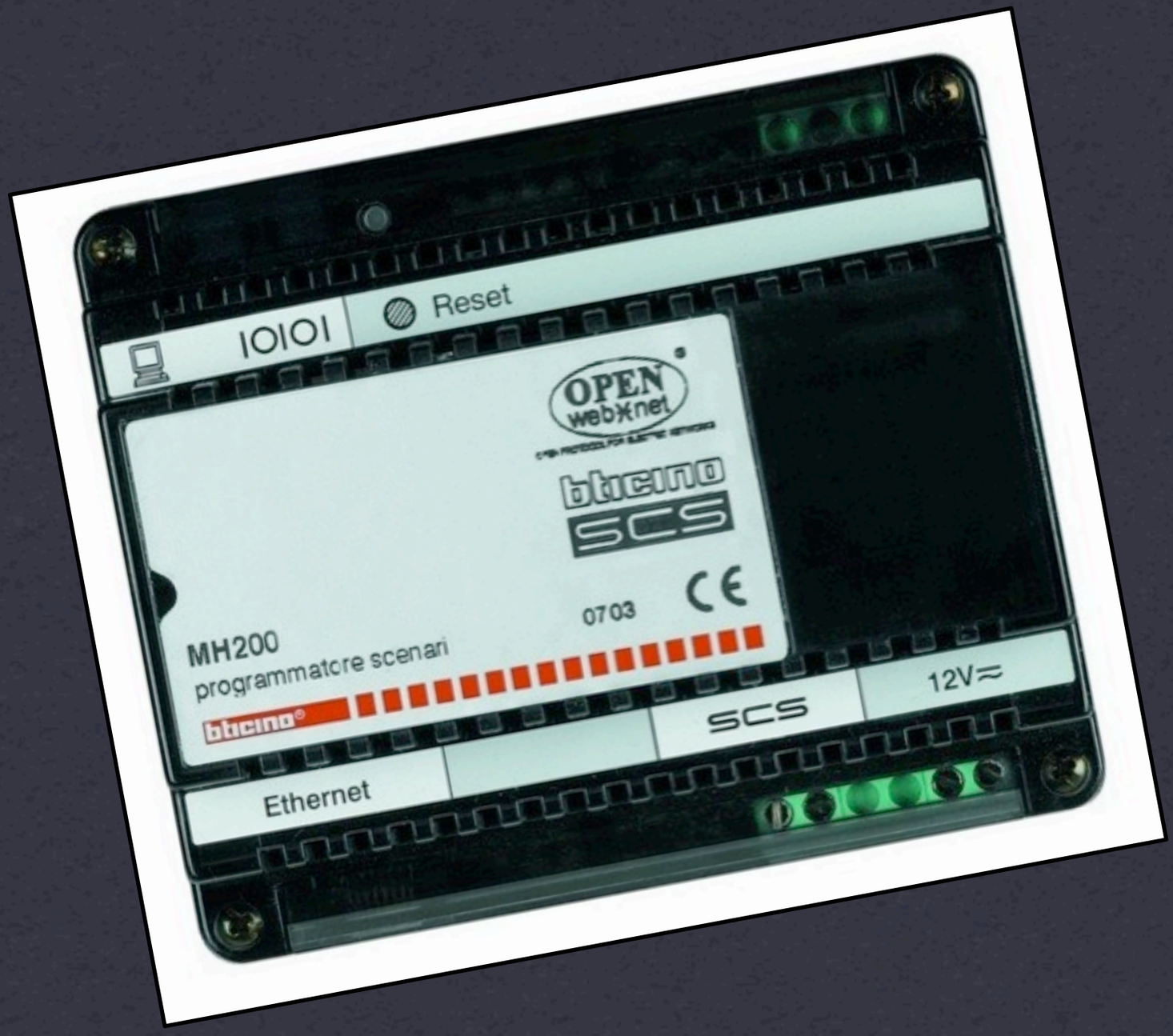


MH200 Scenario Programmer

Program Tutorial

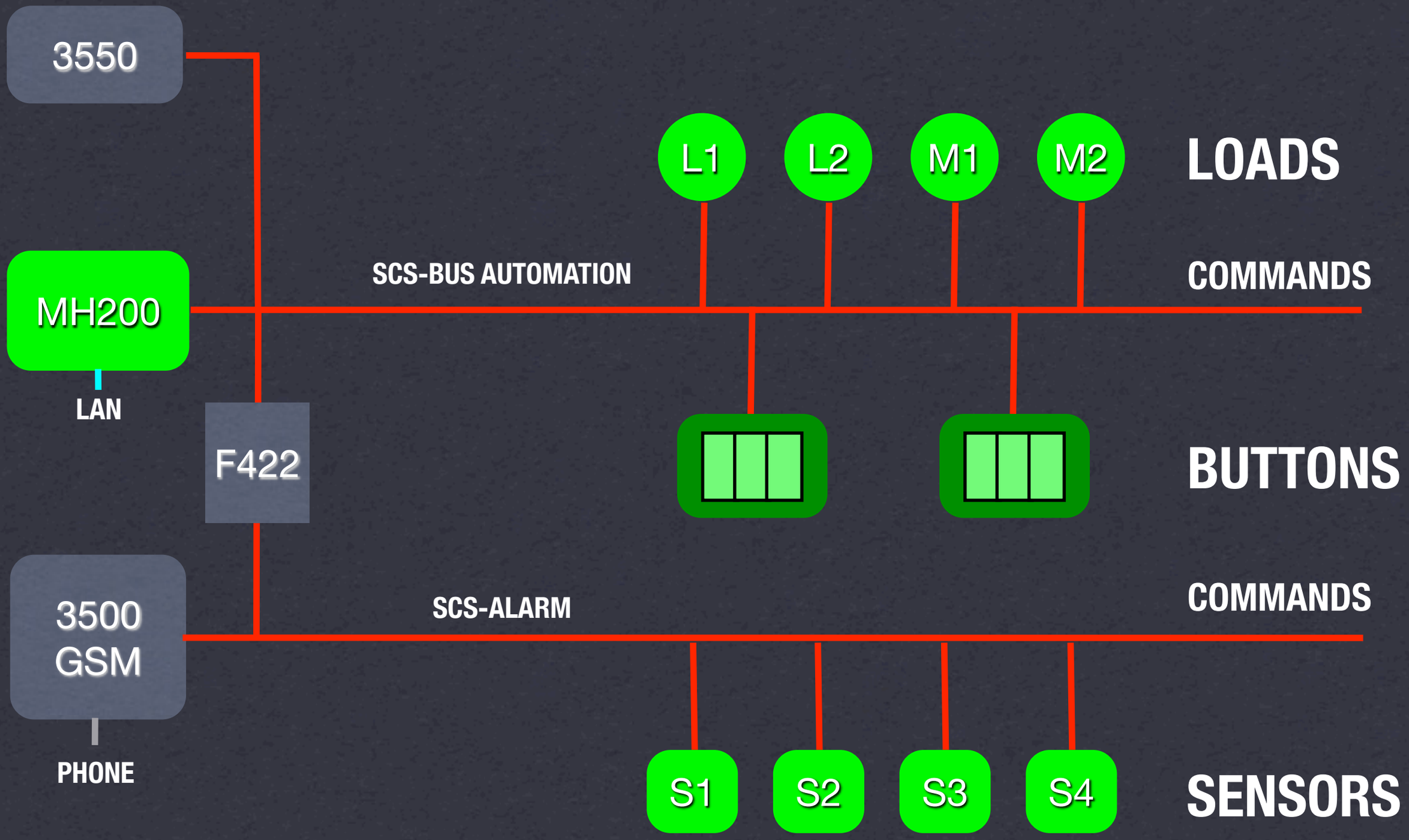
30 DEC 2008

©Andres Albanese, BERKELEY, CA

Home Automation Model

Home is a computer with people living inside with:

- **Loads** controlled by commands
- **Buttons** and **Sensors** generating events
- **Instructions** executing commands based on events and time schedules



Home Wiring

My HoME - bticino

Buttons

- Keys
- Switches
- Rockers
- Keypads

Loads

- Light & Dimmers
- Shutters
- Bells
- Fans
- Electro valves

Commands

- Light_11 = ON
  Light_11 = OFF

- Shutter_12 = UP
  Shutter_12 = DOWN
  Shutter = STOP

- Fan = Clockwise
  Fan = Counter_Clockwise
  Fan = Stop

Sensors

- IR sensors
- Light
- Microswitch
- Water
- Gas
- Temperature

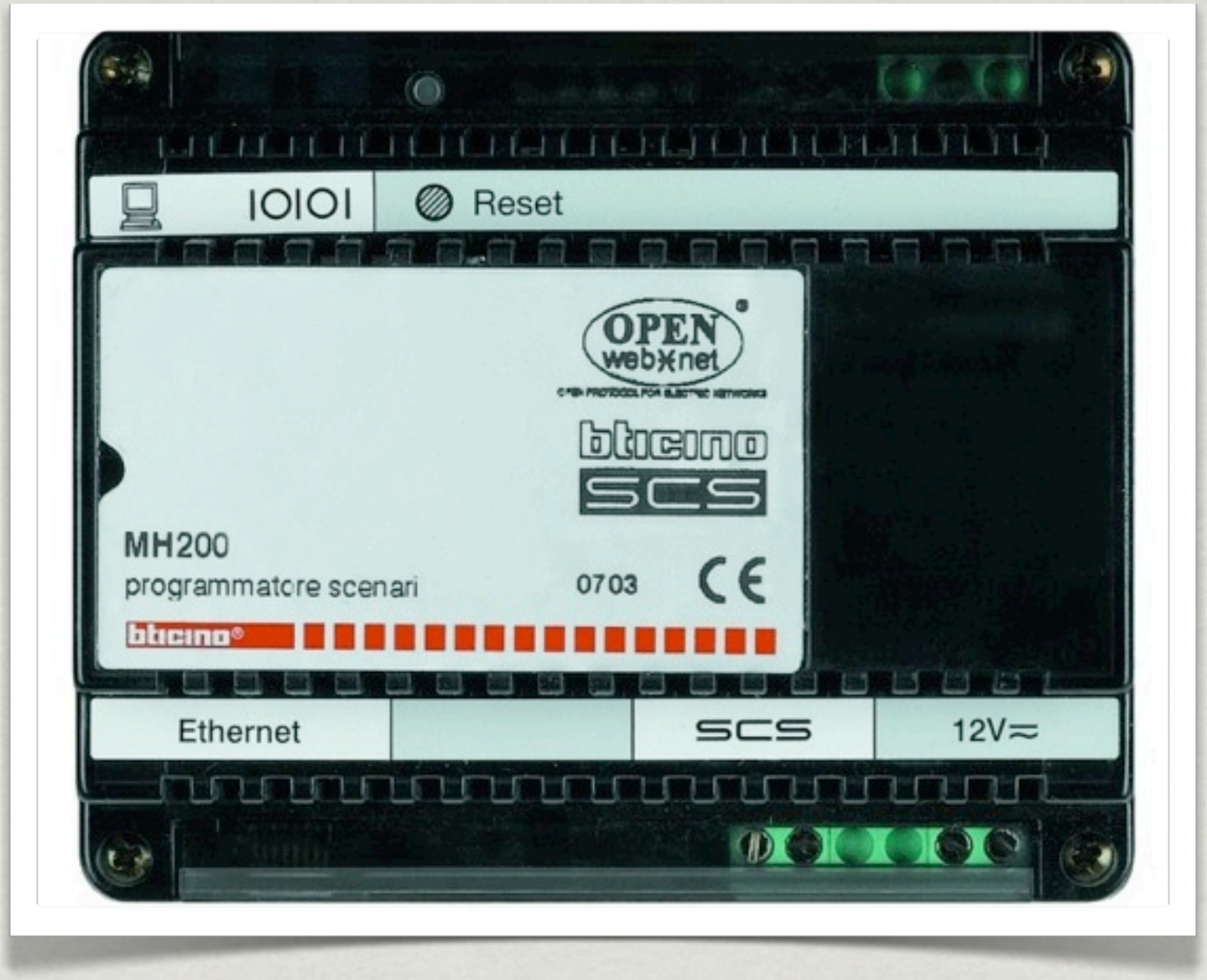
Computer Instruction
Similar to a Scenario

- **NAME**:

When_it_happens: **events**
Only_if_it_happens: **conditions**
Execute: **commands**

My Home Scenarios
Bticino MH200

- **Enable Key**
- **Disable Key**
- **Trigger** events
- **Time** events
- **Conditions**
- **Execute**



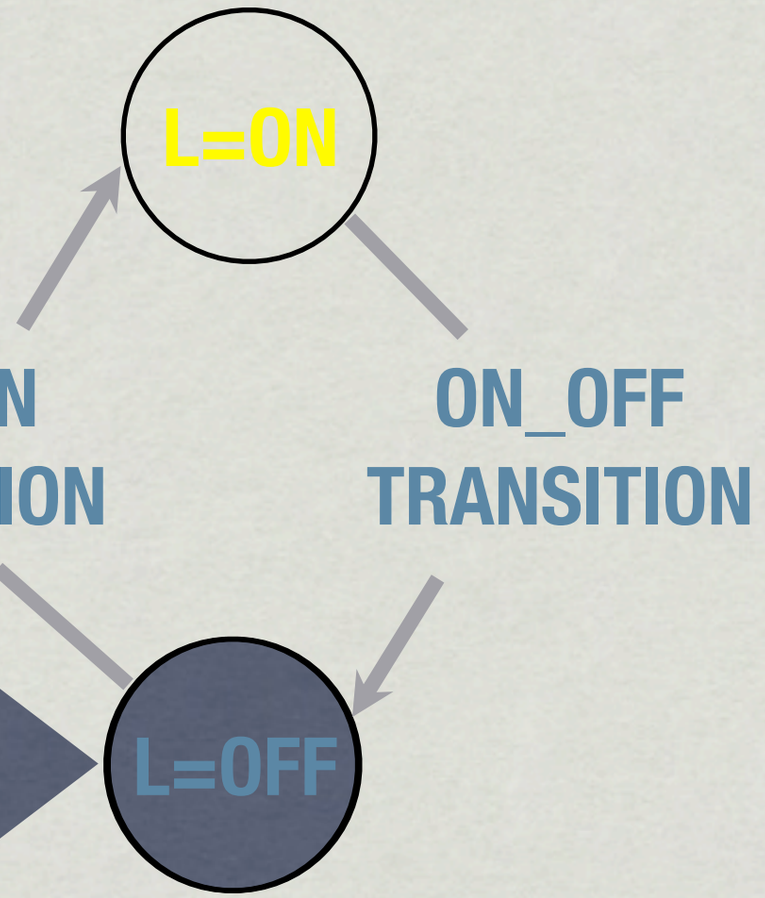
Bticino MH200 Scenarios Similar to Transition in FSM

- **Scenario Enable Key:** (optional)
  Scenario Disable Key: (optional)

- **Transition**: (present_state-next_state)
  When_it_happens: event_1
  Stop_if_it_happens: event_2
  Only_If: present_state (condition)
  Execute: commands (next_state)

One-Click Lamp Finite State Machine

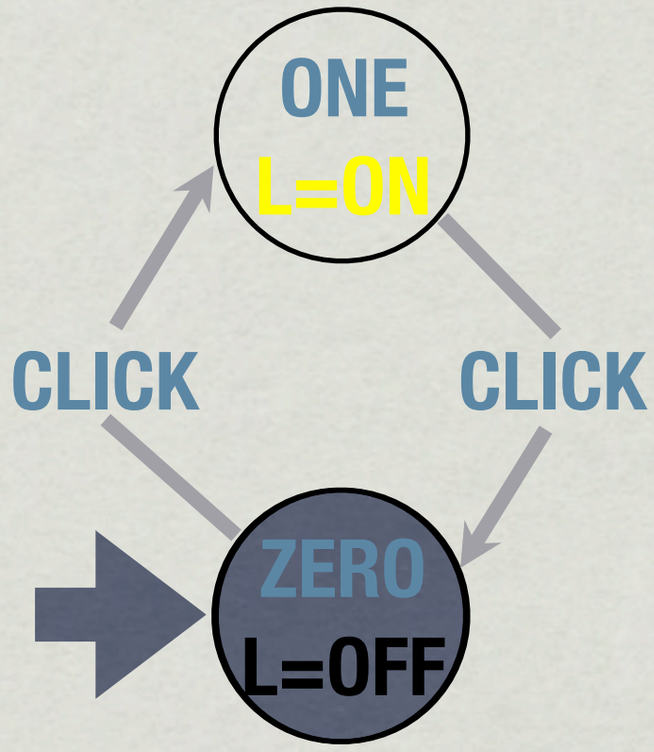
- **State_Transitions**:
  Input, Present_State /
  Commands, Next_State



One-Click Light Scenarios
MH200 Software

- **Zero_ONE**: When: Click=ON
  Only_if: L=OFF
  Execute: L=ON

- **ONE_ZERO**: When: Click=ON
  Only_if: L=ON
  Execute: L=OFF



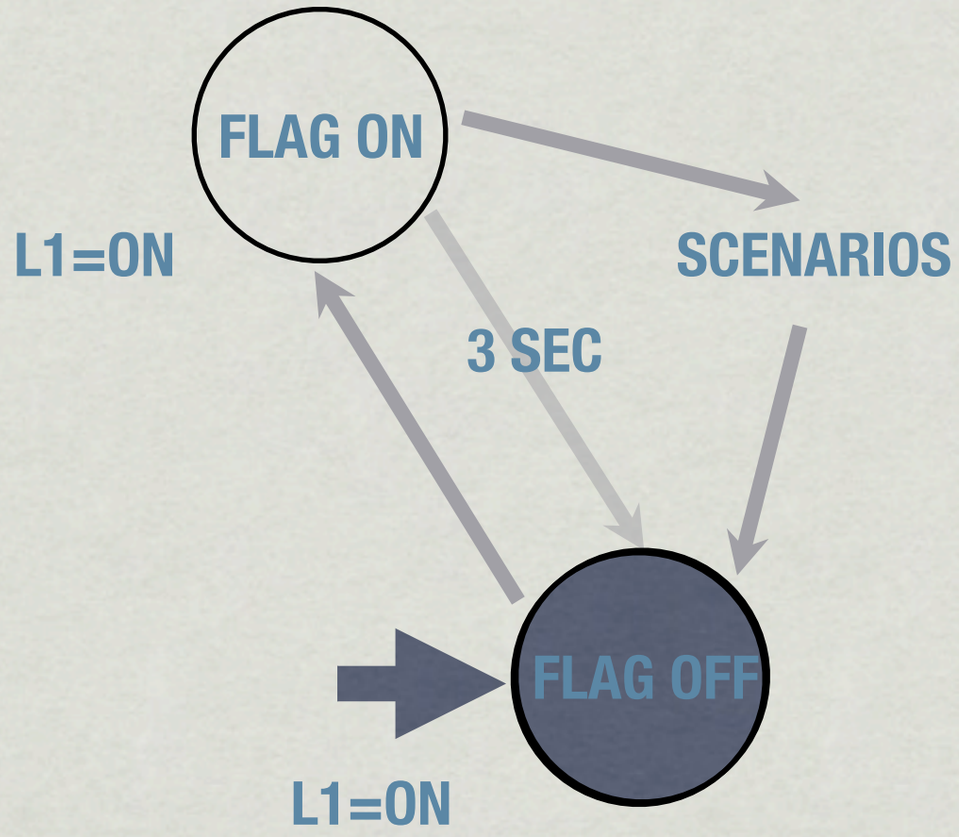
Hidden Commands
Using ON commands

- When a light is turned ON twice within 3 sec. a scenario is activated.
- Otherwise the light operates normal.
- Scenarios can be panic_call, AMB=ON, open_house, water_plants, raise_shutters, ...

Hidden Commands
Panic_Call Scenarios

- **FLAG_OFF_ON**: When: L1=ON
  Only_if: Flag_1=OFF
  Execute: Flag=ON,
  Delay=3 sec,
  Flag_1=OFF

- **FLAG_ON_OFF**: When L1=ON
  Only_if: Flag_1=ON
  Execute: Panic_call= 0.5 sec
  Flag_1=OFF



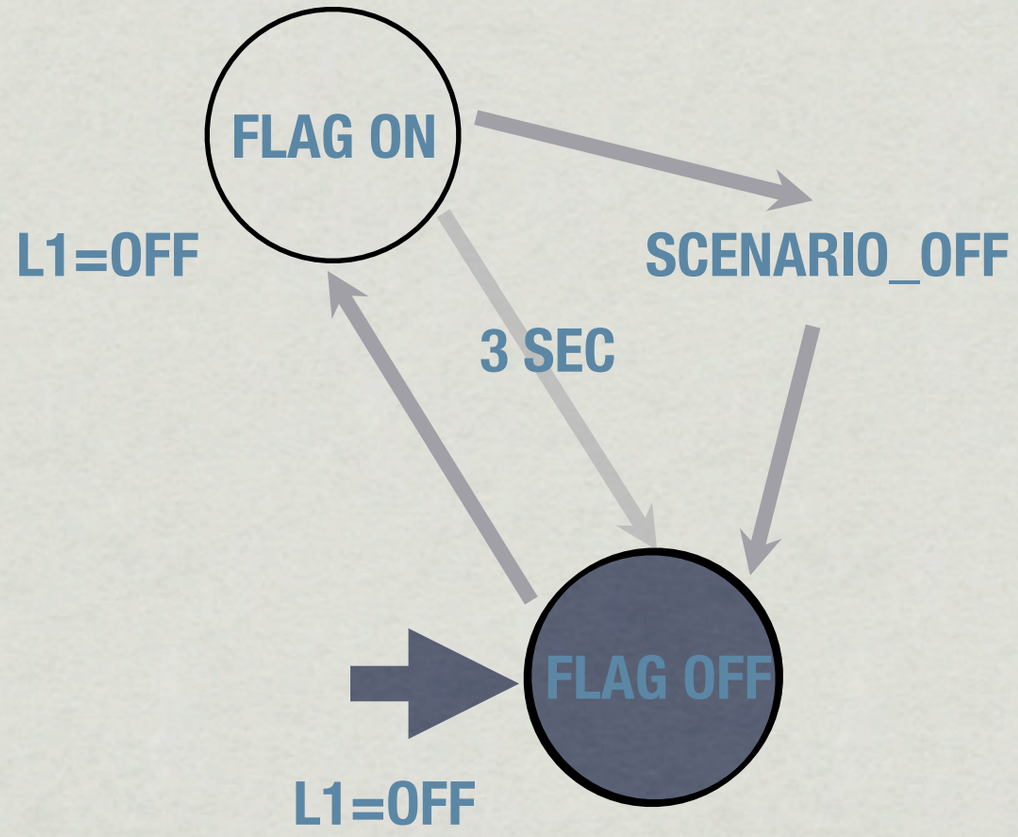
Hidden Commands
Using OFF commands

- When a light is turned OFF twice within 3 sec. a scenario is activated.
- Otherwise the light operates normal.
- Scenarios can be AMB=OFF, GEN=OFF close_house, lower_shutters, ...

Hidden Commands
Using OFF commands

- **FLAG_OFF_ON**: When: L1=OFF
  Only_if: Flag_2=OFF
  Execute: Flag_2=ON,
  Delay=3 sec,
  Flag_2=OFF

- **FLAG_ON_OFF**: When: L1=OFF
  Only_if: Flag_2=ON
  Execute: AMB_1=OFF,
  Flag_2=OFF



Corridor Lighting
Description

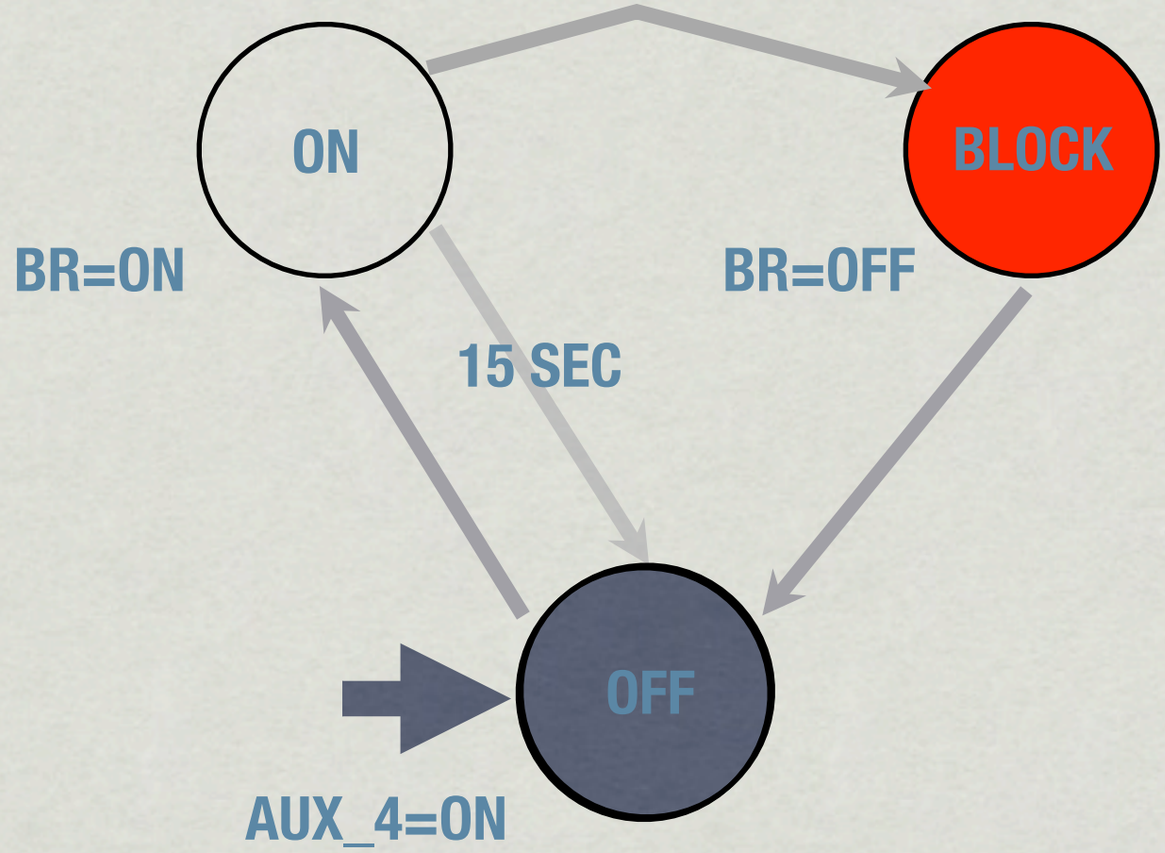
- A sensor turns ON the Corridor light is turned ON 15 sec. Generally a person traverses the Corridor in less than 6 sec.
- The Corridor stays ON until the person leaves the Bathroom.
- The Corridor light is blocked ON if the Bathroom light is turned ON when Hall light is ON.
- The Corridor light goes OFF 15 seconds after Bathroom light is turned OFF.

Corridor Lighting
MH200 Scenarios

- **OFF_ON**: When: Aux_4=ON
  Only_if: Corridor=OFF
  Execute: Corridor=ON,
  D=15 sec,
  Corridor=OFF

- **ON_Block**: When: Bathroom=ON
  Only_if: Corridor=ON
  Execute: Corridor=BLOCK

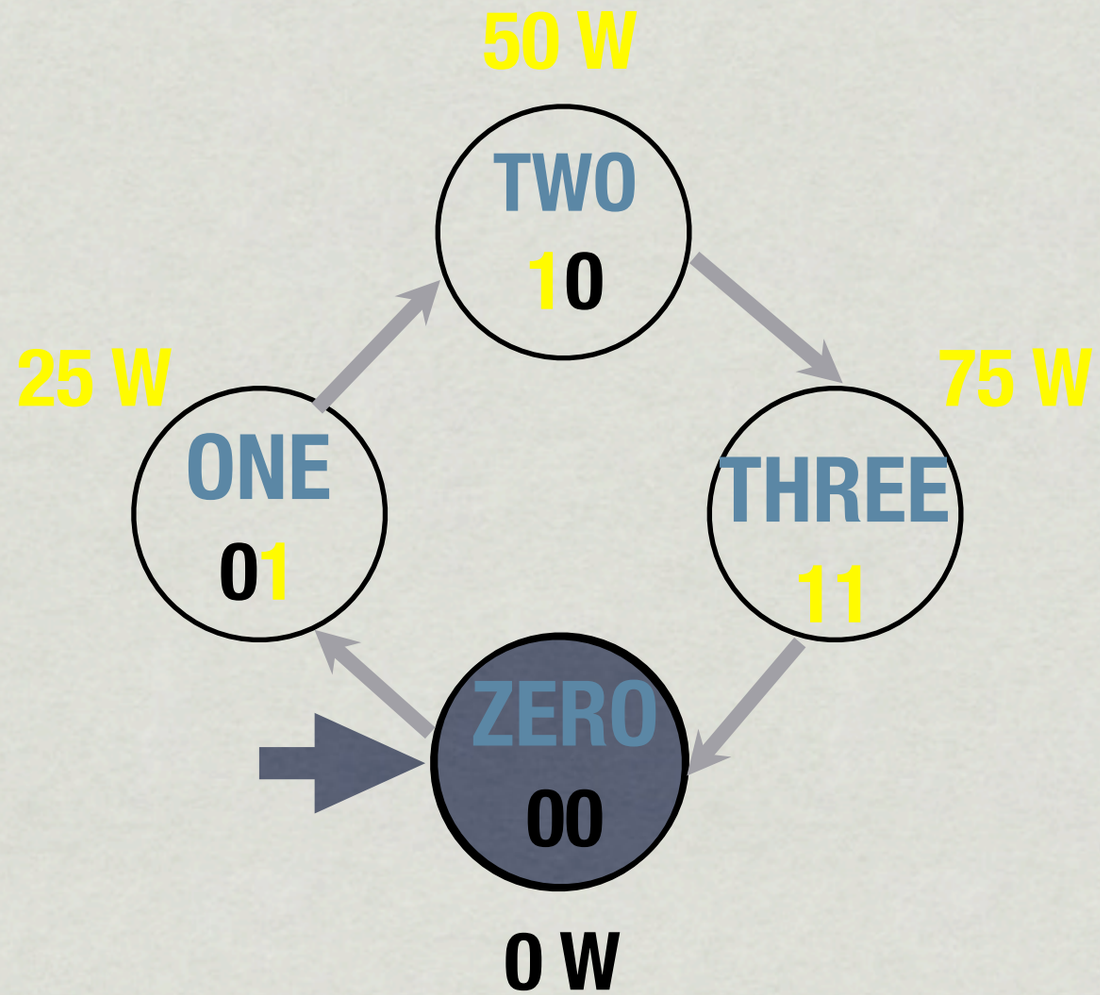
- **Block-OFF:** When: Bathroom=OFF
  Only_if: Bathroom=ON
  Execute: D=15 sec,
  Corridor= UNBLOCK,
  Corridor=OFF



3-Way Lamp
Finite State Machine

- **State_Transition**:
  Inputs,Present State,
  Commands, Next State

- 0 W
  L1=25 W
  L2=50 W
  L1+L2=75 W



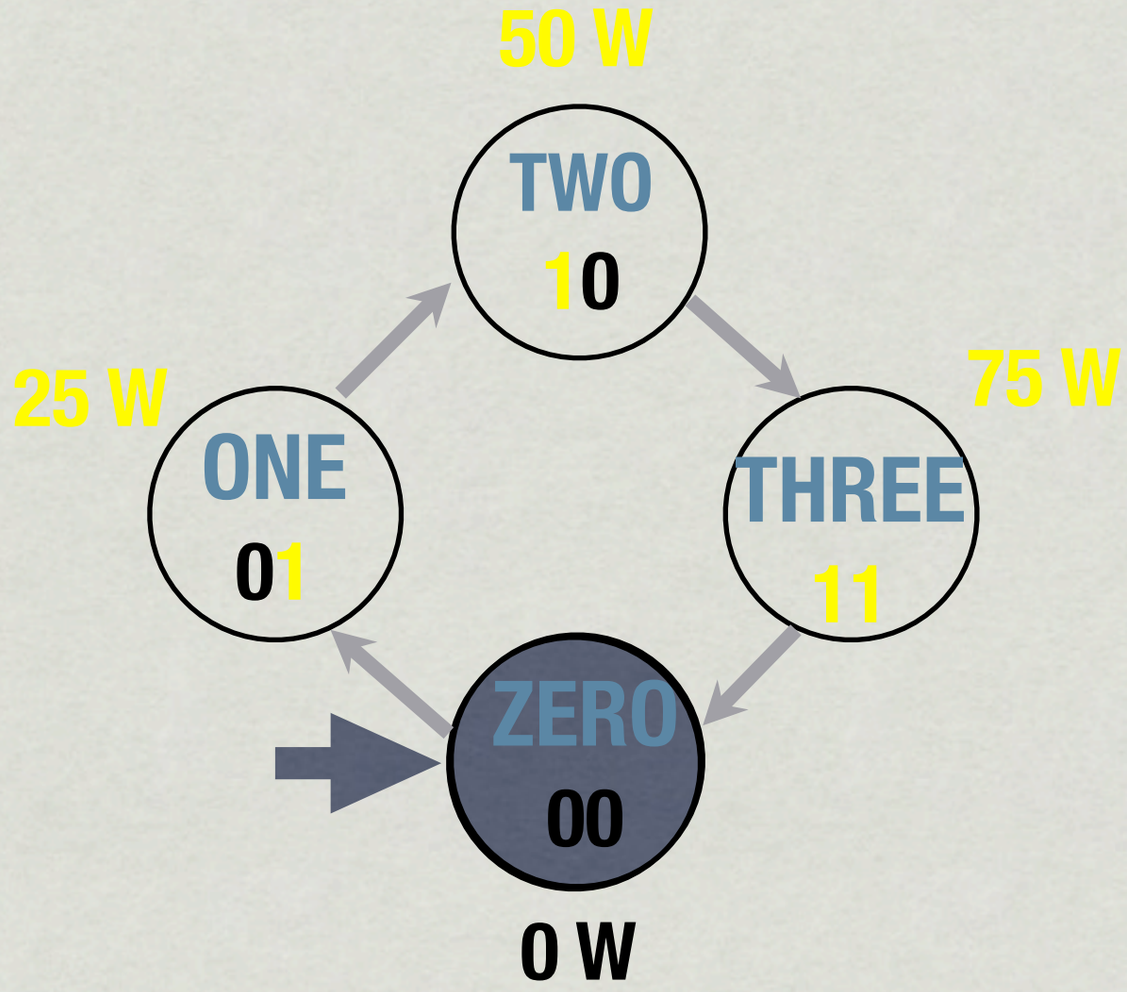
3-Way Lamp
MH200 Scenarios

- **ZERO_ONE:** When click_1=ON
  Only_if: L2=OFF AND L1=OFF
  Execute: L1=ON

- **ONE_TWO:** When click_1=ON
  Only_if: L2=OFF AND L1=ON
  Execute: L2=ON, L1=OFF

- **TWO_THREE:** When click_1=ON
  Only_if: L2=ON AND L1=OFF
  Execute: L1=ON

- **THREE_zero:** When click_1=ON
  Only_if: L2=ON AND L1=ON
  Execute: L2=OFF, L1=OFF



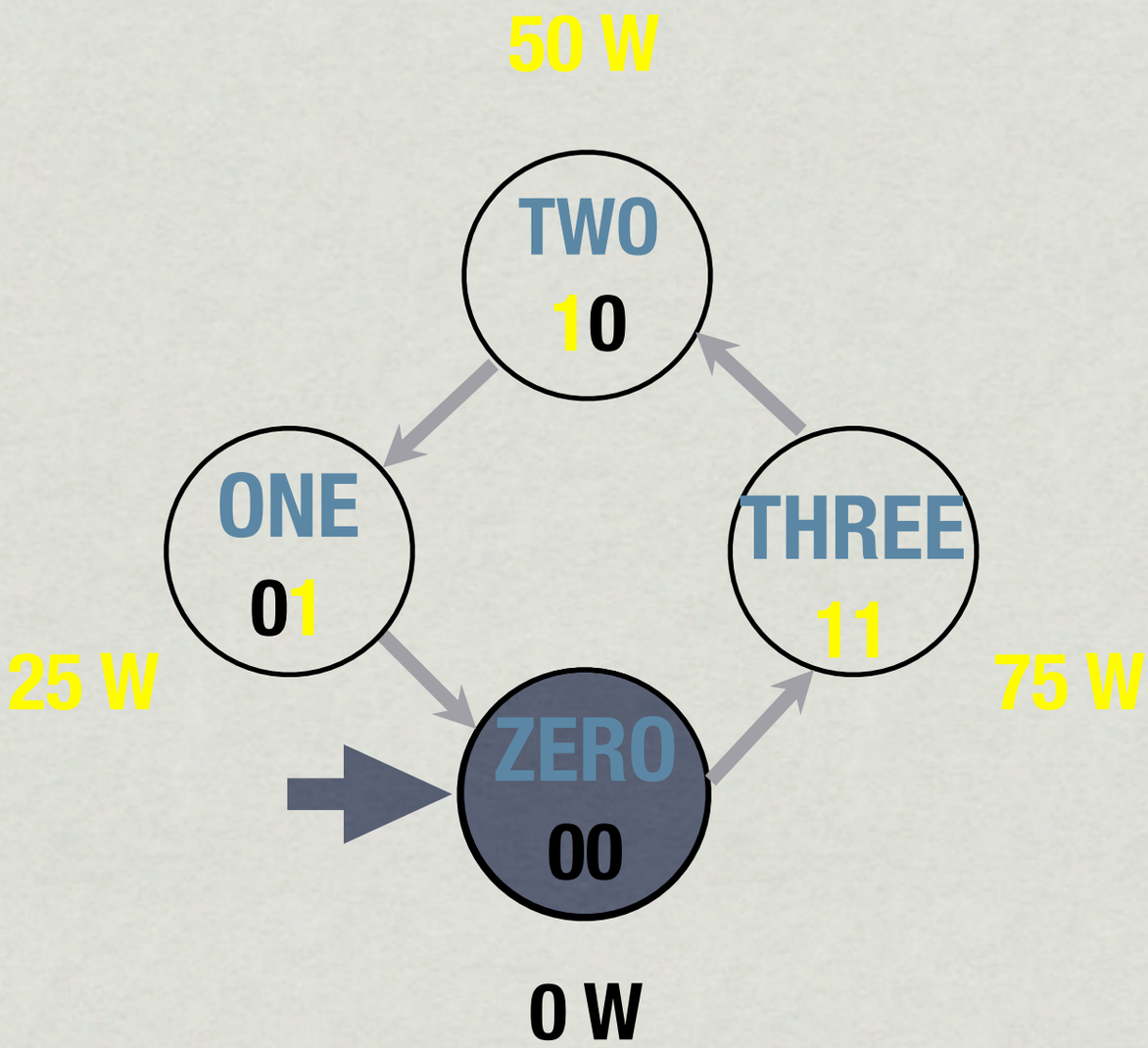
3-Way Lamp (Back)
MH200 Scenarios

- **ZERO-Three:** When click_2=ON
  Only_if L2=OFF AND L1=OFF
  Execute L2=ON, L1=ON

- **Three-TWO:** When click_2=ON
  Only_if L2=ON AND L1=ON
  Execute L2=ON, L1=OFF

- **TWO-ONE:** When click_2=ON
  Only_if L2=ON AND L1=0FF
  Execute L1=ON, L2=OFF

- **one-ZERO:** When click_2=ON
  Only_if L2=OFF AND L1=ON
  Execute L1=OFF, L2=OFF



Home Applications

- Security and Safety
- Comfort (Light, Automation, Video, Sound)
- Climate Control
- Energy Management

MH200 Programs
Up to 300 Scenarios

- Indiana Jones' Traps - A command sequence test
- Simulated Presence - Fibonacci's shift register
- Energy Saving - Warns when there are 5 lights ON simultaneously out of seven lights.

Indiana Jones' Traps
A command sequence test

- A visitor must pass 3 tests in 20 seconds when entering the house.
- **First test:** Turn OFF only one of two ON lights.
- **Second test:** Repeat the First Test a second time.
- **Third Test:** After the same two lights are turned ON again, visitor must guess an additional third light to turn ON.
- If any test fails a Panic call will be set.

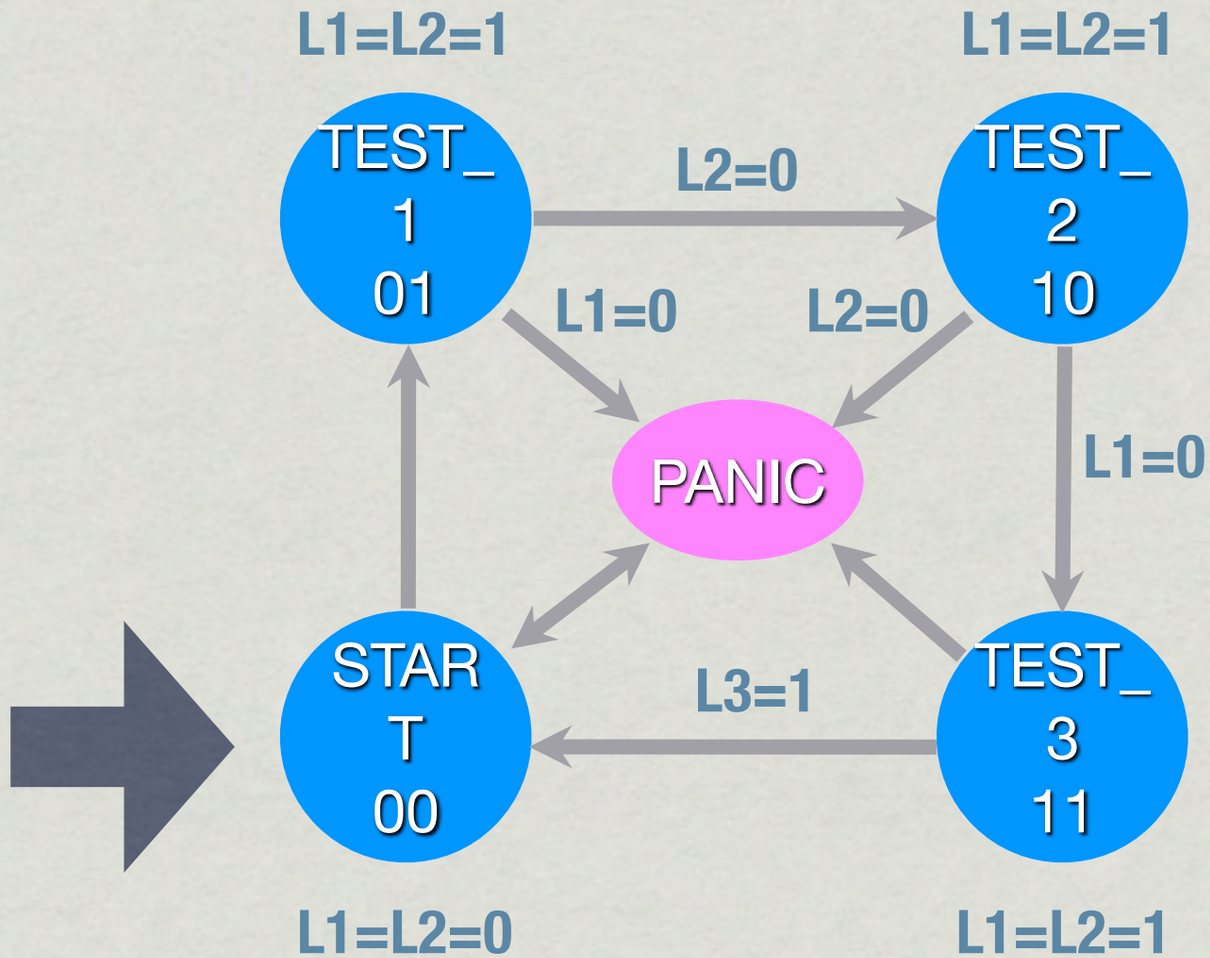
Indiana Jones' Trap

First Test to Enter the Temple

- **START-TEST_1**: When AUX_9=0
  Execute: L1= 1, L2=1,
  C2=0, C1=1,
  D=20 sec, PANIC=1

- **TEST_1-PANIC**: When: L1=0
  Only_if: C2=0 AND C1=1
  Execute: Panic=1, L2=0, C1=0

- **TEST_1-TEST_2**: When L2=0
  Only_if: C2=0 AND C1=1
  Execute: L2=1, C2=1, C1=0

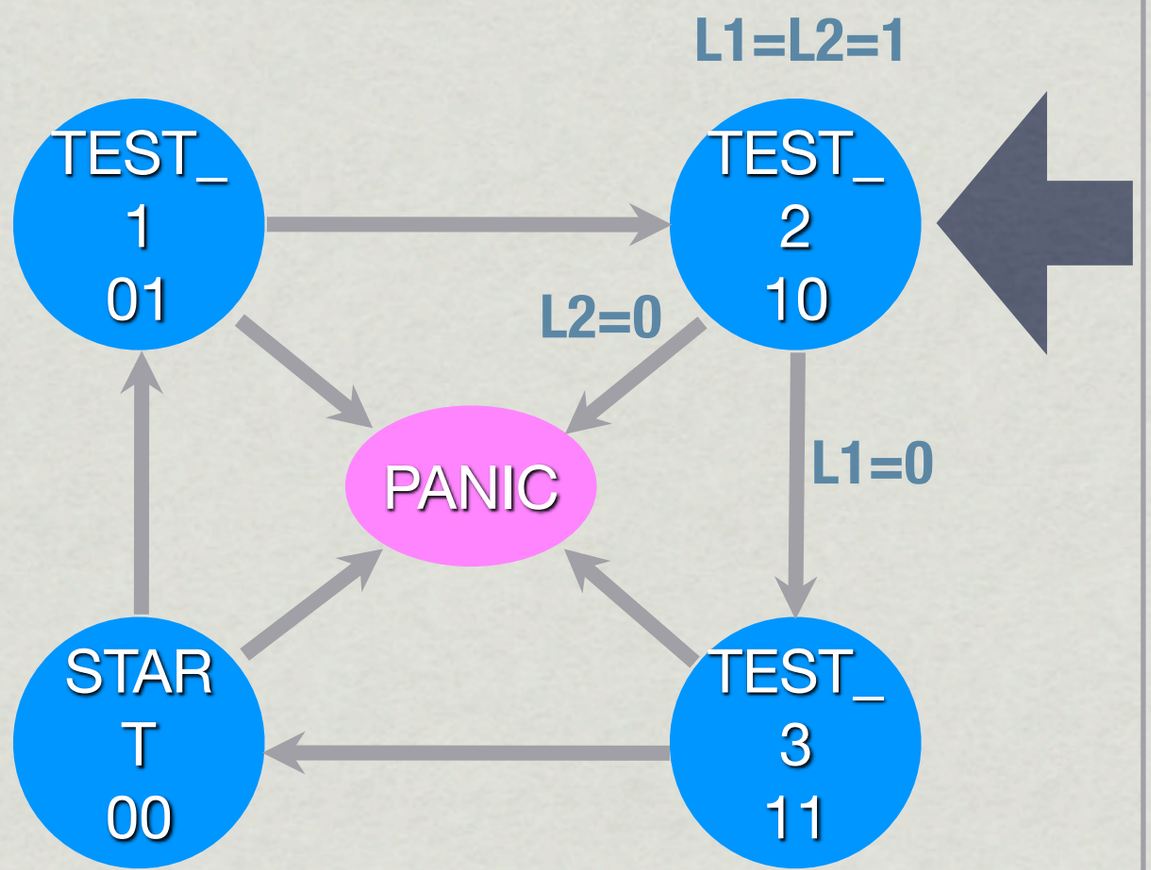


Indiana Jones' Trap

Second Test to Enter the Temple

- **TEST_2-PANIC**: When: L2=0
  Only_if: C2=1 AND C1=0
  Execute: Panic=1,
  L1=0, C2=0

- **TEST_2-TEST_3**: When L1=0
  Only_if: C2=1 AND C1=0
  Execute: L2=1, C1=1

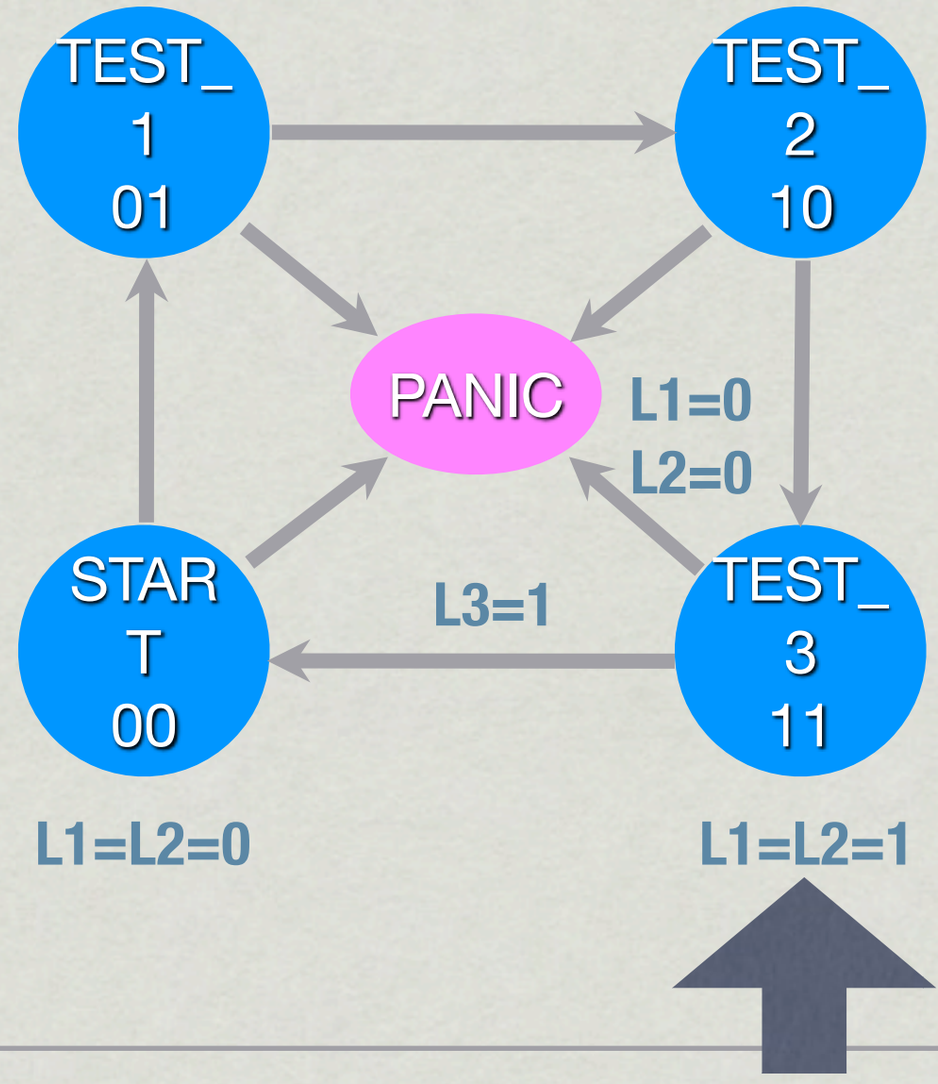


Indiana Jones Trap

Third Test to Enter the Temple

- **TEST_3-PANIC**: When: L2=0, L1=0
  Only_if: C2=1 AND C1=1
  Execute: Panic=1
  L1=0, L2=0
  C2=0, C1=0

- **TEST_2-TEST_3**: When: L3=1
  Only_if: C2=1 AND C1=1
  Execute: PANIC=BLOCK
  L1=0, L2=0
  C2=0, C1=0
  DELAY=20 sec.
  PANIC=UNBLOCK



Simulated Presence Program Fibonacci's Shift Register

- Turn lights ON/OFF pseudo-randomly in a house with four rooms and a center_hall (or stair).
- There are 15 different combinations.
- The combination of lights ON changes every time the center hall or stair lights are turned ON.
- The program stops when all lights are OFF.
- The program starts if any one of the four lights is turned ON.

Fibonacci's Shift Register
15 scenarios

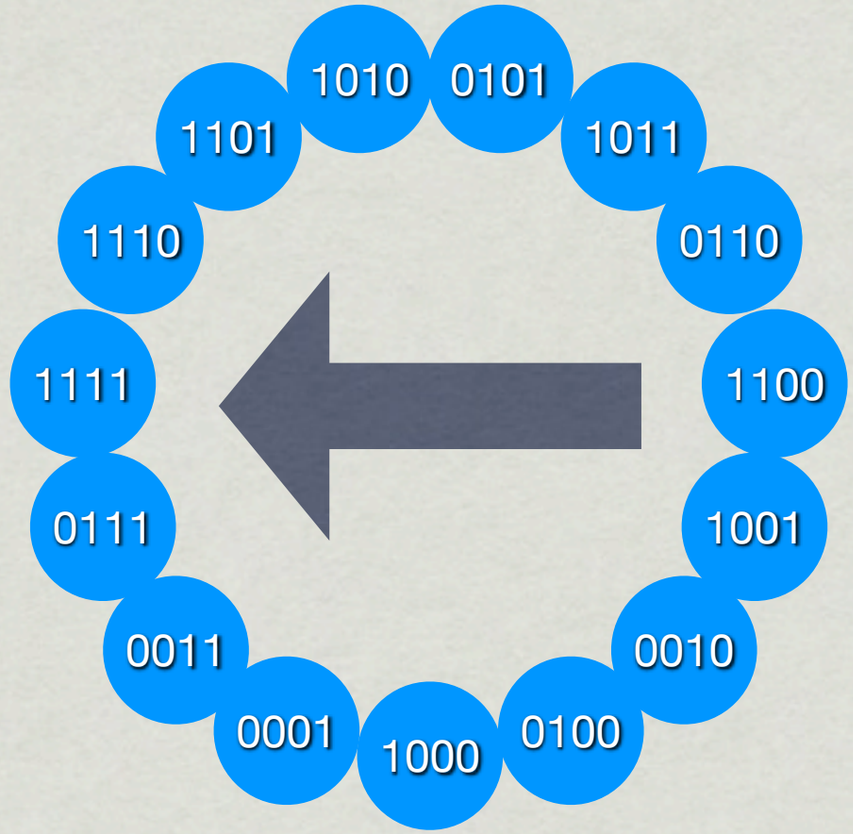
- 1111,0111,0011,0001,1000,0100,
  0010,1001,1100,0110,1011,0101,
  1010,1101,1110

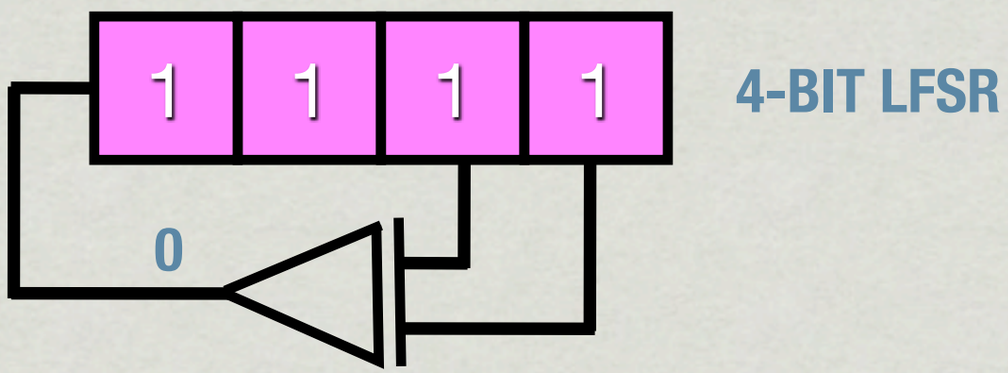
- All scenarios with "repeat action" checked

- **ONE**: Only_if: L1=1 & L2=1 & L3=1& L4=1
  Execute: random_delay, L1=0

- **TWO**: Only_if L1=0 & L2=1 & L3=1 & L4=1
  Execute: random_delay, L2=0

- **FIFTEEN**: Only_if L1=1 & L2=1 & L3=1 & L4=0
  Execute: random_delay, L4=1





Energy Saving Warning

Signals when 5 out of 7 lights are ON.

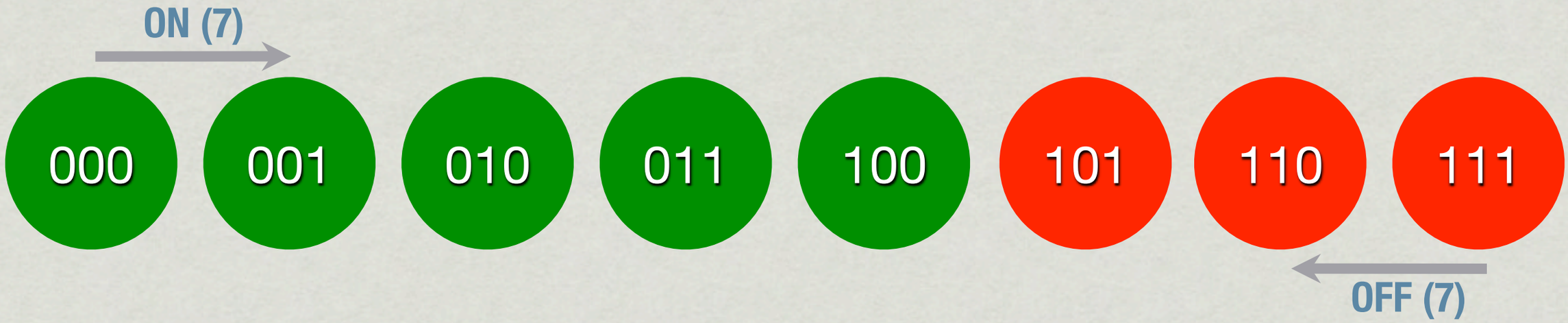
- Set a limit to the number of lights you can have ON simultaneously.
- When the limit is reached a warning light turns ON.
- Option - When the limit is reached all lights are turned OFF.
- It can be solved in two ways: first) adding 3 switches to count 0 to 7, and second) listing all states above the warning transition and listing all the states below the warning transition.

Energy Saving Warning
One) with 3-bit counters

- There are seven states named zero to seven
- Initially all lights are OFF and counter is zero
- Every time a light goes ON there is a transitions to a higher state. 7 up-transitions.
- Every time a light goes OFF there is transition to a lower state. 7 down-transitions
- A warning light is turned on counter equal to five, six, and seven. (101,110,111)

Energy Saving Warning

One) 3-bits counter C3,C2,C1



COUNT_ON_0_1: When: L1=1, L2=1, L3=1, L4=1, L5=1, L6=1, L7=1
Only_if: C3=0 AND C2=0 AND C1=0
Execute: C1=1

COUNT_ON_4_5: When: L1=1, L2=1, L3=1, L4=1, L5=1, L6=1, L7=1
Only_if: C3=1 AND C2=0 AND C1=0
Execute: C1=1, **Warning=1**
--- (7 up_count transitions)
COUNT_OFF_5_4: When: L1=0, L2=0, L3=0, L4=0, L5=0, L6=0, L7=0
Only_if: C3=1 AND C2=0 AND C1=1
Execute: C1=0, **Warning=0**
--- (7 down_count transitions)

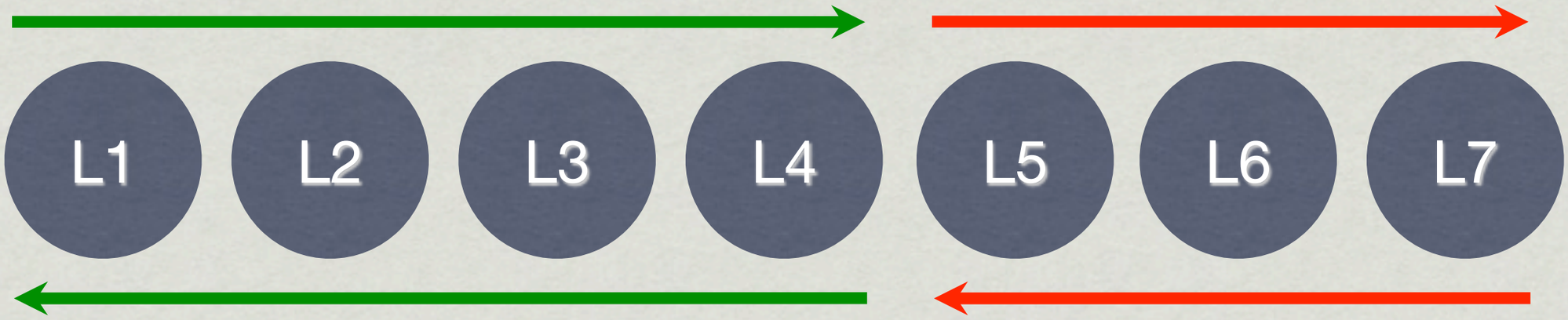
Energy Saving Warning

Two) all states near the warning transition

- 1 state with all 7-lights ON (L1=L2=L3=L4=L5=L6=L7=ON) **(warning)**
- 7 states with 1-light OFF (0111111, 1011111, ... **(warning)**
- 21 states with 2-lights OFF (0011111, 0101111, ...) **(warning)**
- 35 states with 3-lights OFF (0001111,0010111, ...) **(no warnings)**
- **Warning light goes ON** when a light is turned ON in one of the 35 states
- **Warning lights goes OFF** when a light is turned OFF in one of the 21 States
- A total of 56 scenarios
- COMBINATIONS OF SEVEN = 1,7,21,35,21,7,1

Energy Saving Warning

Two) All states near the warning transition



- ---------- (35 states with 4 lights ON)

  LIGHT_ON_1111000: When: L5=1, L6=1, L3=1
  Only_if: L1=1 AND L2=1 AND L3=1 AND L4=1 AND L5=0 AND L6=0 AND L7=0
  Execute: **Warning=1**

- ---------- (21 states with 2 lights OFF)

  LIGHT_OFF_1111100: When: L1=0, L2=0, L3=0, L4=0, L5=0)
  Only_if: L1=1 AND L2=1 AND L3=1 AND L4=1 AND L5=1 AND L6=0 AND L7=0
  Execute: **Warning=0**

Energy Saving Warning

Comparison of Two Methods

	Method One Using Hardware	Method Two Using Scenarios
Hardware	3 switches	0
Software	14 scenarios	56 scenarios
Scenarios with same Start Event	7 scenarios	5 scenarios

Summary
MH200 Tutorial

- The MH200 can implement a Finite State Machine to execute simple computer programs with many states and instructions.
- State transitions are equivalent to scenarios.
- Adding hardware (switches) may lower the number of scenarios required.
- The MH200 can add-on to the home a behavior in many creative ways (Indiana Jones' Traps, Hidden Commands, Energy Saving, Safety, and Comfort).

Links

- http://gallery.me.com/andres.celina#gallery
- e-mail: aalbanese@yahoo.com
- http://www.myopen-bticino.it/