What is Tango Controls?

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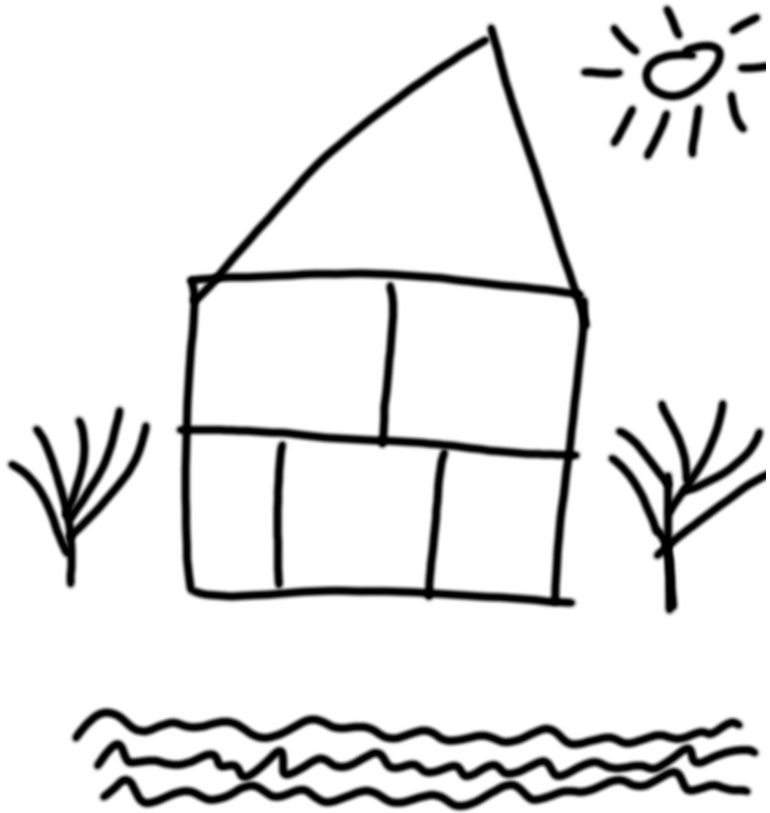
How does it work?

Let's see for ourselves...

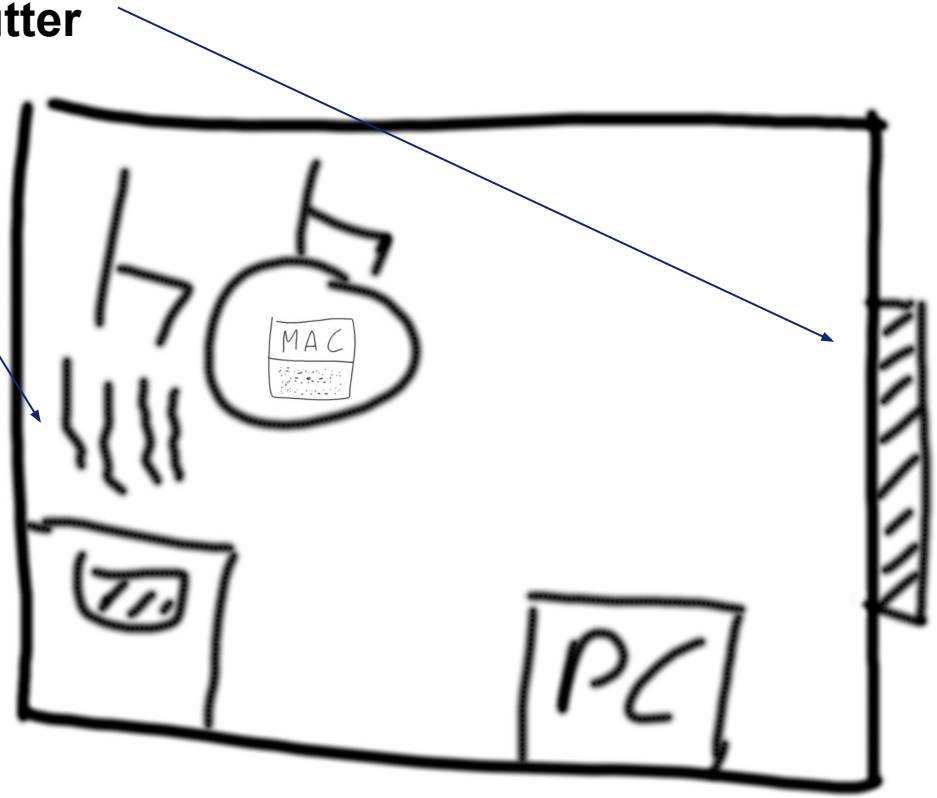
Let’s start with a non-science example

We have a house.
That has some rooms.



Our room

- Window with roller shutter
- Electric Stove
- PC and Mac



Our mission

- **Create reusable and scalable automation**
  - Warm home during the night
  - Energy saving during the day
  - Closed shutters on the window during the night
  - Open shutters during the day
  - Individual software components for:
    - Controller
    - Shutter
    - Heater
    - SunReader

Our hierarchy of device servers

Design choice:

Hierarchical control system

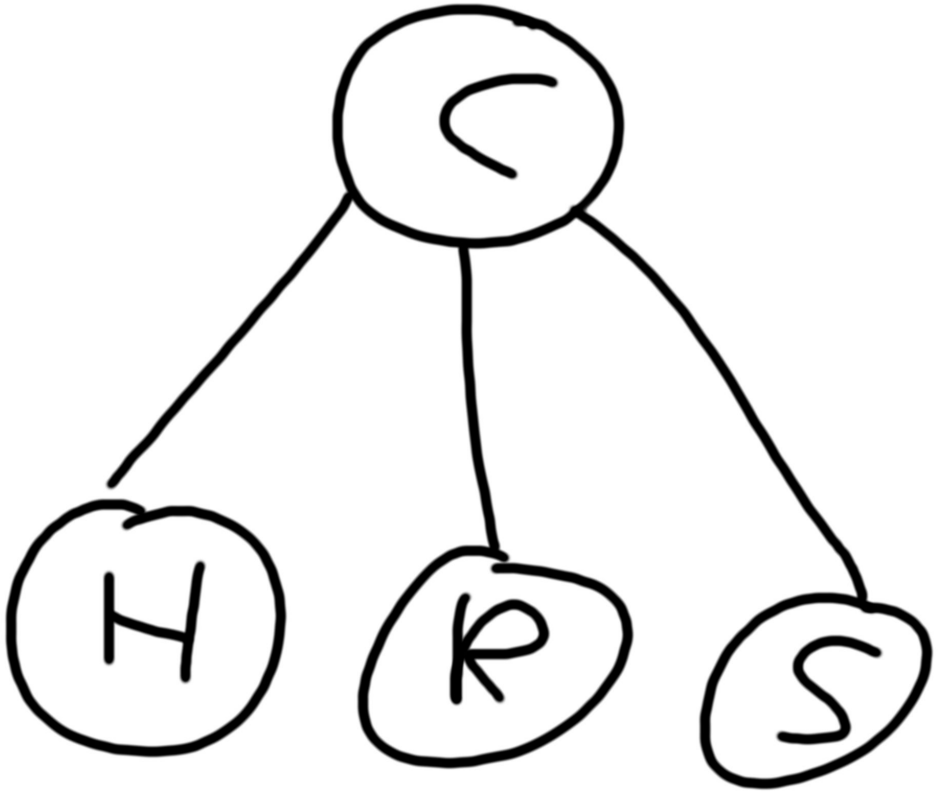
With components:

C - Controller

H - Heater

R - Roller Shutter

S- SunReader



SunReader (SummerHome/LivingRoom/SunReader)

Description: Fetches times of dawn/dusk from local weather agency

Attribute (Read-Only): Sun with boolean values “Yes“ and “No“

Class Property: Latitude, Longitude and Altitude

State: ON, FAULT

Heater (SummerHome/LivingRoom/Heater0)

Description: Electric stove

Attribute (Read-Write): Temperature as double/float

Device Property: TemperatureScaleType with values “Celsius“ or “Fahrenheit“

Commands: On and Off

State: ON, FAULT

Roller Shutter (SummerHome/LivingRoom/RollerShutter0)

Description: Motor for moving the window shutters

Command: ?
Attribute: ?
Property: ?
State: ?

Roller Shutter (SummerHome/LivingRoom/RollerShutter0)

Description: Motor for moving the window shutters

Command: Move, requires an enum input parameter with “Open“/“Close“
Attribute: None
Property: None
State: OPEN, CLOSE, RUNNING, FAULT

Controller (SummerHome/LivingRoom/Ctrl)

Description: Business logic device to control other devices

Attribute (Read/Write): Mode with enum values “On“, “Off“, “Holiday“

Property: DewPointOffsetInKelvin

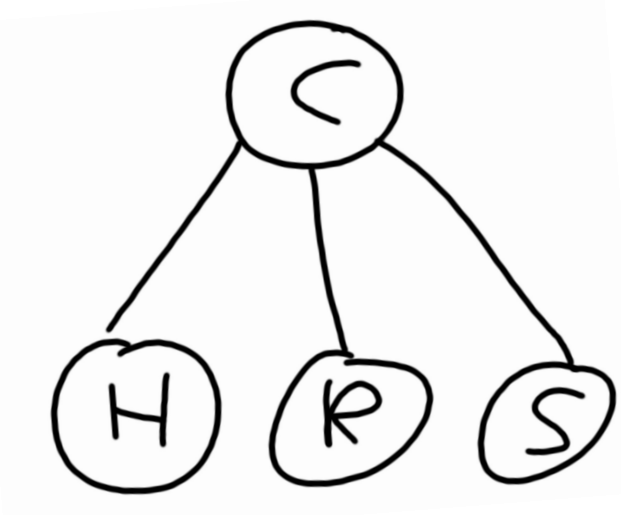
State: ON, FAULT

The control logic

Controller device server subscribes to change event with SunReader's "Sun" attribute.

Event:

- **Asynchronous publish/subscribe mechanism**
- **Callback receives attribute value plus metadata**



Controller mode: “On“

On “No“ for “Sun“:

- Call “Move“ with “Close“ on RollerShutter
- Call “On“ on Heater

On “Yes“ for “Sun“:

- Call “Move“ with “Open“ on RollerShutter
- Call “Off“ on Heater

Controller mode: “Off“

- Call “Move“ with “Open“ of RollerShutter
- Call “Off“ of Heater

Controller mode: “Holiday“

Set the temperature of the Heater to DewPointOffsetInKelvin above the dew point.

Intermission

Questions before we dive into some definitions?

Device Server

A Device Server is a program (executable) which is able to create devices of certain classes. A Device Server may implement one or multiple classes and instantiate one or more devices. A running device server is called a device server instance.

Device

It is an object providing access to its attributes and commands. The list of attributes and commands available for a certain device is defined by its class. The device may be related to a hardware device it interfaces with or it may be a kind of a logical device providing some functionalities not directly related to hardware.

Command

An operation a user may invoke on a device. Tango Controls allows a command to get an input argument and to return a value. List of available commands for a certain device is defined by its device class.

Attribute

Represents a process value (or values) in the system. It may have different formats or dimensions like scalar (0D), spectrum (1D) or image (2D). The attribute allows to read and/or write these values depending on programmer-defined access. The values may have different data types. In addition, an attribute provides some metadata like attribute quality, unit, timestamp or configuration properties.

Device State

A device may be in a certain state which is determined at runtime. The state of a device may reflect the state of a piece of equipment it interfaces with or be determined in another way.

Tango Controls has a set of allowed states the device may be in: ON, OFF, CLOSE, OPEN, INSERT, EXTRACT, MOVING, STANDBY, FAULT, INIT, RUNNING, ALARM, DISABLE and UNKNOWN.

Property

Properties can be assigned to a device class, device or elements of device interface (attributes and commands). Properties can also not be related to a device - such properties are called free properties.

Thank you for your attention!