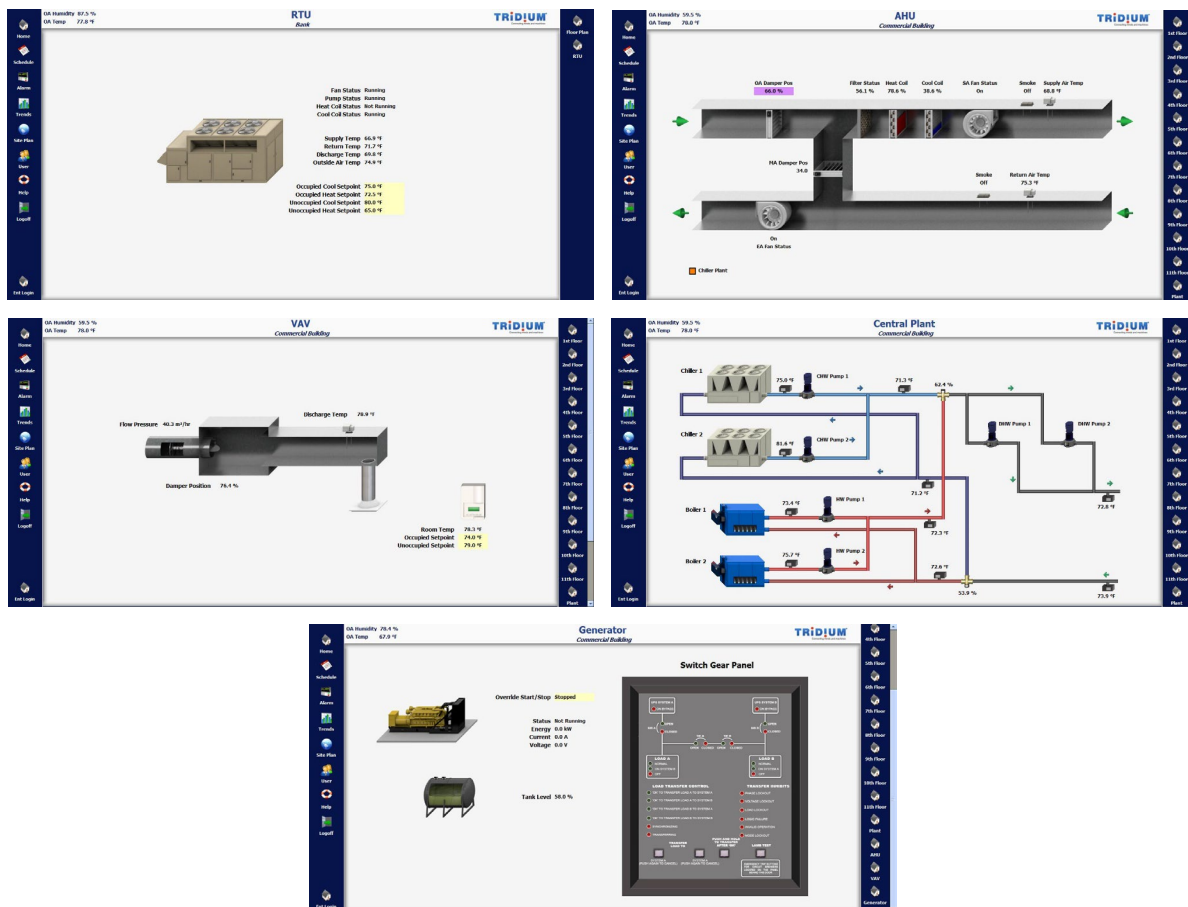


Figure 7: Equipment Details

Designer's Note: Utilizing the graphics tool set provided by Tridium facilitates cost effective support, maintenance, and upgrades. Custom graphics created by third party providers may be used to enhance the visual impact of the user interface, however, the maintenance of the graphics will require administration/development rights to the same software package. If a third-party graphics package is used, the ownership and administration/development rights for the software package must be provided and assigned to the owner.

The details for the real time status of the equipment are provided in graphical format. The graphic standards and specifications for the project should define everything shown on the above screens including the Font (type, size and color), Graphic images (two or three dimensions, size, color, animation, and texture), and Control features (override, setpoint adjustment, and link to other detail screens). Clean graphics with pertinent control and monitoring details are more effective than congested graphics with excessive quantities of points.

Adjustment or override of control parameters, such as the Occupied and Unoccupied setpoints for heating and cooling, Occupied/Unoccupied mode, etc. can be accessed through the graphical image.

Setpoints can be adjusted if the user has the authority to change control points. Right clicking the mouse on a setpoint will allow the user to “Set” the temperature control setpoint, as shown below left for the “Occupied Cooling Setpoint”.



Figure 8: Set Temperature Function

Selecting “Set” will display a Setpoint Value popup window, shown above right, that enables to user to adjust the control setpoint within a pre-defined range. The above operation applies to all adjustable control points.

2.7 Subsystem Selection – Floor Plans

High quantity, application specific controllers can be quickly accessed and evaluated through graphical floor plans. The use of floor plans facilitates troubleshooting through visualization of multiple zones on a single screen. The floor plan can utilize text and thermographs (areas that vary in color based on analog and digital point values) to display real time conditions.

The floor plan screen is displayed by clicking on the “Floor Plan” icon or selecting a specific floor.

HVAC

The graphics shown below illustrate an overview of the HVAC status for all of the devices on the selected floor. Note that the appearance of the floor plans for all four building types is similar. The upper left corner of the images allows the user to select the desired data to display (HVAC, Occupancy, Lighting). The three-dimensional floor plan image helps the user visualize the space and simplifies troubleshooting.



Figure 9: Floor Plan – HVAC Layer

If the zone on the floor contains additional control details for application specific controllers (e.g. VAV) or programmable controllers (e.g. AHU), the user can click in the respective zone and view the details as shown below for VAV and AHU.

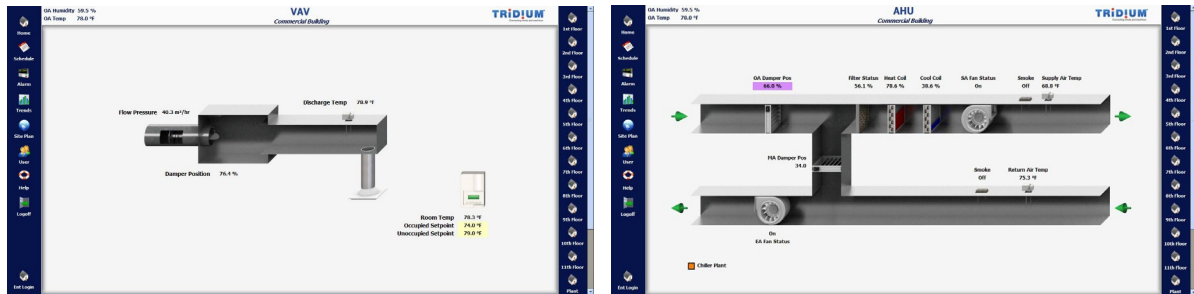


Figure 10: Equipment Detail Screens

Occupancy

The user can quickly switch to the status of the occupancy sensors by checking the Occupancy Layer box in the upper left-hand corner.



Figure 11: Floor Plan – Occupancy Layer

Lighting

The user can quickly switch to the status of the lighting system by checking the Lighting Layer box in the upper left-hand corner.

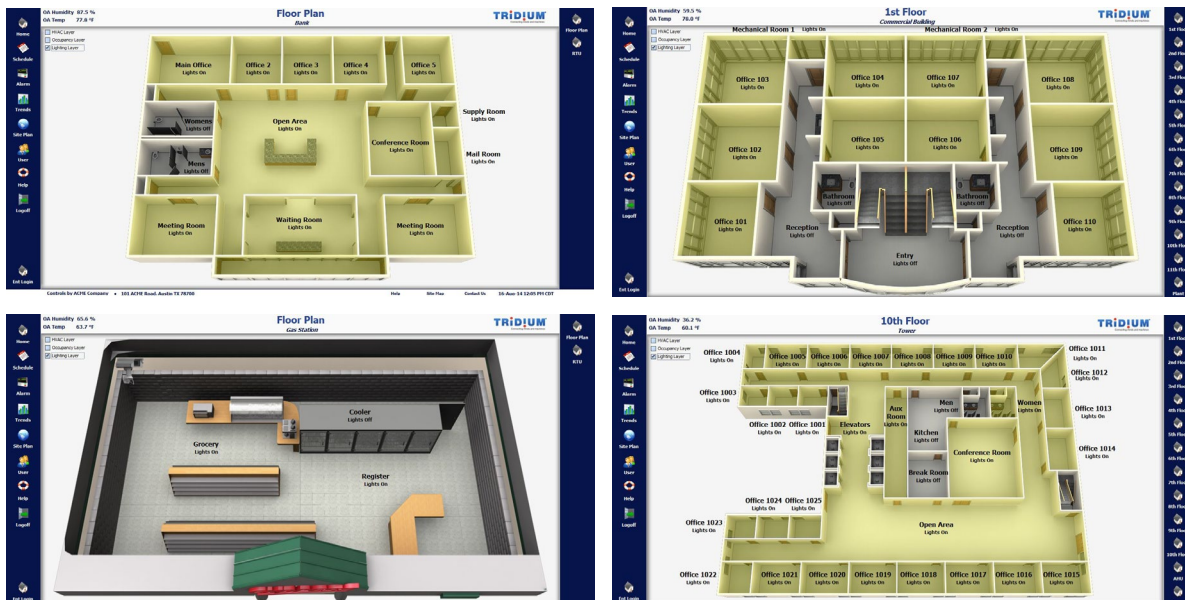


Figure 12: Floor Plan – Lighting Layer

The operating conditions for the devices that reside on the floor are provided in graphical and text format. The primary status variables for each piece of equipment (e.g. Zone temperature, Occupancy status and Lighting status) are displayed on the floor plan. The control points can be adjusted if the user has the authority to change control points. Right clicking the mouse on a room will allow the user to “Set” the control point, as shown below for the temperature setpoint for the Bank “Open Area”.



Figure 13: Set Temperature Function

Selecting (left clicking the mouse) “Set” will display a Setpoint Value popup window that enables to user to adjust the control setpoint within a pre-defined range.

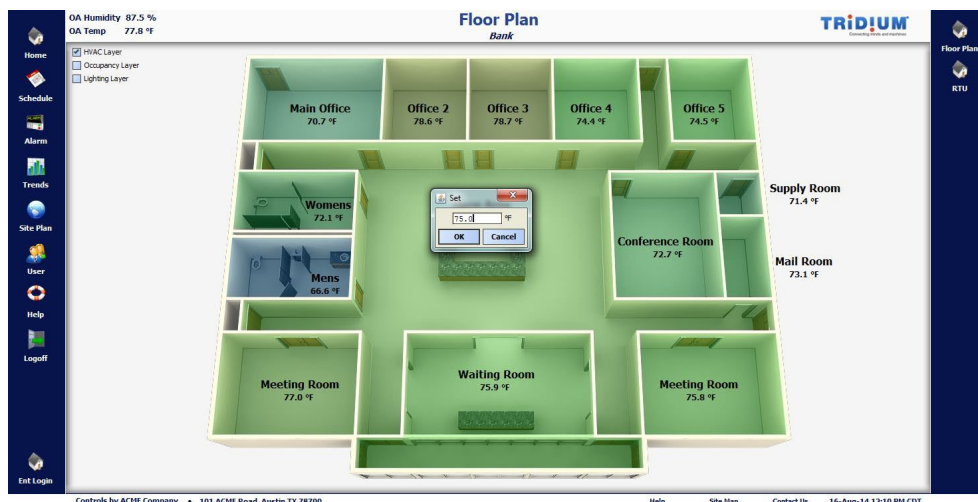


Figure 14: Setpoint Adjustment

The new setpoint value will be sent to the control system after the new value is entered and “OK” is selected (left click).

The same process can be followed for adjusting other control parameters within the same and other facilities. Right clicking the mouse on a room within the Occupancy Floor Plan will allow the user to “Set” the Occupied status, as shown below for the “Open Area”.

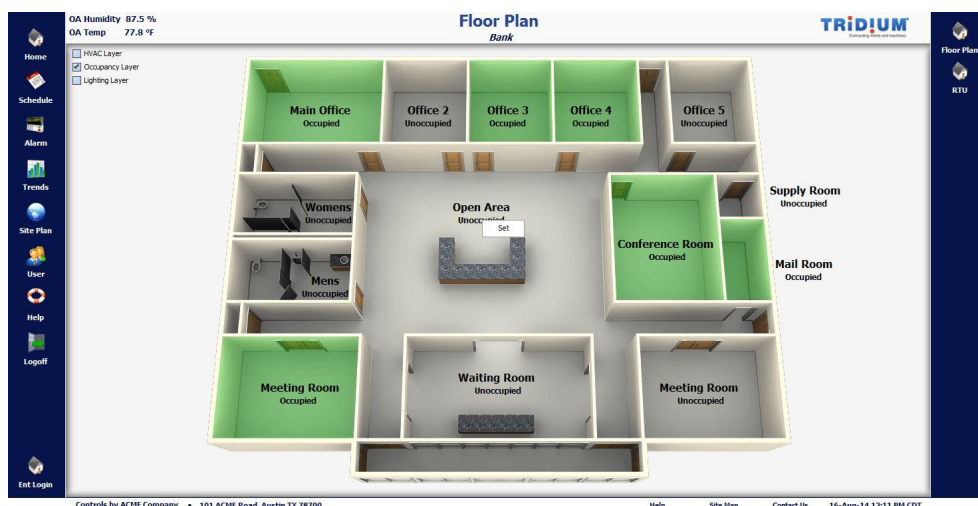


Figure 15: Set Occupancy Function

Selecting “Set” will display an Occupied State popup window that enables to user to toggle the occupied status.

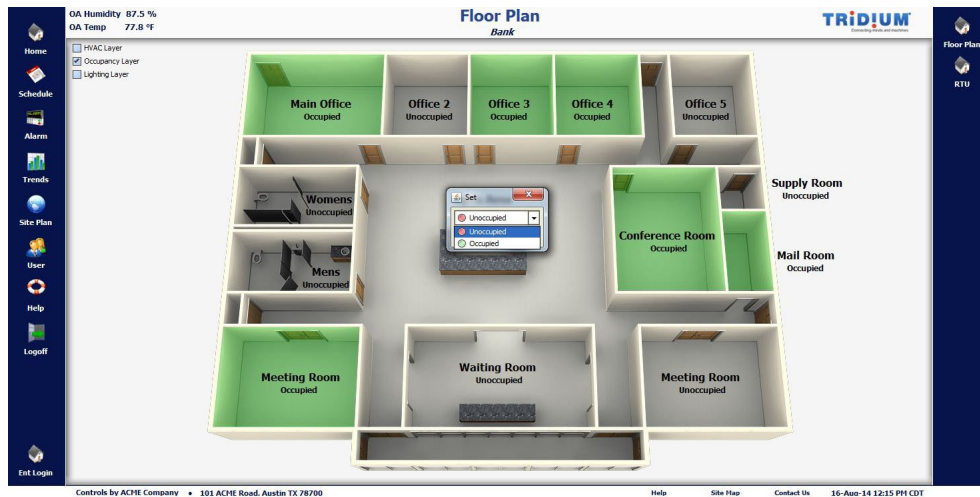


Figure 16: Toggle Occupied Status

The new state will be sent to the control system after the value is entered and “OK” is selected.

Similarly, right clicking the mouse on a room within the Lighting Floor Plan will allow the user to “Set” the Lighting status, as shown below for the “Open Area”.



Figure 17: Set Lighting Function

Selecting “Set” will display a Lighting State popup window that enables to user to toggle the On/Off state for the lighting zone.



Figure 18: Toggle Occupied Status

The new value will be sent to the control system after the value is entered and “OK” is selected.

2.8 Scheduling

Scheduling of Occupied and Unoccupied periods is consistent for all subsystems. The “Schedule” icon is always available on the left side of the user interface, enabling quick access to the schedules for the selected facility. The green shaded area graphically represents the Occupied period.

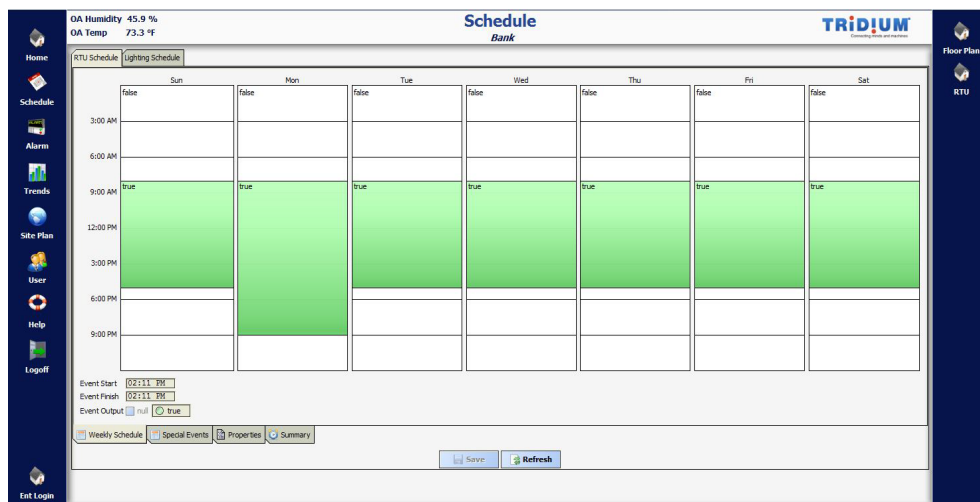


Figure 19: Scheduling RTU

Scheduling is grouped by zone, equipment, or another category. This example demonstrates how to differentiate schedules between RTU and Lighting.

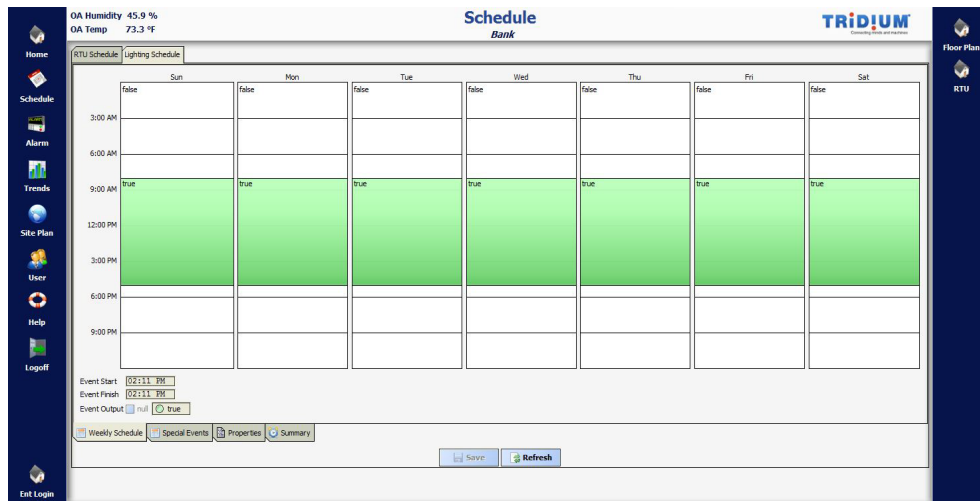


Figure 20: Scheduling Lighting

Special events for each scheduling category, such as extended hours on a specific date, can be entered in advance by selecting the “Special Events” tab on the bottom of the screen (lower left).

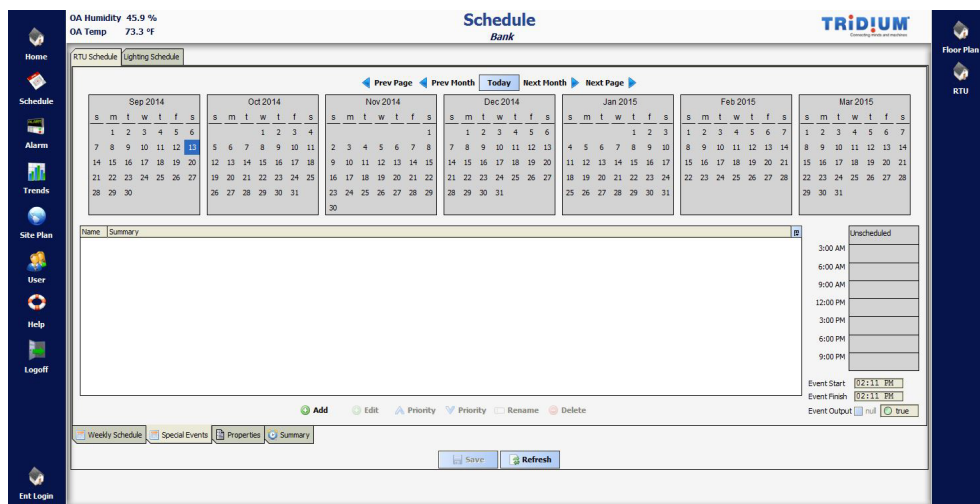


Figure 21: Special Event Scheduling

The special event is created by selecting “Add”. A pop-up window will then be displayed that enables the user to enter the details for the special event. The details include the date(s) of the event and the operating hours for the event.

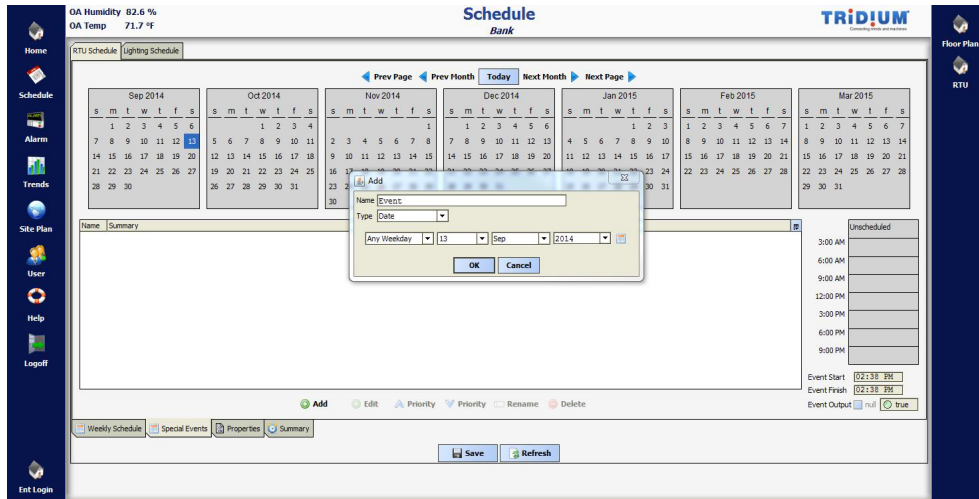


Figure 22: Special Event Details

Once the details for the special event are entered and “OK” is selected, the event will appear on the table as shown below.

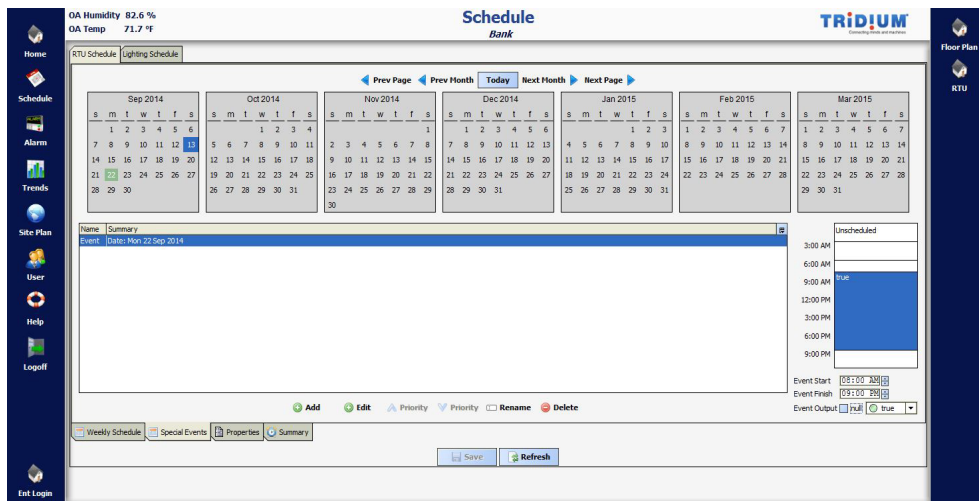


Figure 23: Special Event Scheduling

2.9 Alarming

Alarming is consistent for all subsystems. The “Alarm” icon is always available on the left side of the user interface, enabling quick access to the alarm details for the selected facility.

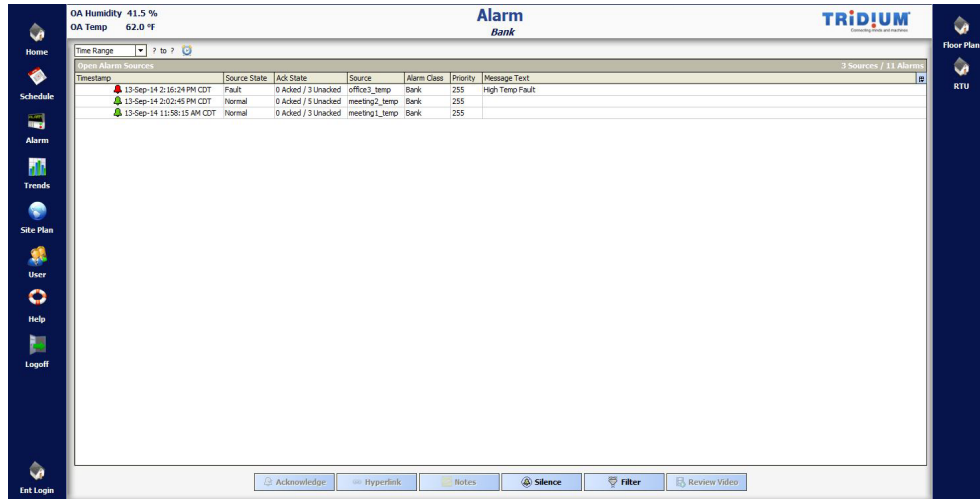


Figure 24: Alarm Details

Alarms will be displayed until they are Acknowledged. When an alarm is selected the user has the option to “Acknowledge”, add “Notes” or “Filter” the alarm. If “Acknowledge” is selected the alarm will be removed from the list.

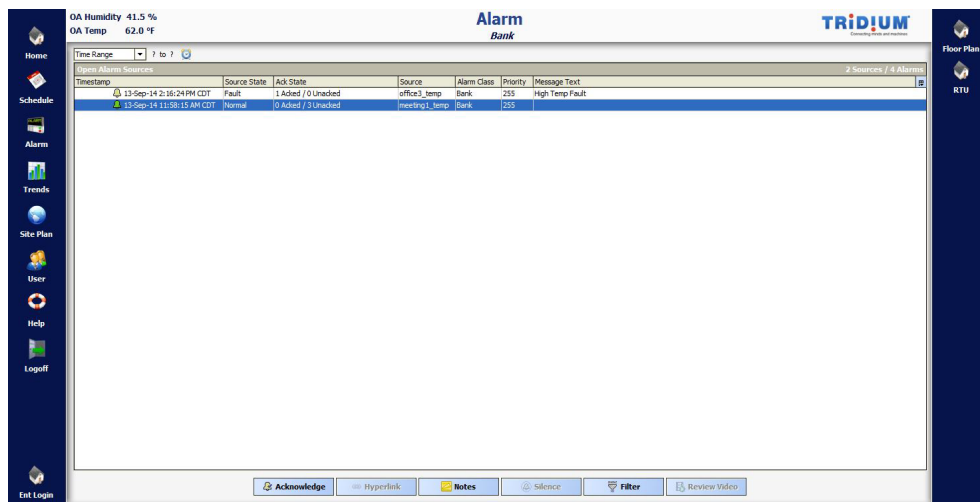


Figure 25: Alarm Selection

Alarms will be displayed until they are Acknowledged. When an alarm is selected the user has the option to “Acknowledge”, add “Notes” or “Filter” the alarm. Selecting “Notes” will allow the user to record details of the action taken to address the alarm and/or cause of the alarm. The details for the alarm are entered into the test box as shown below.

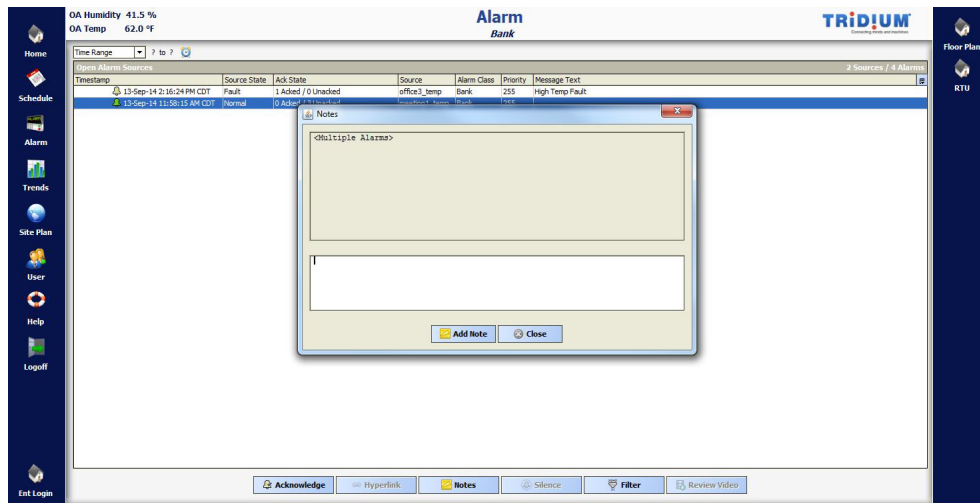


Figure 26: Alarm Note Entry

The alarm table will display all active alarms and can become large. A filtering tool is provided to enable users to quickly access specific alarms. The filtering parameters are entered as shown below, and all of the alarms that meet those parameters will be displayed.

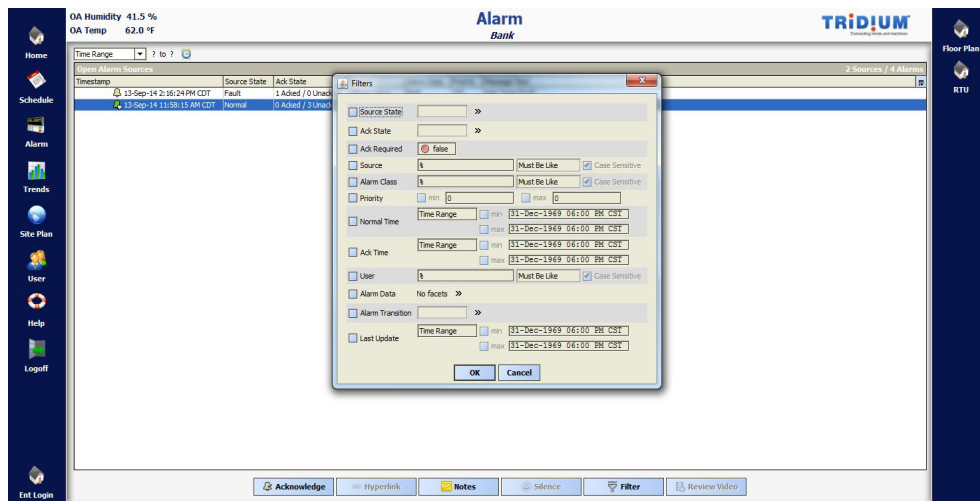


Figure 27: Alarm Filter

2.10 Trending

Trending is consistent for all subsystems. The “Trends” icon is always available on the left side of the user interface, enabling quick access to the trends for the selected facility. A list of all the data points that are being trended will be displayed. The user will drag (left click and hold) the data point to be displayed from the list on the left to the table on the right.

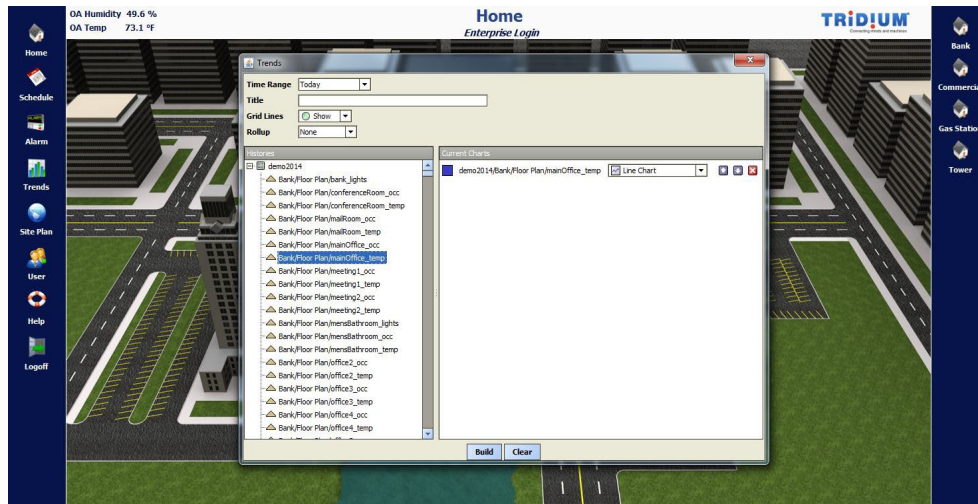


Figure 28: Trend Selection

The default color for the trend graph will be displayed in a box to the left of the point descriptor. Selecting the box will enable the user to change the color of the graph.

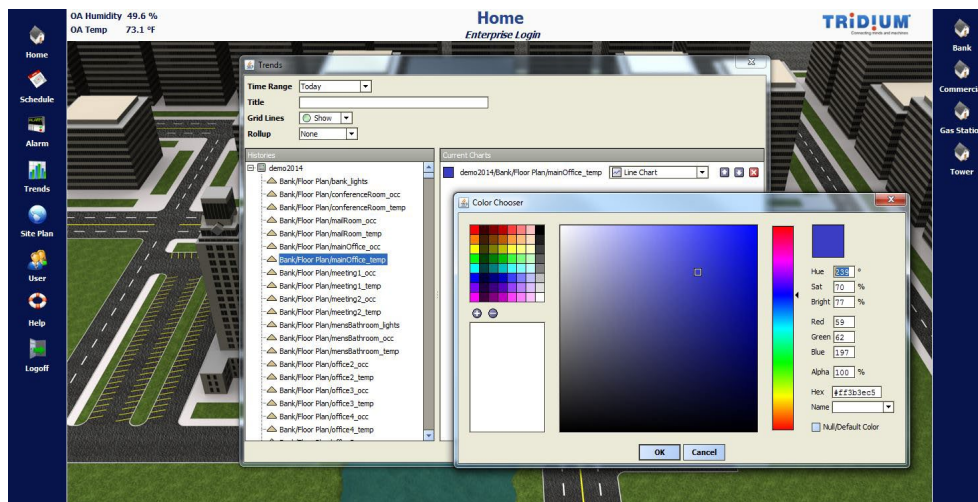


Figure 29: Trend Color Selection

Selecting “Build” will display the trend graph.



Figure 30: Trend Graph – Line Chart

The user can select the type of trend to display including Line Chart, Area Chart, Bar Chart, Stacked Bar Chart, Discrete Line Chart, Discrete Area Chart and Pie Chart. The Line Chart was changed to an Area Chart for the same data point, as shown below.



Figure 31: Trend Graph – Area Chart

The trend function can simplify the troubleshooting process by overlaying relative control points on the same trend graph. Multiple points can be selected by dragging the desired points into the display window.

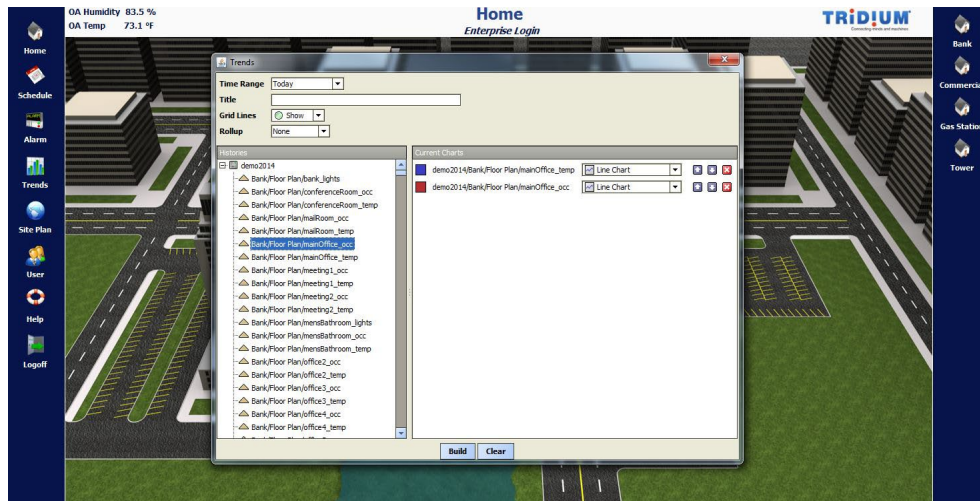


Figure 32: Trend Graph – Multiple Point Selection

The trend graph shown below displays two data points; the Bank Main Office Temperature and Occupancy status.

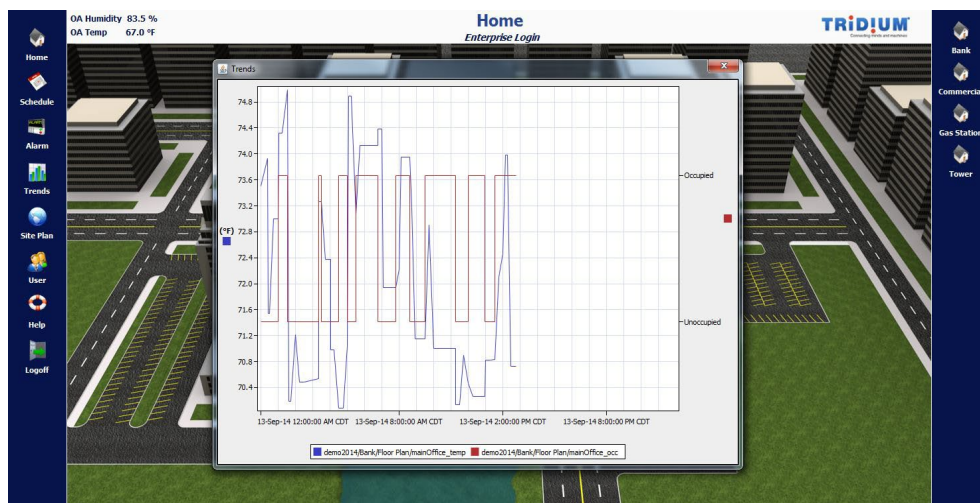


Figure 33: Trend Graph – Multiple Point Line Chart

3.0 Summary

Tridium's Graphics Standards illustrate the functionality of an efficient and functional user interface. The purpose of this document is to provide an overview of the features that should be included and defined for user interface. The design of the user interface will directly impact the operation and performance of the system. Therefore, the IAS design engineer should work closely with all stakeholders to understand expectations, design an efficient IAS user interface and deliver design documents that enable fair evaluation.

Detailed design documents will enable the IAS design engineer to effectively manage the Construction Administration and Commissioning phases of the project, control costs, and meet Owner expectations.

The IAS designer can use this document as a guide for detailing owner expectations and is authorized to copy this document, in part or whole, to include in their design documents.