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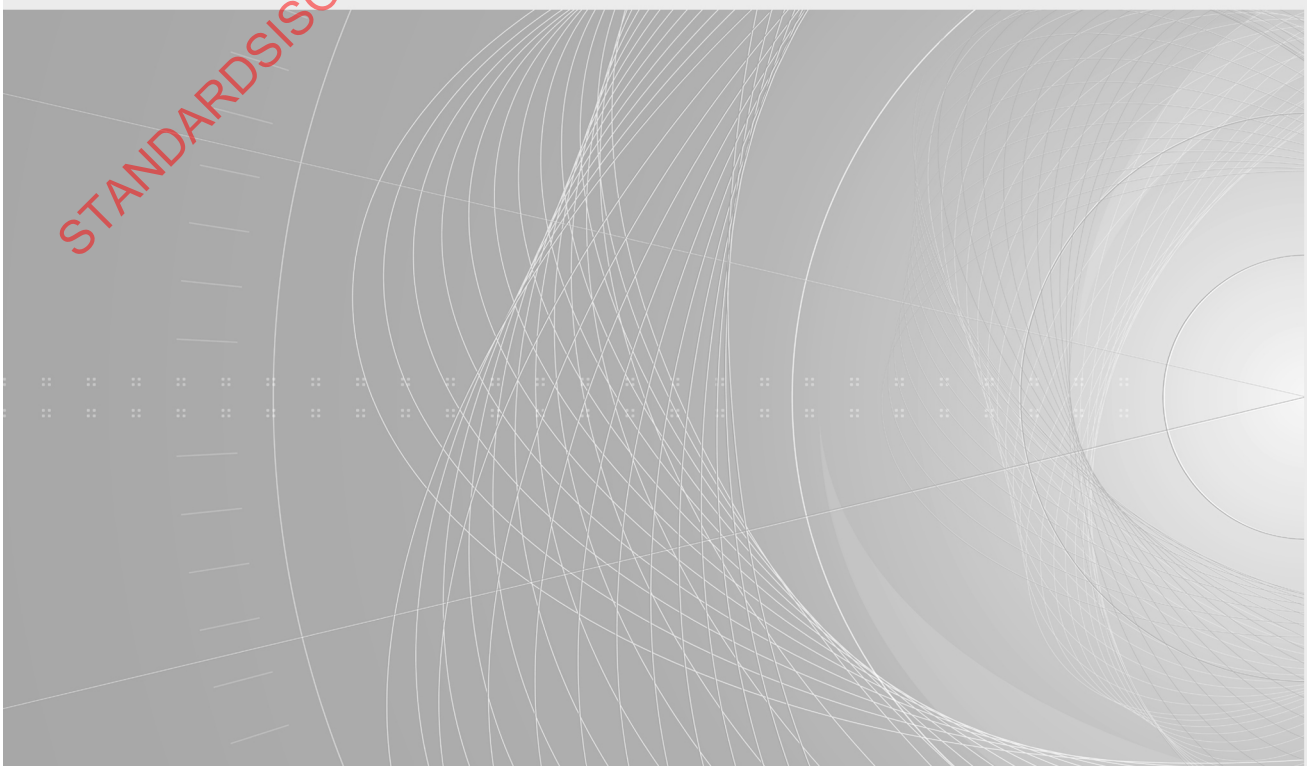
INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture –
Part 6-14: Heating, Ventilation and Air Conditioning Device Control Protocol – Setpoint Schedule Service



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Information technology – UPnP Device Architecture – Part 6-14: Heating, Ventilation and Air Conditioning Device Control Protocol – Setpoint Schedule Service

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CONTENTS

FOREWORD 3
ORIGINAL UPNP DOCUMENTS (informative) 5
1. Overview and Scope 7
2. Service Modeling Definitions 8
2.1. ServiceType 8
2.2. State Variables 8
2.2.1. A_ARG_TYPE_DayOfWeek 9
2.2.2. A_ARG_TYPE_EventName 10
2.2.3. A_ARG_TYPE_StartTime 10
2.2.4. A_ARG_TYPE_HeatingSetpoint 10
2.2.5. A_ARG_TYPE_CoolingSetpoint 10
2.2.6. EventsPerDay 10
2.2.7. Relationships Between State Variables 10
2.3. Eventing and Moderation 11
2.3.1. Event Model 11
2.4. Actions 12
2.4.1. SetEventParameters 12
2.4.2. GetEventsPerDay 13
2.4.3. Non-Standard Actions Implemented by a UPnP Vendor 13
2.4.4. Relationships Between Actions 14
2.4.5. Common Error Codes 14
2.5. Theory of Operation 15
3. XML Service Description 17
4. Test 20

LIST OF TABLES

Table 1 State Variables 8
Table 2 AllowedValueList for A_ARG_TYPE_DayOfWeek 9
Table 3 AllowedValueList for A_ARG_TYPE_EventName 9
Table 4 Eventing & Moderation 11
Table 5 Event Model 11
Table 6 Values of EventsPerDay String 12
Table 7 Action list 12
Table 8 Arguments for SetEventParameters 12
Table 9 Arguments for GetEventsPerDay 13
Table 10 Common Error Codes 14
Table 11 Example Table 16

INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 6-14: Heating, Ventilation and Air Conditioning Device Control Protocol – Setpoint Schedule Service

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The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Universal plug and play (UPnP) architecture*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

ORIGINAL UPNP DOCUMENTS
(informative)

Reference may be made in this document to original UPnP documents. These references are retained in order to maintain consistency between the specifications as published by ISO/IEC and by UPnP Implementers Corporation. The following table indicates the original UPnP document titles and the corresponding part of ISO/IEC 29341:

UPnP Document Title	ISO/IEC 29341 Part
UPnP Device Architecture 1.0	ISO/IEC 29341-1
UPnP Basic:1 Device	ISO/IEC 29341-2
UPnP AV Architecture:1	ISO/IEC 29341-3-1
UPnP MediaRenderer:1 Device	ISO/IEC 29341-3-2
UPnP MediaServer:1 Device	ISO/IEC 29341-3-3
UPnP AVTransport:1 Service	ISO/IEC 29341-3-10
UPnP ConnectionManager:1 Service	ISO/IEC 29341-3-11
UPnP ContentDirectory:1 Service	ISO/IEC 29341-3-12
UPnP RenderingControl:1 Service	ISO/IEC 29341-3-13
UPnP MediaRenderer:2 Device	ISO/IEC 29341-4-2
UPnP MediaServer:2 Device	ISO/IEC 29341-4-3
UPnP AV Datastructure Template:1	ISO/IEC 29341-4-4
UPnP AVTransport:2 Service	ISO/IEC 29341-4-10
UPnP ConnectionManager:2 Service	ISO/IEC 29341-4-11
UPnP ContentDirectory:2 Service	ISO/IEC 29341-4-12
UPnP RenderingControl:2 Service	ISO/IEC 29341-4-13
UPnP ScheduledRecording:1	ISO/IEC 29341-4-14
UPnP DigitalSecurityCamera:1 Device	ISO/IEC 29341-5-1
UPnP DigitalSecurityCameraMotionImage:1 Service	ISO/IEC 29341-5-10
UPnP DigitalSecurityCameraSettings:1 Service	ISO/IEC 29341-5-11
UPnP DigitalSecurityCameraStillImage:1 Service	ISO/IEC 29341-5-12
UPnP HVAC_System:1 Device	ISO/IEC 29341-6-1
UPnP HVAC_ZoneThermostat:1 Device	ISO/IEC 29341-6-2
UPnP ControlValve:1 Service	ISO/IEC 29341-6-10
UPnP HVAC_FanOperatingMode:1 Service	ISO/IEC 29341-6-11
UPnP FanSpeed:1 Service	ISO/IEC 29341-6-12
UPnP HouseStatus:1 Service	ISO/IEC 29341-6-13
UPnP HVAC_SetpointSchedule:1 Service	ISO/IEC 29341-6-14
UPnP TemperatureSensor:1 Service	ISO/IEC 29341-6-15
UPnP TemperatureSetpoint:1 Service	ISO/IEC 29341-6-16
UPnP HVAC_UserOperatingMode:1 Service	ISO/IEC 29341-6-17
UPnP BinaryLight:1 Device	ISO/IEC 29341-7-1
UPnP DimmableLight:1 Device	ISO/IEC 29341-7-2
UPnP Dimming:1 Service	ISO/IEC 29341-7-10
UPnP SwitchPower:1 Service	ISO/IEC 29341-7-11
UPnP InternetGatewayDevice:1 Device	ISO/IEC 29341-8-1
UPnP LANDevice:1 Device	ISO/IEC 29341-8-2
UPnP WANDevice:1 Device	ISO/IEC 29341-8-3
UPnP WANConnectionDevice:1 Device	ISO/IEC 29341-8-4
UPnP WLANAccessPointDevice:1 Device	ISO/IEC 29341-8-5
UPnP LANHostConfigManagement:1 Service	ISO/IEC 29341-8-10
UPnP Layer3Forwarding:1 Service	ISO/IEC 29341-8-11
UPnP LinkAuthentication:1 Service	ISO/IEC 29341-8-12
UPnP RadiusClient:1 Service	ISO/IEC 29341-8-13
UPnP WANCableLinkConfig:1 Service	ISO/IEC 29341-8-14
UPnP WANCommonInterfaceConfig:1 Service	ISO/IEC 29341-8-15
UPnP WANDSLLinkConfig:1 Service	ISO/IEC 29341-8-16
UPnP WANEthernetLinkConfig:1 Service	ISO/IEC 29341-8-17
UPnP WANIPConnection:1 Service	ISO/IEC 29341-8-18
UPnP WANPOTSLinkConfig:1 Service	ISO/IEC 29341-8-19
UPnP WANPPPConnection:1 Service	ISO/IEC 29341-8-20
UPnP WLANConfiguration:1 Service	ISO/IEC 29341-8-21
UPnP Printer:1 Device	ISO/IEC 29341-9-1
UPnP Scanner:1.0 Device	ISO/IEC 29341-9-2
UPnP ExternalActivity:1 Service	ISO/IEC 29341-9-10
UPnP Feeder:1.0 Service	ISO/IEC 29341-9-11
UPnP PrintBasic:1 Service	ISO/IEC 29341-9-12
UPnP Scan:1 Service	ISO/IEC 29341-9-13
UPnP QoS Architecture:1.0	ISO/IEC 29341-10-1
UPnP QosDevice:1 Service	ISO/IEC 29341-10-10
UPnP QosManager:1 Service	ISO/IEC 29341-10-11
UPnP QosPolicyHolder:1 Service	ISO/IEC 29341-10-12
UPnP QoS Architecture:2	ISO/IEC 29341-11-1
UPnP QOS v2 Schema Files	ISO/IEC 29341-11-2

UPnP Document Title	ISO/IEC 29341 Part
UPnP QosDevice:2 Service	ISO/IEC 29341-11-10
UPnP QosManager:2 Service	ISO/IEC 29341-11-11
UPnP QosPolicyHolder:2 Service	ISO/IEC 29341-11-12
UPnP RemoteUIClientDevice:1 Device	ISO/IEC 29341-12-1
UPnP RemoteUIServerDevice:1 Device	ISO/IEC 29341-12-2
UPnP RemoteUIClient:1 Service	ISO/IEC 29341-12-10
UPnP RemoteUIServer:1 Service	ISO/IEC 29341-12-11
UPnP DeviceSecurity:1 Service	ISO/IEC 29341-13-10
UPnP SecurityConsole:1 Service	ISO/IEC 29341-13-11

1. Overview and Scope

This service definition is compliant with the UPnP Device Architecture version *1.0*.

This service provides the following variables:

- A_ARG_TYPE_DayOfWeek variable indicating the the day for which a set of timed setpoints is established.
- A_ARG_TYPE_EventName variable indicating the named events for which timed setpoints may be established.
- A_ARG_TYPE_StartTime variable indicating the starting time of a scheduled change in setpoints.
- A_ARG_TYPE_HeatingSetpoint variable to be part of a scheduled change in a heating setpoint.
- A_ARG_TYPE_CoolingSetpoint variable to be part of a scheduled change in a cooling setpoint.
- EventsPerDay a delimited string indicating the scheduled setpoint changes on a given day.

This service provides the following actions:

- SetEventParameters establishes a new or updates an existing event with the appropriate parameters.
- GetEventsPerDay returns a list of the events for the specified day of week.

This service does not provide the following:

- The interface between the schedule table and setpoint objects or services.

2. Service Modeling Definitions

2.1. ServiceType

The following service type identifies a service that is compliant with this template:

URN:SCHEMAS-UPNP-ORG:SERVICE:HVAC_SETPOINTSCHEDULE:1

2.2. State Variables

Table 1 State Variables

Variable Name	Req. or Opt.	Data Type	Allowed Value[2]	Default Value[2]	Eng. Units
A_ARG_TYPE_DayOfWeek	R	string	See Table 2	All	none
A_ARG_TYPE_EventName	R	string	See Table 3	Home	none
A_ARG_TYPE_StartTime	R	ui2	Minimum = 0 Maximum <= 1439 Step = 1	0	Minutes from mid night
A_ARG_TYPE_HeatingSetpoint	R	i4	Minimum: vendor defined Maximum: vendor defined Step=1	Vendor defined	.01 degrees Celsius
A_ARG_TYPE_CoolingSetpoint	R	i4	Minimum: vendor defined Maximum: vendor defined Step=1	Vendor defined	.01 degrees Celsius
EventsPerDay	R	string	N/a	Zero length string	none
Non-standard state variables implemented by an UPnP vendor go here.	*X*	*TBD*	*TBD*	*TBD*	*TBD*

[1] R = Required, O = Optional, X = Non-standard.

[1] Values listed in this column are required. To specify standard optional values or to delegate assignment of values to the vendor, you must reference a specific instance of an appropriate table below.

Table 2 AllowedValueList for A_ARG_TYPE_DayOfWeek

Value	Req. or Opt. [1]
Sun	O
Mon	O
Tue	O
Wed	O
Thu	O
Fri	O
Sat	O
All	R
Weekdays	O
Weekend	O
Standby	O
*	R
Vendor-defined	*R/O*

[1] R = Required, O = Optional, X = Non-standard.

Table 3 AllowedValueList for A_ARG_TYPE_EventName

Value	Req. or Opt. [1]
Home	R
Wake	R
Sleep	R
Away	R
Sunrise	O
Sunset	O
Vendor-defined	*R/O*

[1] = Required, O = Optional, X = Non-standard.

2.2.1. A_ARG_TYPE_DayOfWeek

Defined only to provide typing for one or more action arguments. This variable serves as the primary index to the schedule list. DayOfWeek values are in general defined by the manufacturer, however there are two required values:

- "All" – this is for the basic functionality of a one-day schedule i.e. when all days of the week follow the same time schedule.
- "*" (wildcard symbol) – this is a special symbol that used only in the GetEventsPerDay action for retrieving the complete schedule in a single operation.

2.2.2. A_ARG_TYPE_EventName

Defined only to provide typing for one or more action arguments. This variable is the secondary index to the list. EventNames are established by the manufacturer.

2.2.3. A_ARG_TYPE_StartTime

Defined only to provide typing for one or more action arguments. This variable provides the time from midnight (in minutes) to the start of an event

2.2.4. A_ARG_TYPE_HeatingSetpoint

Defined only to provide typing for one or more action arguments. This variable provides the heating setpoint for this event

2.2.5. A_ARG_TYPE_CoolingSetpoint

Defined only to provide typing for one or more action arguments. This variable provides the heating setpoint for this event.

2.2.6. EventsPerDay

This string variable is a comma-delimited list of the events, start times, heating setpoints, and cooling setpoints for a specific day, or for a specific event.

2.2.7. Relationships Between State Variables

This service generates a list of tuples (StartTime, CoolingSetpoint, HeatingSetpoint) indexed by A_ARG_TYPE_DayOfWeek and by A_ARG_TYPE_EventName

An event is set using the SetEventParameters action. This action uses five arguments: (SubmittedDayOfWeek, SubmittedEventName, NewStartTime, NewHeatingSetpoint, NewCoolingSetpoint).

This allows a Control Point or other devices to set start times and both heating and cooling setpoints for each event in each day of the week.

The tuples for a given DayOfWeek may be read using the GetEventsPerDay action. Here the Control Point submits a DayOfWeek and the service returns all of the scheduled events for the submitted DayOfWeek along with their associated tuples as a delimited string.

2.3. Eventing and Moderation

Table 4 Eventing & Moderation

Variable Name	Evented	Moderated Event	Max Event Rate[1]	Logical Combination	Min Delta per Event[2]
A_ARG_TYPE_DayOfWeek	No				
A_ARG_TYPE_EventName	No				
A_ARG_TYPE_StartTime	No				
A_ARG_TYPE_HeatingSetpoint	No				
A_ARG_TYPE_CoolingSetpoint	No				
EventsPerDay	Yes	No			
Non-standard state variables implemented by an UPnP vendor go here.	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*

[1] Determined by N, where Rate = (Event)/(N secs).
[2] (N) * (allowedValueRange Step).

2.3.1. Event Model

Table 5 Event Model

Variable Name	UI requirements	Async Requirements	Func. Vs max rate tradeoffs	Est of Max rate	Reason not evented
A_ARG_TYPE_DayOfWeek					Variable used is an argument only
A_ARG_TYPE_EventName					Variable is reported as part of a return value
A_ARG_TYPE_StartTime					Variable is reported as part of a return value
A_ARG_TYPE_HeatingSetpoint					Variable is reported as part of a return value
A_ARG_TYPE_CoolingSetpoint					Variable is reported as part of a return value
EventsPerDay	UI needs to know when a scheduled event is added, removed or changed				

The service must send event messages for the EventsPerDay state variable whenever a) a new event is added to the setpoint schedule, b) an existing event is modified, or c) an existing event is deleted. Event messages must be sent for EventsPerDay in response to a) changes made via the SetEventParameters action, and b) changes made through another user interface.

EventsPerDay returns a comma-delimited string for a ***single*** event in the form defined in the following table below. NOTE: This differs from the behavior of EventsPerDay under the UPnP Control Action "GetEventsPerDay" (paragraph 2.4.2) where ***zero or more*** events are concatenated.

If a series of individual changes are made in the setpoint schedule, then a corresponding series of event messages must be transmitted.

Table 6 Values of EventsPerDay String

Cause of Event	Value of EventsPerDay
New event is added	Day,Event,StartTime,HeatingSetpoint,CoolingSetpoint
Existing event is modified	Day,Event,newStartTime,newHeatingSetpoint,newCoolingSetpoint
Existing event is deleted	Day,Event,0,0,0

2.4. Actions

Table 7 Action list

Name	Req. or Opt. [1]
SetEventParameters	Req
GetEventsPerDay	Req
Non-standard actions implemented by an UPnP vendor go here.	*X*

[1] R = Required, O = Optional, X = Non-standard.

2.4.1. SetEventParameters

This action establishes a new or overwrites an existing event with the appropriate parameters. It is event and day of week specific.

If NewStartTime is 0, the event is removed from the list.

2.4.1.1. Arguments

Table 8 Arguments for SetEventParameters

Argument	Direction	relatedStateVariable
SubmittedDayOfWeek	In	A_ARG_TYPE_DayOfWeek
SubmittedEventName	In	A_ARG_TYPE_EventName
NewStartTime	In	A_ARG_TYPE_StartTime
NewHeatingSetpoint	In	A_ARG_TYPE_HeatingSetpoint
NewCoolingSetpoint	In	A_ARG_TYPE_CoolingSetpoint

2.4.1.2. Dependency on State

None

2.4.1.3. Effect on State

Changes the respective set point schedule entry.

2.4.1.4. Errors

errorCode	errorDescription	Description
700	Day of Week not available	Request for invalid DayOfWeek
701	EventName not available	Request for invalid EventName

2.4.2. GetEventsPerDay

This action returns a comma-delimited string in the form:

Day,Event1,StartTime1,HeatingSetpoint1,CoolingSetpoint1,Day,Event2,StartTime2,HeatingSetpoint2, CoolingSetpoint2, … until all events in the specified DayOf Week have been reported.

In other words, the action returns a concatenation of ***zero or more*** events. NOTE: This differs from the behavior of EventsPerDay under the UPnP Event Model (see paragraph 2.3.1) where a ***single*** event is transmitted.

If there are no events matching the specified DayOfWeek, then the action returns a zero length string.

If SubmittedDayOfWeek is "*" (wildcard symbol), then the action returns a concatenation of ***all*** events in the schedule.

2.4.2.1. Arguments

Table 9 Arguments for GetEventsPerDay

Argument	Direction	relatedStateVariable
SubmittedDayOfWeek	In	A_ARG_TYPE_DayOfWeek
CurrentEventsPerDay	Out [R]	EventsPerDay

[R] - Return Value

2.4.2.2. Dependency on State

CurrentEventsPerDay must return the full comma-delimited list of all the events in the setpoint schedule that match the respective SubmittedDayOfWeek (i.e. zero or more events).

2.4.2.3. Effect on State

None

2.4.2.4. Errors

errorCode	errorDescription	Description
700	Day of Week not available	Request for invalid DayOfWeek

2.4.3. Non-Standard Actions Implemented by a UPnP Vendor

To facilitate certification, non-standard actions implemented by UPnP vendors should be included in this service template. The UPnP Device Architecture lists naming requirements for non-standard actions (see the section on Description).

2.4.4. Relationships Between Actions

None.

2.4.5. Common Error Codes

The following table lists error codes common to actions for this service type. If an action results in multiple errors, the most specific error should be returned.

Table 10 Common Error Codes

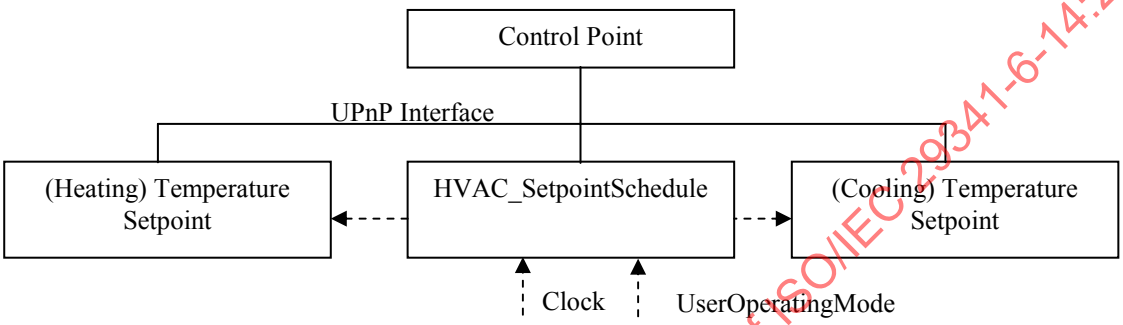
errorCode	errorDescription	Description
401	Invalid Action	See UPnP Device Architecture section on Control.
402	Invalid Args	See UPnP Device Architecture section on Control.
404	Invalid Var	See UPnP Device Architecture section on Control.
501	Action Failed	See UPnP Device Architecture section on Control.
600-699	TBD	Common action errors. Defined by UPnP Forum Technical Committee.
701-799		Common action errors defined by the UPnP Forum working committees.
800-899	*TBD*	*(Specified by UPnP vendor.)*

2.5. Theory of Operation

This service provides a means to establish a logical schedule table where each row represents a separate event. Control points may add, remove or modify an event by using the SetEventParameters action. Control points may discover the events established for a given period by using the GetEventPerDay action.

"All" events repeat all days of the week, each day of the week, weekly or on weekends.

The logic or connection to the temperature setpoint controllers is not exposed by this design. It is presumed that internal actions of an implementation of this service will cause the appropriate setpoints to be modified.



Note: Dotted lines indicate internal interfaces and are not necessarily visible from the UPnP interface

The manufacturer establishes the Day of Week list and the EventName list. The list of allowed Day of Week values is a superset of what may be implemented by a particular vendor. The list of EventNames may be extended by a manufacturer. The allowed-value XML description provides the implemented days and event names for Control Points.

This service generates a list or table of tuples (StartTime, CoolingSetpoint, HeatingSetpoint) indexed by A_ARG_TYPE_DayOfWeek and by A_ARG_TYPE_EventName

An event is set using the SetEventParameters action. This action uses five arguments: (SubmittedDayOfWeek, SubmittedEventName, NewStartTime, NewHeatingSetpoint, NewCoolingSetpoint).

This allows a Control Point or other devices to set start times and both heating and cooling setpoints for each event in each day of the week.

The tuples for a given DayOfWeek may be read using the GetEventsPerDay action. Here the Control Point submits a DayOfWeek and the service returns all of the scheduled events for the submitted DayOfWeek along with their associated tuples as a delimited string.

Table 11 Example Table

DayOfWeek	EventName	StartTime	HeatingSetpoint	CoolingSetpoint
Mon	Wake	440	2065	2389
Mon	Leave	540	1833	2667
Mon	Home	1020	2222	2389
Mon	Sleep	1320	1833	2389
Tue	Wake	440	2222	2389
Tue	Sleep	1320	1833	2389
Wed	Wake	440	2222	2389
Wed	Leave	540	1833	2667
Wed	Home	1020	2222	2389
Wed	Sleep	1320	1833	2389
Thu	Wake	440	2222	2389
Thu	Sleep	1320	1833	2389
Fri	Wake	440	2222	2389
Fri	Sleep	1320	1833	2389
Weekend	Wake	540	2222	2389
Weekend	Sleep	1320	1833	2389

Example response to GetEventsPerDay (Tue)

Tue,Wake,440,2222,2389,Tue,Sleep,1320,1833,2389

3. XML Service Description

```
<?xml version="1.0"?>
<scpd xmlns="urn:schemas-upnp-org:service-1-0">
  <specVersion>
    <major>1</major>
    <minor>0</minor>
  </specVersion>
  <actionList>
  <action>
    <name>SetEventParameters</name>
      <argumentList>
      <argument>
          <name>SubmittedDayOfWeek</name>
          <direction>in</direction>
          <relatedStateVariable>A_ARG_TYPE_DayOfWeek</relatedStateVariable>
        </argument>
        <argument>
          <name>SubmittedEventName</name>
          <direction>in</direction>
          <relatedStateVariable>A_ARG_TYPE_EventName</relatedStateVariable>
        </argument>
          <argument>
            <name>NewStartTime</name>
            <direction>in</direction>
             <relatedStateVariable>A_ARG_TYPE_StartTime</relatedStateVariable>
        </argument>
        <argument>
          <name>NewHeatingSetpoint</name>
          <direction>in</direction>
          <relatedStateVariable>A_ARG_TYPE_HeatingSetpoint</relatedStateVariable>
        </argument>
          <argument>
          <name>NewCoolingSetpoint</name>
          <direction>in</direction>
          <relatedStateVariable>A_ARG_TYPE_CoolingSetpoint</relatedStateVariable>
        </argument>
  </action>
  <action>
    <name>GetEventsPerDay</name>
      <argumentList>
        <argument>
          <name>SubmittedDayOfWeek</name>
          <direction>in</direction>
          <relatedStateVariable>A_ARG_TYPE_DayOfWeek</relatedStateVariable>
        </argument>
        <argument>
          <name>CurrentEventsPerDay</name>
          <direction>out</direction>
          <retval />
          <relatedStateVariable>EventsPerDay</relatedStateVariable>
        </argument>
      </argumentList>
    </action>

 Declarations for other actions added by UPnP vendor (if any) go here

  </actionList>
  <serviceStateTable>
    <stateVariable sendEvents="no">
      <name>A_ARG_TYPE_DayOfWeek</name>
      <dataType>string</dataType>
      <defaultValue>All</defaultValue>
```