Design and Implementation of a Template-Based System for Flexible Smart Home Automation

Master's Thesis

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Presentation Overview

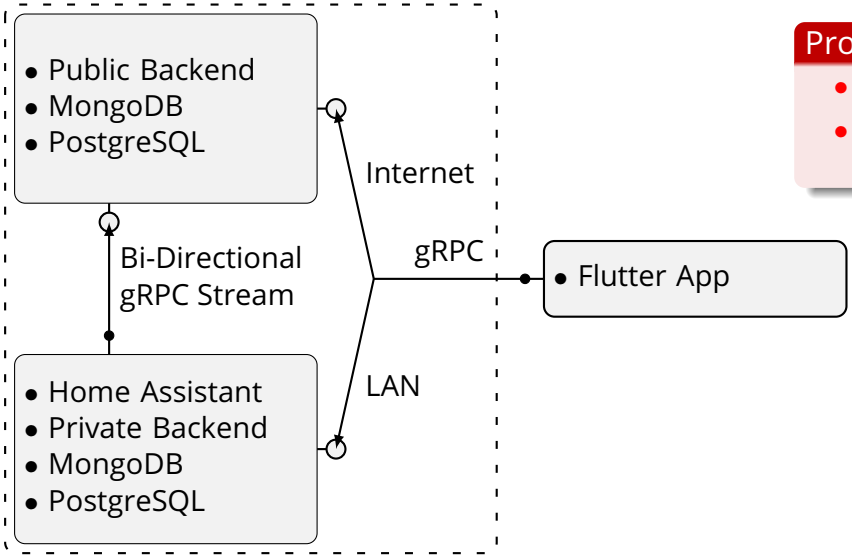
1. Introduction
2. Starting Point
   - Public & Private Backend
   - 1st Generation Automation
3. Solution
   - Public Backend Removal
   - 2nd Generation Automation

About:

Smart Home Automation

Public & Private Backend

Public & Private Backend

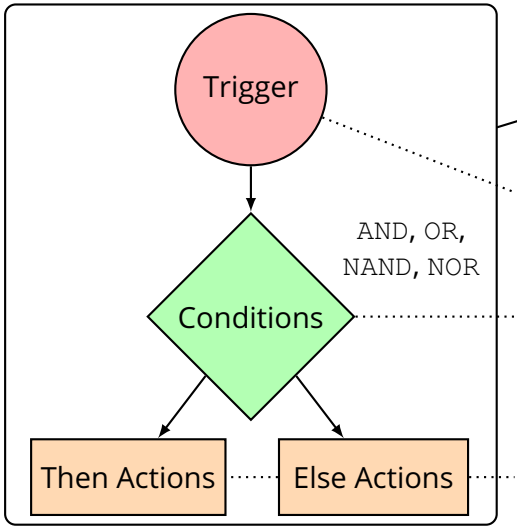


Problems

- Code Duplication
- Synchronization Issues

1st Generation Automation

Old Rules



Device D

1:1

- Every X Time

- X State is On/Off
- $S_1 \leq$ X State $\leq S_2$
- $T_1 \leq$ Time $\leq T_2$
- Recursive Aggregate

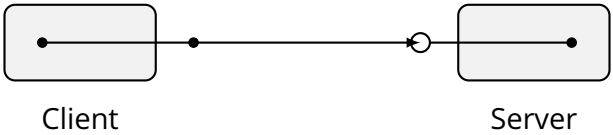
- D State to On/Off
- D State to S
- Lock D State for T Time

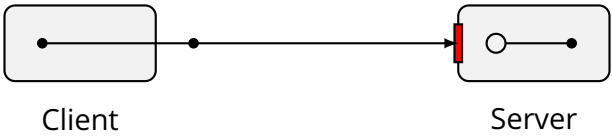
Problems

- 1:1 Relationship
- No Flexibility
- Recursive Duplication
- Locks are Final

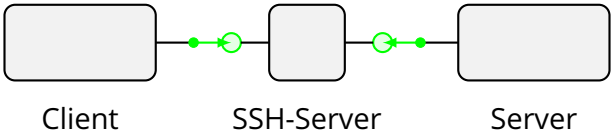
Public Backend Removal

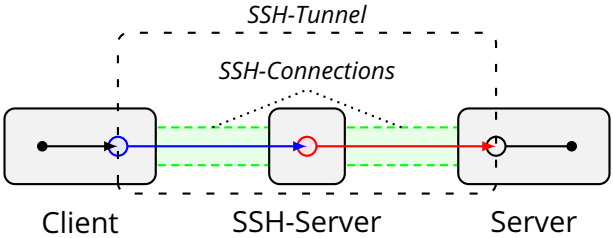
Direct Connection





SSH Tunnel


Client
SSH-Server
Server


SSH-Tunnel
SSH-Connections
Client
SSH-Server
Server

2nd Generation Automation

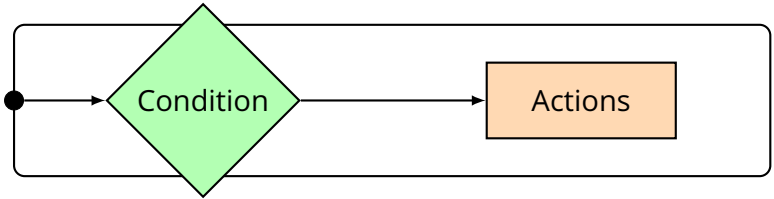
2nd Generation Automation

Idea

Users should have the option to:

- Fully define their own automated systems.
- Configure pre-made automated systems.

Templates (1/4)



- Immediate Boolean
- X State is On/Off
- $S_1 \leq$ X State $\leq S_2$
- $T_1 \leq$ Time $\leq T_2$
- Recursive `AND`, `OR`, `NOT`
- CRON

- X State to On/Off
- X State to S
- Enable/Disable Rule

Improvements

- Recursive Structure
- De-coupling from Devices (no 1:1)
- Toggle-able (on/off)

Templates (2/4)

Rule

- Condition
- List of Actions
- Initial State (on/off)

Rule Instance

- Rule (Base)
- Current State (on/off)

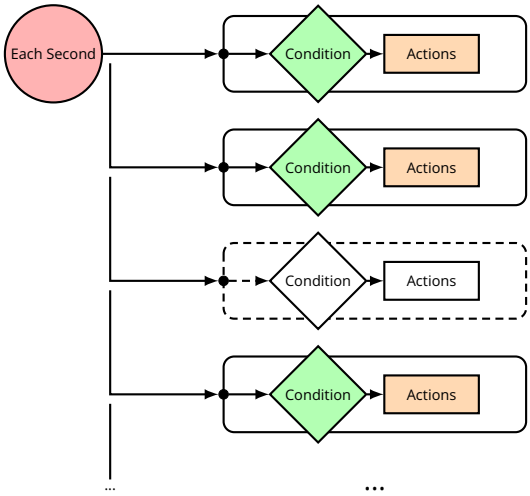
Variable

- Name & Description
- Data Type
- Either:
  - Immediate
  - Dynamic

Data Types

- `BOOL`, `INT`
- `CRON`
- `SENSOR`, `NUMERIC_SENSOR`
- `ENTITY_DEVICE`

Templates (3/4)



Template

- Name & Description
- List of Rules

Template Instance

- Template (Base)
- List of Rule Instances
- Dynamic Values

Templates (4/4)

2 Ways for Automation

- Supports both “simple” and “advanced” users
- They can work together:
  - “Advanced” user creates templates
  - “Simple” user configures templates
- Easy re-use of automation “pieces”

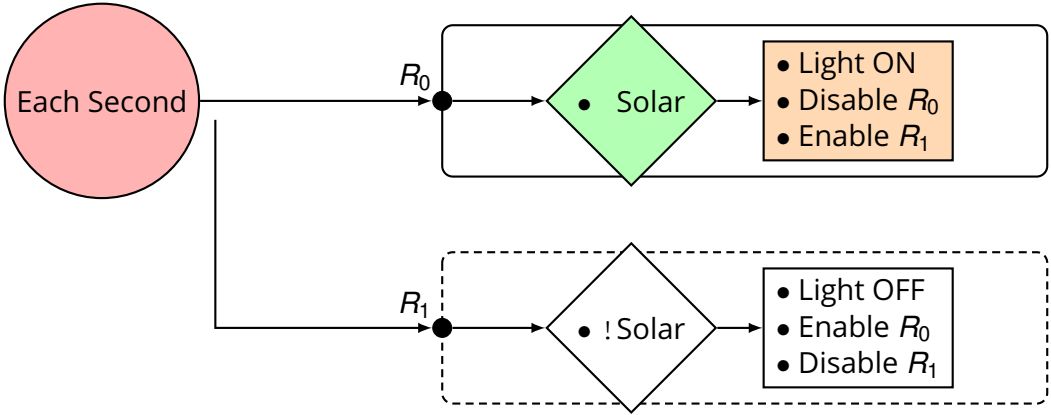
“Simple” Configuration

- Select a template
  - Based on their description
  - Internet sharing!
- Configure dynamic variables
  - Like filling out a form

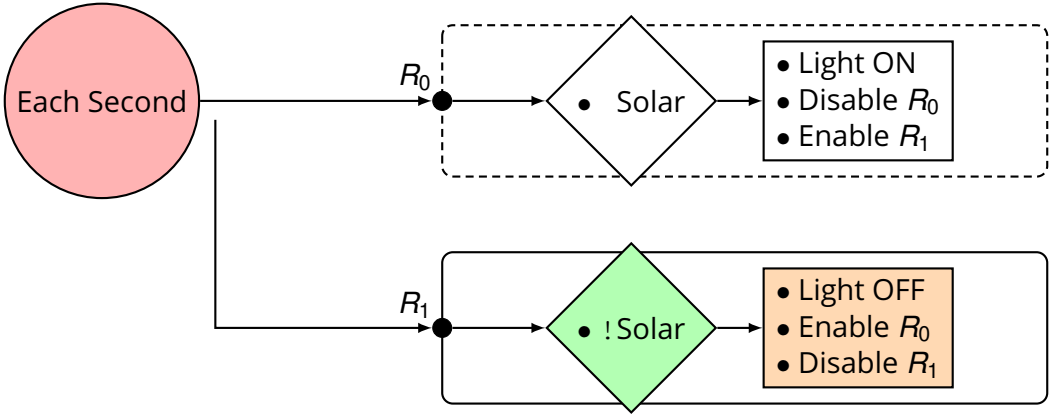
“Advanced” Configuration

- Fully design your own templates
- Configure them as you like

Example (1/2)


Each Second
R_0
• Solar
• Light ON
• Disable R_0
• Enable R_1
R_1
• ! Solar
• Light OFF
• Enable R_0
• Disable R_1

Example (2/2)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Thank You!

Questions? Comments?

Tech Stack

- Home Assistant
- Go
- gRPC & protoc
- PostgreSQL
- MongoDB
- Docker
- Raspberry Pi