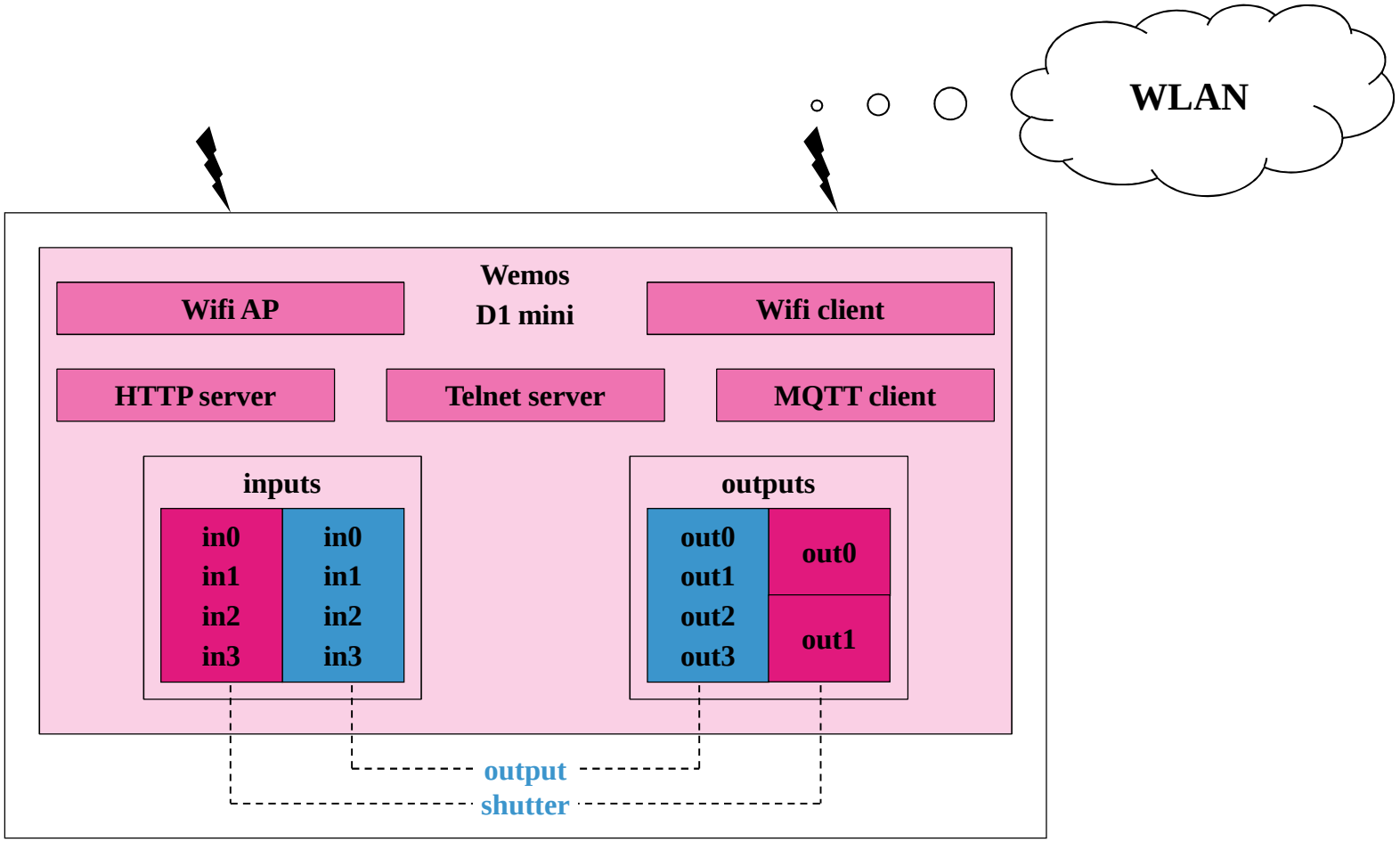
# wiControl

Jo Simons (simonjo@telenet.be)

# Project Target

- Build simple module to control lights and shutters
- Must be small enough to retrofit an existing 220V electrical system (unterputz)
- Able to work standalone
- Or work centralized but then in a wireless fashion
- Upgradable over-the-air
- Remote diagnostic and test functionality
- Secure when connected wireless
- Scalable software framework for different configurations
- Low cost

# Module Structure (1/5)



# Module Structure (2/5)

- Makes use of ESP8266 module on Wemos D1 mini subassembly
  - Easy due to built-in USB interface and 5V-to-3V3 convertor
  - Doesn't require implicit boardspace due to it's leveraged mounting
  - Has Wifi client to connect to remote access point
    - Not required if you want to operate the module in standalone mode
    - Else configure SSID + security method + secret
  - Has Wifi AP accessible @ 192.168.4.1
    - Can be secured with password and/or turned off
    - If Wifi client is disabled or fails, the Wifi AP will be turned on at module boot
  - Configuration/setup can be done via HTTP
  - 9 GPIO's used

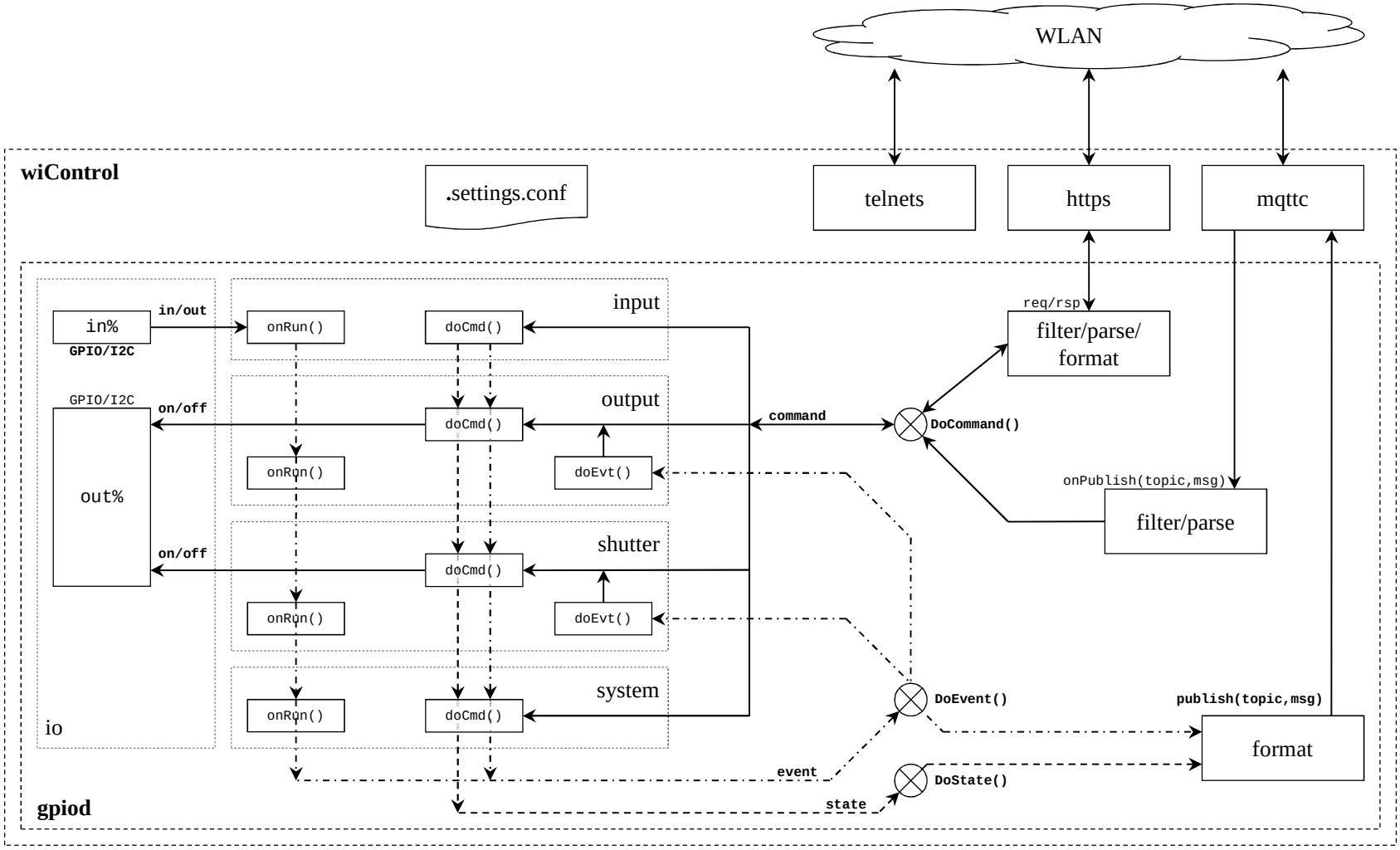
- Controllable objects included are:
  - 4 low-voltage inputs supporting normal-open push-buttons that connect to ground when pressed
  - 4 high-voltage (220V) SSR outputs upto 1A

- System LED
  - Helps to locate a module

- 3D printed protective cover
  - Against accidental touching 220V contacts
  - For mounting in installation box
  - For attaching Niko blind frontplate

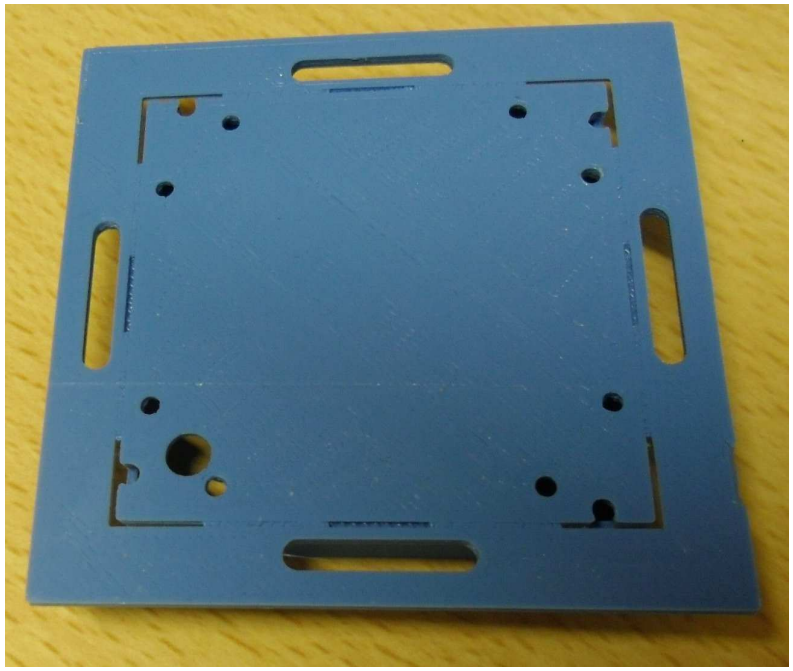
# Module Structure (3/5)

- Functional Block Diagram



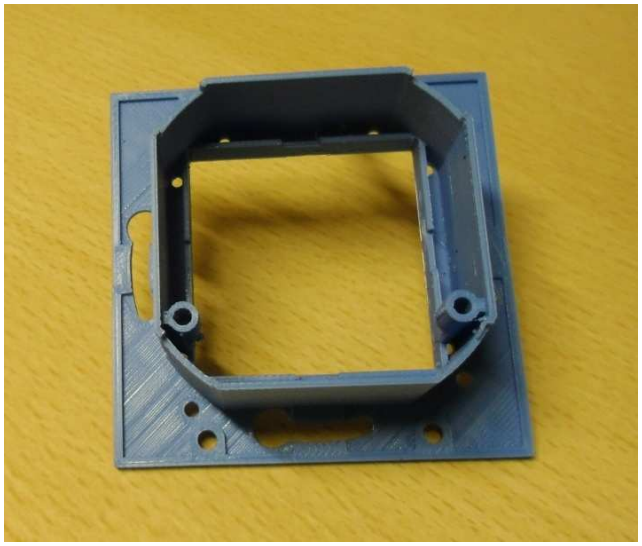
# Module Structure (4/5)

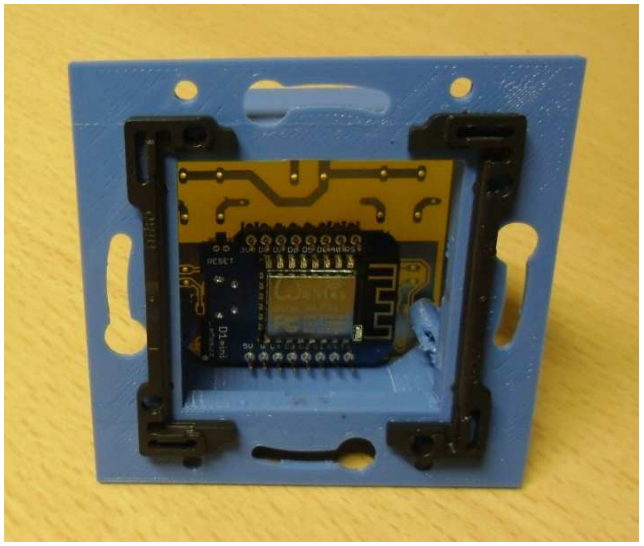
- PCB edition 01

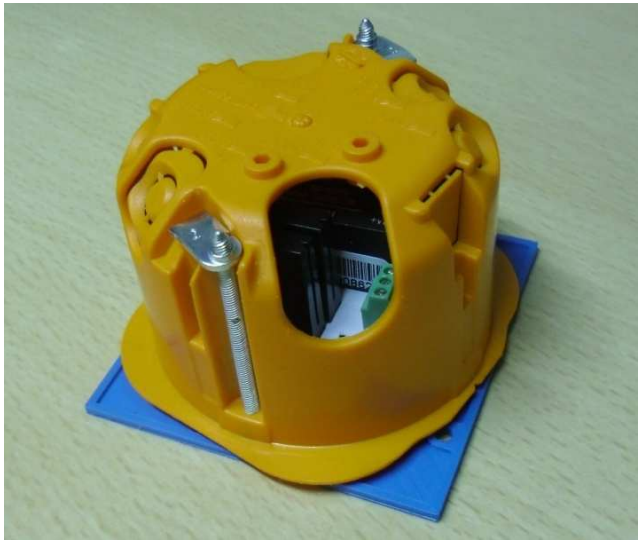



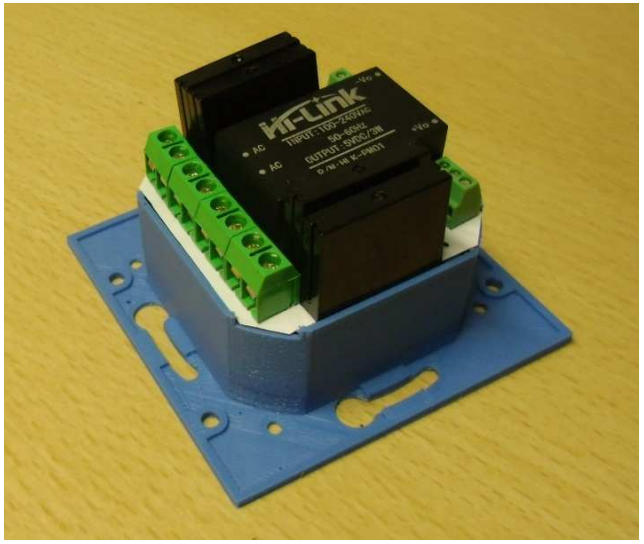
# Module Structure (5/5)

- PCB edition 02









# Features (1/3)

- Supported emulations:
  - Output
    - drives 4 individual outputs
    - dedicated set of commands: off, on, toggle, ontimed, …
  - Shutter
    - combines 2x2 outputs to drive 2 shutter/jalousie
    - dedicated set of commands: stop, up, down, …

- Supported modes:
  - Standalone
    - inputs control outputs locally
    - requires no extra infrastructure to operate
    - emulator has fixed logic onboard to link input events to output commands
  - MQTT
    - connects to MQTT broker, so extra infrastructure is required
    - allows remote operation via MQTT protocol
  - Both
    - combines standalone and MQTT modes

- Safe mode:
  - To be defined

# Features (2/3)

- MQTT Client
  - Not possible if there is no Wifi connection
  - Not required if you want to operate the module in standalone mode
  - Else configure broker IP address/port, optional username/password, optional <node-id> override
    - default <node-id> is module chipid, i.e. esp12345
    - structured <node-id> can be <location>/<floor>/<number>
  - Requires an MQTT broker to be operational (i.e. Mosquitto on Synology NAS)
  - Uses a request only model
  - Is low on memory overhead for the system
  - Also used for automatic testing
  - Once connected to broker
    - the module will subscribe to command topic <node-id>/cmd/#
    - the module will publish it's topology and version <node-id>/boo/hw=<topo>, <node-id>/boo/<sw>=<version>
  - In general
    - incoming publish messages will be handled by emulator <node-id>/cmd/<object>=<cmd> *[.<parm>]
    - object generated events are published to broker <node-id>/evt/<object>=<event>
    - object status requests are published to broker <node-id>/sta/<object>=<state>In general
  - Event/status formats
    - can be textual (default) i.e. myHouse/3/0/out0=on
    - can be numerical i.e. myHouse/3/0/out0=1

# Features (3/3)

- HTTP Server
  - Not possible if there is no Wifi connection
  - Uses a request-response model
  - Has more overhead on memory for the system, can drain the system
  - Main task is to configure the module with a browser
  - Also allows to send commands to the controllable objects using structured URL
    - URL: http://<ip-address>/ats?ccmd=<object>.<cmd> *[.<parm>] [; <object>.<cmd> *[.<parm>]]
    - command results are sent in HTTP response in terse mode
    - also used for automatic testing
- Telnet Server
  - Not possible if there is no Wifi connection
  - Mainly used for remote diagnostic/support

# Terminology

- The module contains controllable objects
  - in0..in3
  - out0..out3 (or out0..out1 for shutter emulation)

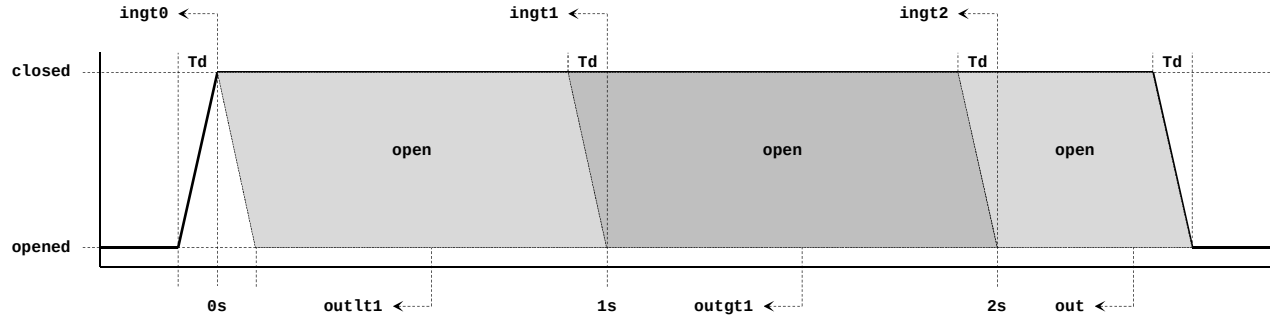
- Objects accept commands
  - That instructs it to do something and update it's state
  - MQTT <node-id>/cmd/<object>=<cmd> *[.<parm>] *[; <cmd> *[.<parm>]]
  - HTTP http://<ip-address>/ats?ccmd=<object>.<cmd> *[.<parm>] *[; <object>.<cmd> *[.<parm>]]
    - returns current state in numerical terse format, i.e. '0', '1', '2'
    - response of multiple commands will be concatinated, i.e. '0;1'

- When an object changes state
  - It will raise an event which will be distributed depending on configuration
  - To output objects as per emulation
  - To MQTT <node-id>/evt/<object>=<event>
  - Not to HTTP !!!

- A status command will report an objects state regardless of change
  - To MQTT <node-id>/sta/<object>=<state>
  - To HTTP http://<ip-address>/ats?ccmd=<object>.status
    - returns current state in numerical terse format, i.e. '0', '1', '2'
    - response of multiple commands will be concatinated, i.e. '0;1'

# Inputs (1/2)

- Input changes are validated with an adjustable decounce period (Td), default=100ms
- Validated changes are fed into a time based state machine to generate events




- Supported events
  - ingt0 (2) input was initially closed
  - outlt1 (3) input was opened after less than 1 second
  - ingt1 (4) input was closed for more than 1 second
  - outgt1 (5) input was opened after more than 1 but less than 2 seconds
  - ingt2 (6) input was closed for more than 2 seconds
  - out (7) input was opened after more than 2 seconds

# Inputs (2/2)

- Supported commands
  - status — return current state of input, 0=out|1=in
  - ingt0 — simulate input closed initially
  - outlt1 — simulate input opened after less than 1 second
  - ingt1 — simulate input closed for more than 1 second
  - outgt1 — simulate input opened after more than 1 but less than 2 seconds
  - ingt2 — simulate input closed for more than 2 seconds
  - out — simulate input opened after more than 2 seconds
  - debounce [.<time>] — get or set debounce time (Td)

- Parameters
  - time — 0-3600000 ms

# Outputs – Output Emulation (1/2)

- Supported commands
  - status — return current status of output, 0=off|1=on
  - on — turn output on
  - off — turn output off
  - onlocked — turn output on and lock it
  - offlocked — turn output off and lock it
  - toggle — toggle output between off and on
  - unlock — unlock output, all commands will be executed after this
  - ondelayed.<delay> — turn output on after <delay> seconds
  - offdelayed.<delay> — turn output off after <delay> seconds
  - ontimed.<run> — turn output on during <run> seconds, then back off
  - offtimed.<run> — turn output off during <run> seconds, then back on
  - toggledelayed.<delay> — toggle output after <delay> seconds, lock it till command done
  - toggletimed.<run> — toggle output for <run> seconds, lock it till command done
  - lock — lock output, no command exept unlock will be executed
  - locktimed.<run> — lock output for <run> seconds
  - timeset.<run> — set running time again to <run> seconds
  - timeadd.<run> — add <run> seconds to running time
  - timeabort — abort running time without unlocking or final action, will leave output as-is !!!
  - blink — alternate output between on and off with a 1s cadence, all outputs are synched
  - blinktimed.<run> — blink output for <run> seconds
  - emultime <def-run> — set default run time for standalone emulation

# Outputs – Output Emulation (2/2)

- Supported events
  - off (0) output was turned off
  - on (1) output was turned on

- Parameters
  - delay 1-3600 seconds
  - run, def-run 1-3600 seconds

# Outputs – Shutter Emulation (1/2)

- Uses the concept of priority level (0=highest, 5=lowest) and lock (0=no-lock, 1=lock)
  - When a command of a given level sets the lock, any lower level commands are refused
  - Useful for protecting extending sunblinds against strong winds or rain with a sensor locking the blinds in prio 0 or 1
  - Mask versus level: a priority mask has a bit per level, level 0=0x01, 1=0x02, 2=0x04, 3=0x08, 4=0x10, 5=0x20

- Supported commands

| | |
|---|---|
| – status | return current status of shutter, 0=stop\|1=up\|2=down |
| – stop.<level> | stop shutter |
| – toggleup.<level>.<lock>.<run> | toggle between stop and up for given run time |
| – toggledown.<level>.<lock>.<run> | toggle between stop and down for given run time |
| – up.<level>.<lock>.<run> | move shutter up for given run time |
| – down.<level>.<lock>.<run> | move shutter down for given run time |
| – tipup.<level>.<lock>.<run> | short move up to tip the lamello's on a jalousie |
| – tipdown.<level>.<lock>.<run> | short move down to tip the lamello's on a jalousie |
| – priolock.<mask> | lock given levels, all non-locked levels remain operational |
| – priounlock.<mask> | unlock given levels |
| – prioset.<mask> | set given levels, only set level and higher levels remain operational |
| – prioreset.<mask> | reset given levels |
| – delayedup.<level>.<lock>.<delay>.<run> | move shutter up for given run time after delay |
| – delayeddown.<level>.<lock>.<delay>.<run> | move shutter down for given run time after delay |
| – tipdelayedup.<level>.<lock>.<delay>.<run>.<tip> | move shutter up for given run time after delay, do reverse tip move |
| – tipdelayeddown.<level>.<lock>.<delay>.<run>.<tip> | move shutter down for given run time after delay, do reverse tip move |
| – emultime <def-run> | set default run time for standalone operation |

# Outputs – Shutter Emulation (2/2)

- Supported Events
  - upon (1) shutter started moving up
  - downon (2) shutter started moving down
  - upoff (3) shutter stopped moving up
  - downoff (4) shutter stopped moving down

- Parameters
  - <level> 0 (highest) – 5 (lowest)
  - <lock> 0 (no lock) – 1 (lock)
  - <delay> 0-3600 seconds
  - <run>, <def-run> 1-3600 seconds
  - <tip> 0-3600 1/10$^{th}$ seconds
  - <mask> bit per level, 0=0x01, 1=0x02, 2=0x04, 3=0x08, 4=0x10, 5=0x20

# System

- Supported commands
  - ping — will blink the LED for about 10 seconds
  - version — get current sw version
  - memory — get current memory statistics
  - restart.ack — restart module
  - loglevel [.<level>] — get or set loglevel where level can be decimal or hexadecimal
  - emul [.<emul>] — get or set emulation, 1=output|2=shutter
  - mode [.<mode>] — get or set mode, 1=standalone|2=MQTT|3=both
  - efmt [.<format>] — get or set MQTT event formatting, 1=numerical|2=textual
  - lock [.<lock>] — get or set system commands lock state, when locked only get cmds, ping and lock will work

- Supported events
  - version — 4.x.y.z
  - memory — <bytes> in decimal format
  - restart — 1
  - loglevel — <loglevel> in decimal format
  - emul — 1-2 or output|shutter for efmt=numerical/textual respectively
  - mode — 1-3 or standalone|mqtt|both for efmt=numerical/textual respectively
  - efmt — 1 or textual for efmt=numerical/textual respectively
  - lock — 0-1 or off|on for efmt=numerical/textual respectively

# Standalone Mode

- Allows module to work without further infrastructure by using input events to control outputs

- Emulation=output
  - in%.outlt1 -> out%.toggle
  - in%.ingt2 -> out%.blink(if <def-run> == 0)
  - in%.ingt2 -> out%.blinktimed <def-run> (if <def-run> != 0)

- Emulation=shutter
  - in0.ingt0/in1.ingt0 -> out0.stop
  - in0.ingt1 -> out0.up. <def-run>
  - in1.ingt1 -> out0.down. <def-run>
  - in2.ingt0/in3.ingt0 -> out1.stop
  - in2.ingt1 -> out1.up. <def-run>
  - in3.ingt1 -> out1.down. <def-run>

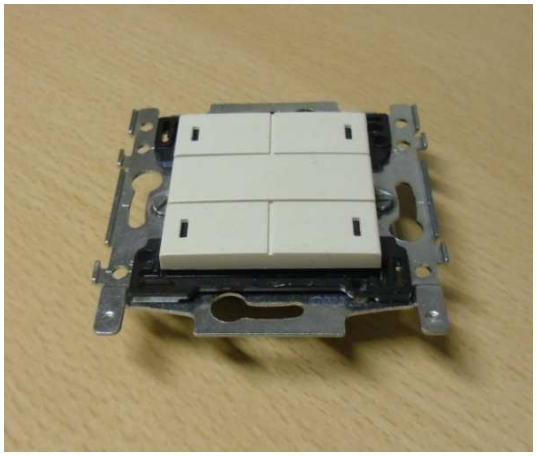
# Outstanding

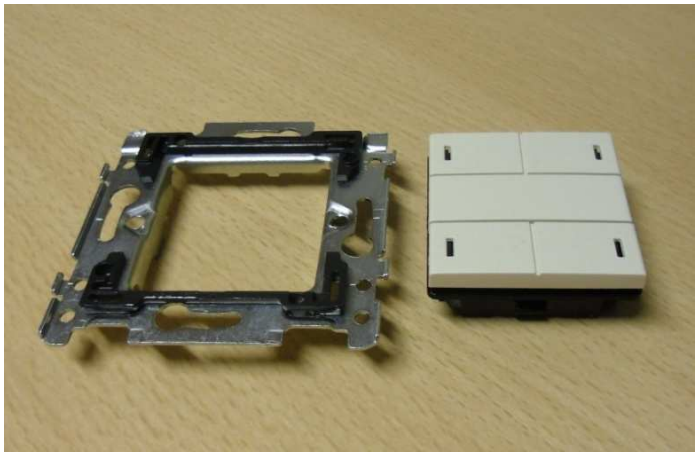
- Additional timer or clock objects
- Compact mode
  - reduce required pushbuttons
  - i.e. outlt1 -> out0.toggle, ingt2 -> out1.toggle
- Variants
  - DIN rail module with 8-16 outputs…
- Telnet command interface
- Enhance shutter logic
  - introduce clocks
  - couple to internet dawn/sunset markers
- Check overall handling of Wifi / broker connection vs mode

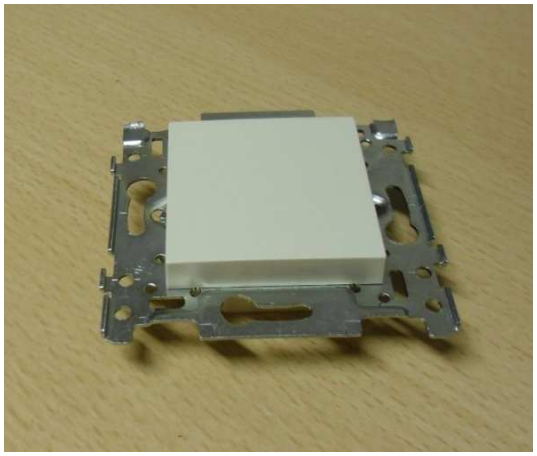
# Backup slides

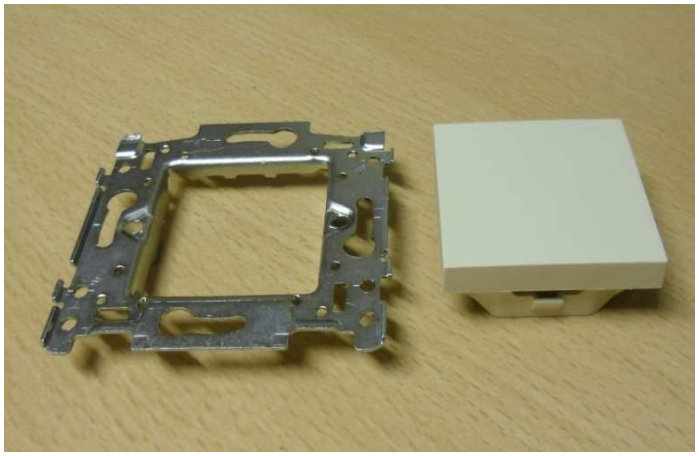
Jo Simons (icontrol@telenet.be)

# Niko Integration: Disassembly Blindplate/4-Fold Button

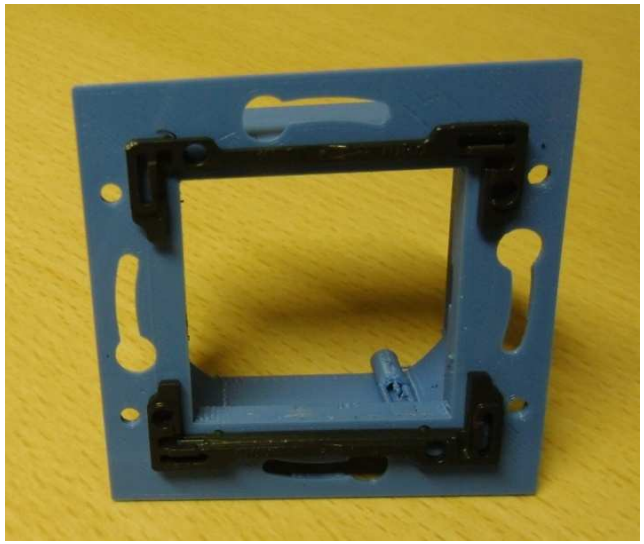








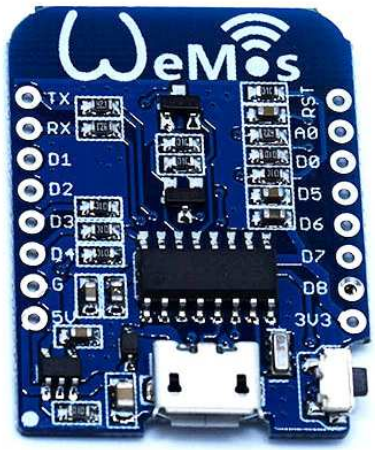
# Niko Integration: Assembly Blindplate/4-Fold Button



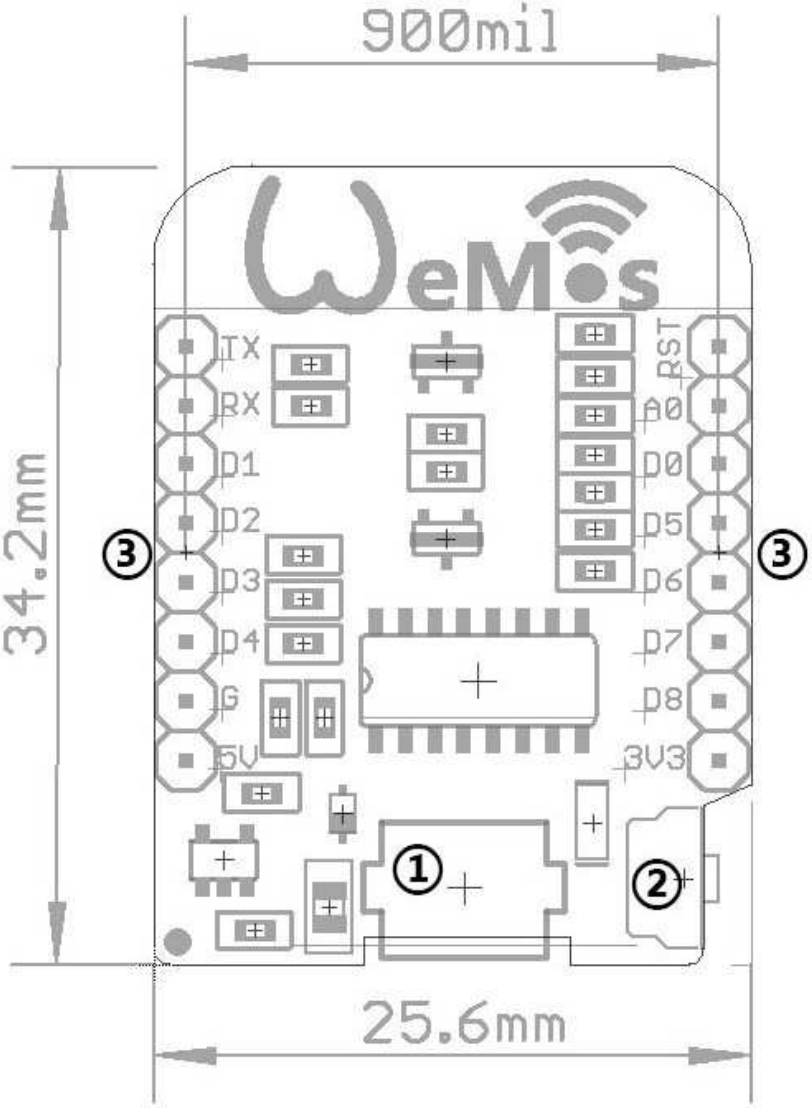

# Wemos D1 Mini (1/2)

- ESP8266 based


TOP



BOTTOM



# Wemos D1 Mini (2/2)