User Manual

Ayla Schedules

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1. Introduction

Schedules are a common, sometimes underestimated, feature in many home appliance and other consumer products that play an essential role in the long-term ownership experience of a product. Ayla provides our customers with the ability to develop schedules for all connected devices built on Ayla's IoT platform.

1.2 About this Document

This document describes Ayla schedules and provides a high-level explanation of how they work and should be configured.

1.3 Intended Audience

This document is written for all users of the Ayla Developer Portal.

1.4 Related Documentation

For additional information, refer to the *Ayla Developer Portal User Manual,* AY006UDP3.

1.5 Abbreviations and Acronyms

Most abbreviations and acronyms are spelled out the first time that they are used in the document and are not always listed in the following table. However, abbreviations and acronyms that are frequently used in Ayla user documentation, industry standards (i.e. HTTP), or commonly known by the intended audience of the document may only be spelled out in this table.

MCU	Microcontroller unit
UTC	Coordinator Universal Time
RTC	Real-time clock setting

1.6 Document Conventions

This document uses the following conventions:

- Text that you type (such as commands) and names, scripts, names of commands, properties in a file, code, and the like are in `courier new` font, for example: Use the `psm-dump` command to …
- Words or phrases that are specifically defined and could potentially be misunderstood are initially in “quotes” the first time they appear in the document.
- Names of buttons, keys on the keyboard, links on a website, and the like are written as is; for example, press the Reset button.
- Network paths, file paths, menu paths and the like are shown in courier font and each point that you have to click to navigate to the next is separated by “/.”
- Ancillary information that is important to emphasize is shown as:

NOTE The commands provided in the example assume your evaluation board is `mw300_rd` and your chip is `mw300`. If otherwise, make the appropriate substitutions.

- Information describing hazards that could damage a product, including data loss, is shown as:

CAUTION Ensure that the appropriate data buffering is accounted for in deployed devices, where loss of data is critical to the core functionality or the services provided by the systems.

2. What Are Schedules?

Schedules are used to automatically trigger property updates and other events on the Ayla device. For example, a schedule can prompt the water sprinkler to turn on at a certain time every morning. You can configure schedules for local time or universal time (UTC) and for many other parameters, such as months and days of the year, start and end times of the day, intervals, durations, etc.

The Ayla device is the source of support for schedules. The schedules are developed and available to create as soon as an Ayla Template has been associated with an Ayla device. Schedules are therefore located on the MCU of the device once they are received through this process of template association. Each schedule has the ability to support actions that can trigger those various events that are related to individual properties defined in the Ayla Template. Actions are also referred to as schedule actions. Before creating any schedules, Ayla schedules require a template, and the template must have at least one property to enable schedule actions. You create the templates through the Ayla Developer Portal; refer to the *Ayla Developer Portal User Manual* for more information on templates.

When the device updates the properties based on the scheduled events, the device should also update the cloud and any LAN client so that both are in sync with the device. It is more reliable to execute schedules on the device than to execute them on the cloud because the device doesn't need to have internet connectivity at all times.

As templates contain more properties and evolve, customers should maintain the schedules between versions to ensure consistent, stabile functionality. Keep in mind that schedules are the same as properties in that if they are removed from a template, they no longer exist on the device.

As stated, the Ayla schedules provide the ability to trigger a property update and other events at specific, defined times each day and on specific days, dates, times, etc. whether in local time or UTC time. Ayla schedule actions are attached to Ayla schedule objects that describe the changes configured to occur when the schedule executes an action. The schedule actions specify the update that should occur in the Ayla property when the schedule executes, and the information on whether the action should execute at the start, end, or in range of the schedule; for example:

- `At Start` specifies that the action executes on the property in alignment with the `Start Time Each Day` setpoint.
- `At End` specifies that the action executes on the property in alignment with the `End Time Each Day` setpoint.
- `In Range` – specifies that the action executes on the property within the defined range between the `Start Time Each Day` and `End Time Each Day` setpoints. This selection provides the highest confidence level that the action executes regardless of external factors causing a schedule to start at time other than the specified `Start Time Each Day` setpoint.

3. How Do Schedules Work?

Creating a schedule in the Developer Portal is just the beginning of the process to enable the schedule on the device. Once created, this information is sent to the device using the `schedule_in` call. When the service sets `schedule_in` to a particular value, the MCU sets the property to the same value and sends it back to the service.

When creating schedules, the host MCU should be coded with the same name as the schedule created in the cloud. The MCU interprets and parses the schedule to determine when the next event in the schedule is set to occur. The MCU therefore must have access to the real-time clock (RTC) setting.

When needed, the MCU can obtain this information from the module if the `MCU_TIME_SUBSCRIPTION` flag is set in the `feature_mask` of the MCU that it sends to the module. When this flag is set, the module provides the MCU with the latest UTC time, time zone information, and daylight savings information that it receives from the Ayla cloud.

To evaluate the schedules stored in the properties table, the `sched_run_all` function is called. Using this information, `sched_run_all` can call `sched_evaluate` to determine the scheduled event. The `sched_evaluate` function defined `in schedeval.c` parses a schedule and returns the UTC time of the next event in the schedule. There are many complexities that are involved in calculating the next event time, and these complexities are abstracted away and in the `schedeval.c` and `clock_utils.c` files. Refer to the demo code provided in the *Ayla Demo API* document on the Ayla Support site (www.support.aylanetworks.com) as an example.

Along with returning the next scheduled event time, `sched_evaluate` also runs any events that are set for a given time. Using the next scheduled event time returned by `sched_evaluate`, the `sched_run_all` function determines the `next_event_tick`, which is the tick count of the next scheduled event.

Table 1 provides a description of the functions (calls) referenced in this section.

Table 1: Descriptions of the Functions (Calls) Used to Explain How Ayla Schedules Work

Function (Call)	Description
`Schedule_in`	This is the call made from service to the device, which sets the value for schedule property.
`Sched_run_all`	This lists all schedules stored in the properties table.
`Mcu_time_subscription`	This is the flag set in module to provide the MCU with the RTC time from Ayla module (used in Blackbox development projects only)
`Sched_evaluate`	This function is used to return the next scheduled event time (and any other events scheduled for that time also run).
`Next_event_tick`	This returns the tick count of the next scheduled event.
`Schedeval.c`	This function is used in demo code only.
`sched.h`	This provides descriptions of the functions that execute schedule properties.

4. Creating a Schedule with Schedule Actions

Schedules are a component of a device template, and these templates are created through the Ayla Developer Portal, which you can access at www.developer.aylanetworks.com. This section provides the steps to create a schedule with a schedule action in the Ayla Developer Portal.

NOTE: This document is written with the assumption that users have a basic knowledge of templates. To learn more about templates, review the *Developer Portal User Manual* located on the Ayla Support site, www.support.aylanetworks.com.

1. Create an account for the Ayla Developer Portal, and then click the Templates tab in the Ayla Developer Center to create a template. Figure 1 shows the location on the Templates tab where you fill in the appropriate fields to create a template.

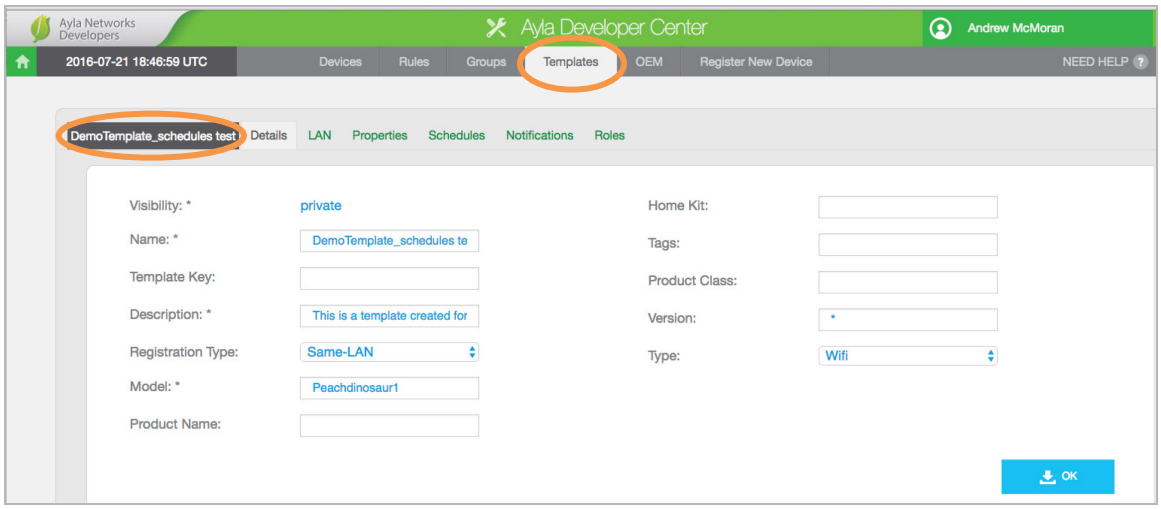

Figure 1: Using the Templates Tab to Create a Template

2. Click OK to create the template.

3. Click Schedules on the Template tab to create a schedule. Figure 2 shows the view for creating schedules.

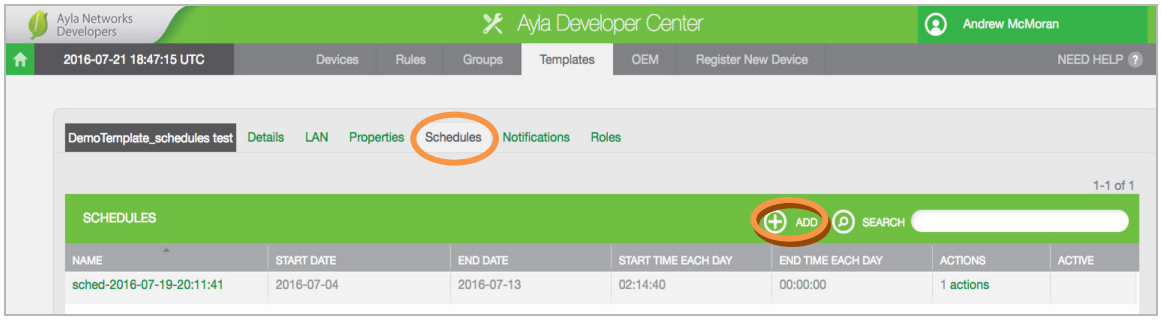

Figure 2: The Schedules View on the Template Tab

4. Click the plus sign icon (shown above in Figure 2) to display the Details view (shown below in Figure 3) where you set basic information for the schedule, including name, start/end date (if applicable), and whether the schedule should run against local time or UTC. Figure 3 shows the Details view.

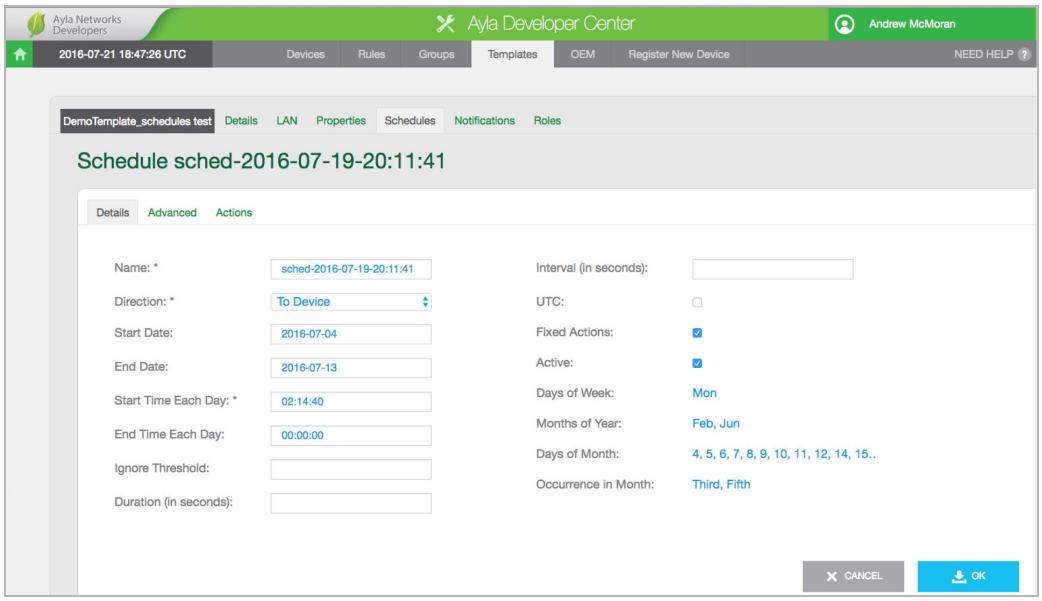

Figure 3: The Details View on the Template Tab

Following is a description of some of the fields in the Details view:

- Ignore Threshold – Defines how many seconds can pass before the action is ignored if the schedule did not execute the schedule action at the specified time for some reason.
- Duration – Defines the time in seconds for how long the schedule event should be active.
- Interval – Defines the time in seconds between consecutive schedule events.

- Fixed Actions – If selected, does not permit users to add any more actions than those defined in the template. This means that the `updateSchedule` call from the mobile application has reduced functionality when the Fixed Actions checkbox is selected. We recommend selecting this checkbox for schedules that are not intended to support significant customization by the end user.

5. Click Advanced to display the Advanced view on the Templates tab to enter the specific times to run the schedule. Figure 4 shows the Advance view.

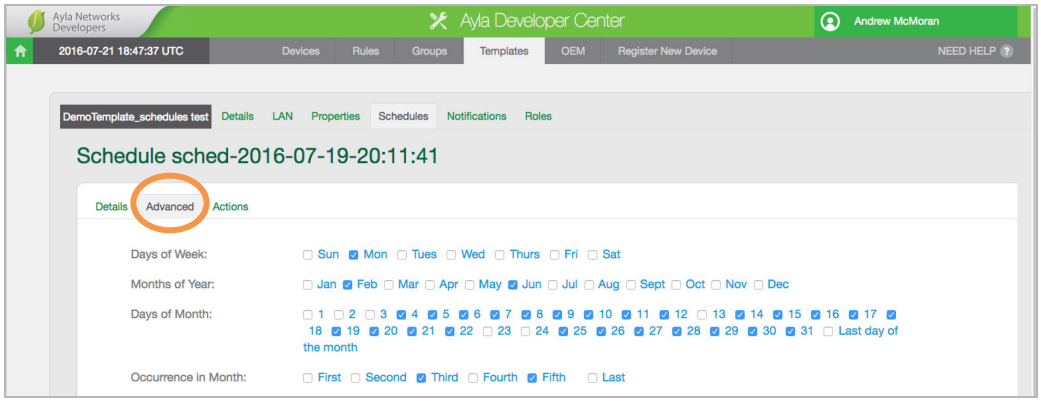

Figure 4: The Advanced View on the Template Tab

6. Click Actions in the Schedules View of the Templates tab to display then Actions view where you add actions. Figure 5 shows the Actions view.

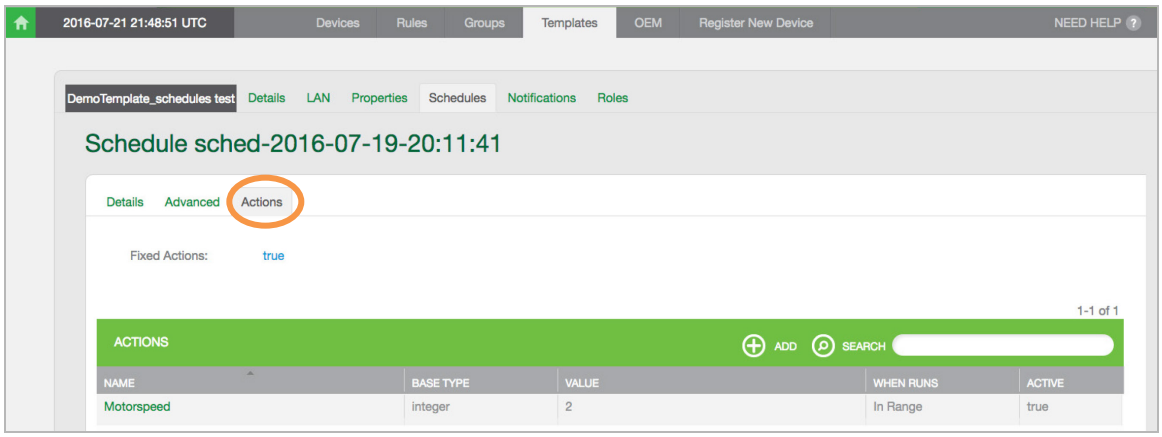

Figure 5: The Actions View for Schedules on the Template Tab

7. Click the plus sign to add an action in the Edit Schedule Action dialog box, shown in Figure 6.

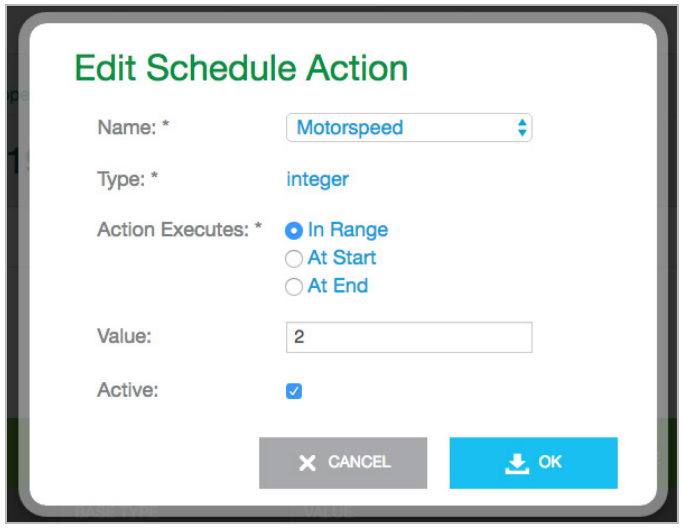

Figure 6: The Edit Schedule Actions Dialog Box

Following are descriptions of the fields in this dialog box:

- Name – A list of properties to select to enable a schedule action.
- Type – Automatically populated based on the property selected in the Name field.
- Action Executes – Radio buttons to select to specify when to execute the action:
- At Start – action will execute on property in alignment with 'Start Time Each Day' setpoint
- At End – action will execute on property in alignment with 'End Time Each Day' setpoint
- In Range – action will execute on property within the defined range between 'Start Time Each Day' and 'End Time Each Day' set points. This selection provides the highest confidence level the action will execute regardless of external factors causing a schedule to start at time other than specified 'Start Time Each Day' setpoint.
- Value – A field to set the value for the selected property used when the schedule executes the action.
- Active – A checkbox that must be selected to set the intended action to execute.

5. Additional Contextual Examples

This section provides answers to common questions about schedules.

5.1 How do I delete a schedule from a device?

There is no specific API call to create or delete a schedule; schedules are derived from the template associated with the device. We recommend that you take time needed to plan the best way you should use the schedules and consider use cases of the product during the product development phase of the project. Over time, if the schedules are no longer being used as expected when planning, you can remove or add schedules by developing a new device template with the updated schedules matrix. If you don't want to completely remove the schedule, you can de-select the Active checkbox in the Edit Schedule Action dialog box to make the schedule the inactive.

If you delete a schedule or make it inactive, the template must be associated with the device through an OTA update to ensure that the firmware is updated in parallel since, as stated earlier in this document, schedules are typically stored in the MCU of the device.

5.2 How to Ensure Schedule Actions Are Updated on the Device

As the usage data on the device is accumulated over time, you may consider new schedule actions to optimize your end user experience. If you add schedule actions, we recommend performing a `PUT` command to the device to ensure that the schedule has received the updated schedule actions.

5.3 Are there Limits on the Number of Schedules a Device Can Support?

For devices running in GPIO mode, schedules are limited to 10. For the MCU mode, schedules are limited by the amount of RAM resources available for use.

NOTE: While not a limitation, developers should be aware that any empty and null days or events should be explicitly stated as such to ensure that they are accurately handled.

5.4 Are There Limits on Bundling Multiple Unique Recurring Occurrences?

Even though schedules are powerful, there are limitations on how many unique recurring occurrences a single schedule can handle. Let's consider street cleaning as an example; there may be street cleaning every second Monday of the month on one side of the street while the other side of the street is cleaned every third Tuesday of the month. Similarly, the GUI allows you to select a combination of recurring events in a single schedule. However, we do not recommend this setup. Instead, we recommend that you create separate schedules for each unique recurring occurrence just as there would be two street signs to indicate the different street cleaning schedules in our example. This avoids potential for confusion. Creating two unique schedules avoids potential for confusion and provides reliable schedules, which reduces the troubleshooting requirements if the number of actions in the schedule increases as it evolves.

5.5 What Is the Impact of an OTA update of firmware with a new template that does not include the schedules that were previously enabled?

The association of a new template implies that the host MCU has received a new firmware image and that the RAM has been erased or deleted. Once a template is associated with the device, the previous data structure, including the previous schedules, are no longer available. To ensure all of the schedules remain available, the new template must include the previously designed schedules.

5.6 How to Ensure the Intended Order of Schedule Actions?

There are multiple ways to ensure the order of schedule actions. The recommendation is to set a start and end time for schedule actions that are in a particular order. Otherwise, schedule actions are sent in the order of an ascending creation date, for example, the first created, the first sent, and so on. The latter does not always line up with the order you intended for each schedule action. This may require you to delete all of the actions and re-create them in the intended order. For schedule actions that are defined as *in range,* we recommend that you create these actions in the same order as they are intended to execute from the schedule to ensure accuracy.

5.7 Are There Differences Between Schedules on Blackbox Devices and Whitebox Devices?

The simple answer is “yes.” Schedules have slightly different relationships to the device between the Blackbox and the Whitebox. In the Blackbox, the schedules are like properties in that they have to be defined in the template and the same schedule name has to be coded in the host MCU. For the Whitebox and gateway implementations, the schedule name does not have to be coded on the device. If the name does not exist, the device creates a schedule dynamically.

While you can create schedules dynamically on the Whitebox and in gateway implementations, it is important to note that you cannot delete a schedule dynamically. Even though the Whitebox and gateway implementations can support the creation of a dynamic schedule, we recommend that all schedules exist in a template when possible and that you only use the dynamic creation option when the precise number of schedules is not known during development.

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