Interacting with Tesla vehicles locally over BLE using ESPHome

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https://github.com/yoziru/esphome-tesla-ble

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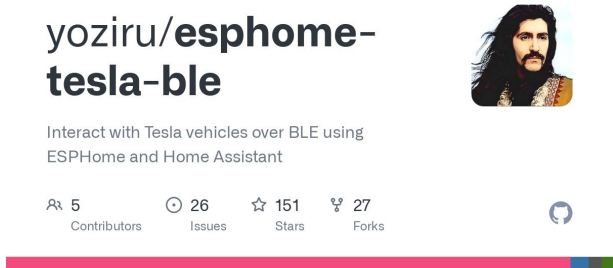


Dynamic charging with Home Assistant

Solar excess charging

Battery boost

Load balancing

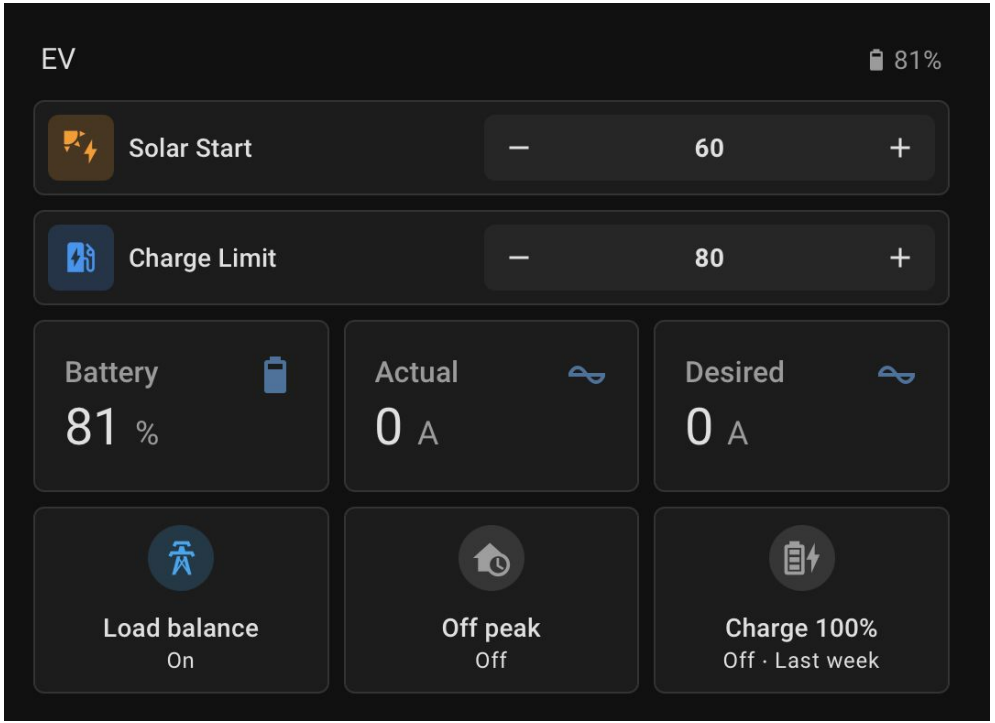
Overload protection

Off peak charging

Capacity tariff limits

Update every 10 seconds

= up to 8.640 vehicle commands per day

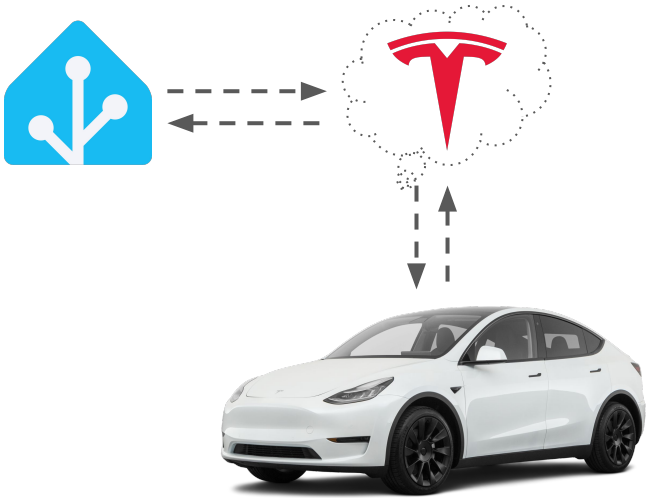


Relying on cloud = bad

Tesla API rate limits introduced

8.640 > 50 requests / day

Scrambled for solutions



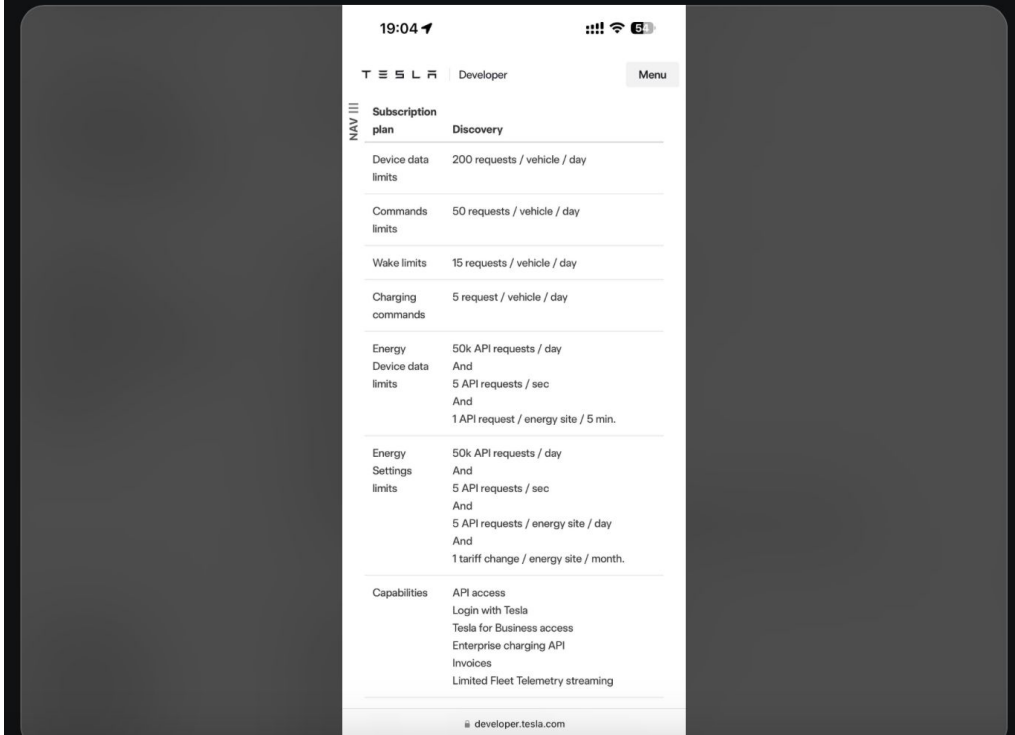
r/homeassistant · 7 mo. ago
ezfrag2016

Tesla Fleet API request limits - how are you coping?

I recently had to switch to using the Fleet API since the Tesla integration stopped sending commands. Unfortunately I'm struggling with the API request limits.

I was using HA to vary the charge amps every minute during daytime charging to use excess solar energy but since we only have 50 commands per day this is now screwed.

How have you guys changed your Tesla automations to cope?



Could it be done locally? No internet, no rate limits

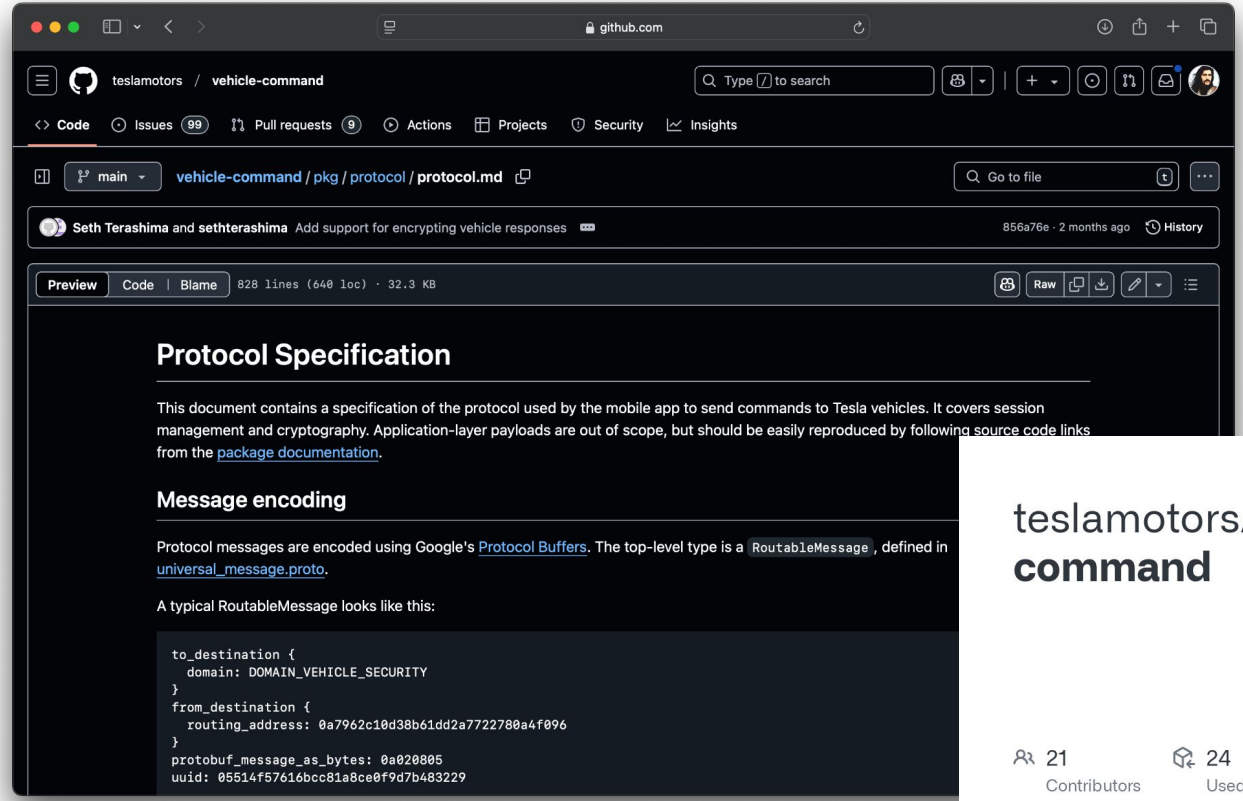
Why ESP32?

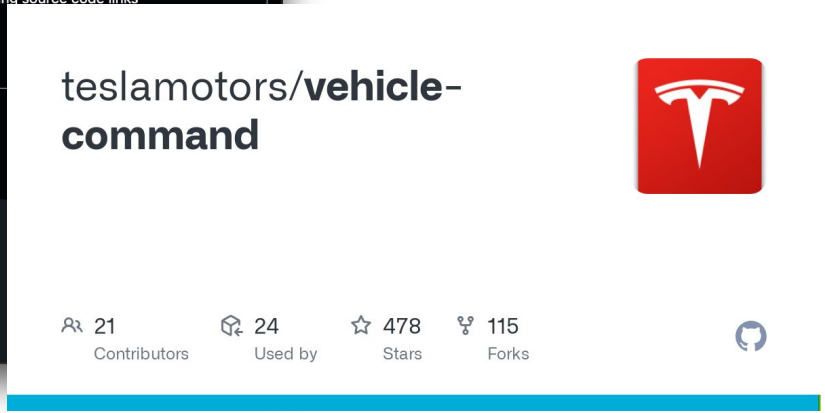
- Low cost, low power
- Small = easy to place close to car
- BLE built-in

Challenge:

- Limited 2MB flash, 512kB SRAM
- Low power: single core 160 Mhz
- ESPHome with custom C++

Tesla OSS: vehicle-command (Golang)





Tesla Vehicle Protocol: 2 subsystems

VCSEC (Vehicle Security)

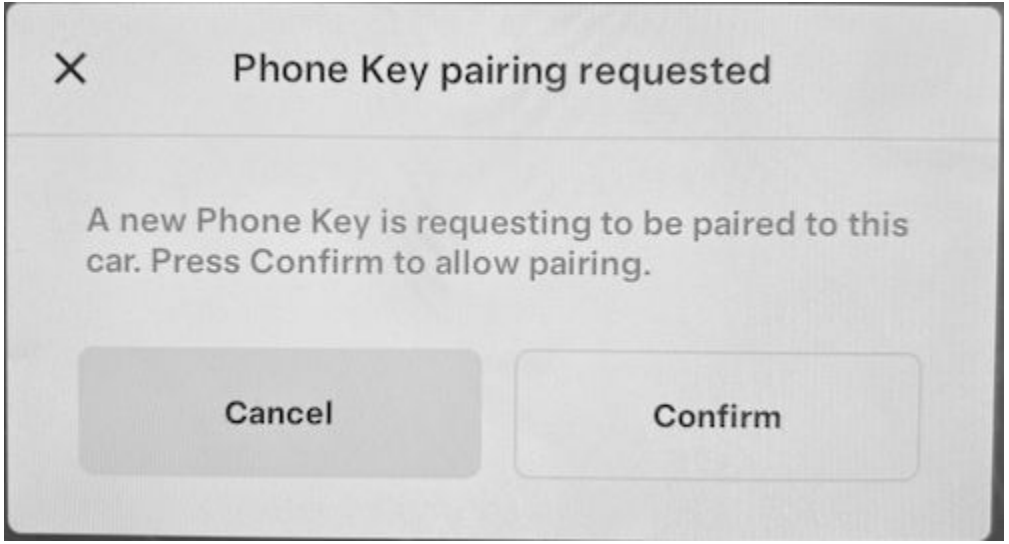
- Controls locks, remote start, trunk
- Request simple data about vehicle state: lock state, sleep status, user presence
- Always listening over BLE

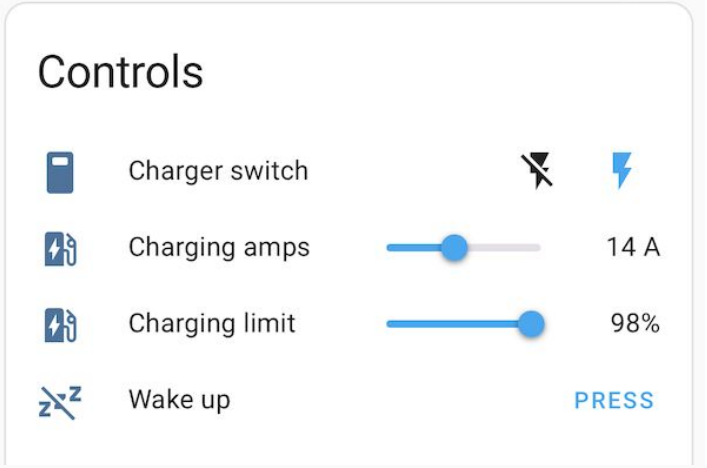
INFOTAINMENT

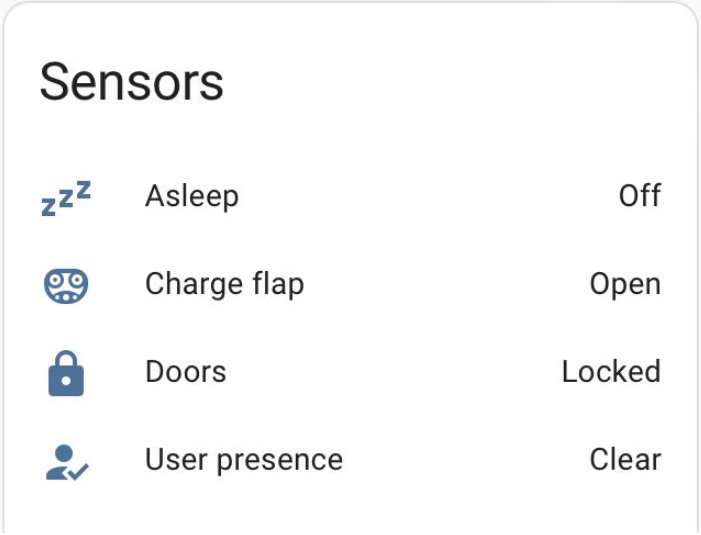
- All other commands: charging, heating, ..
- Request more data about vehicle (added in recent update 3 months ago!)
- Goes to sleep when not active
  - Consumes significantly more power!

Each domain has different public keys
→ separate handshakes + session state!

ESPHome pairing

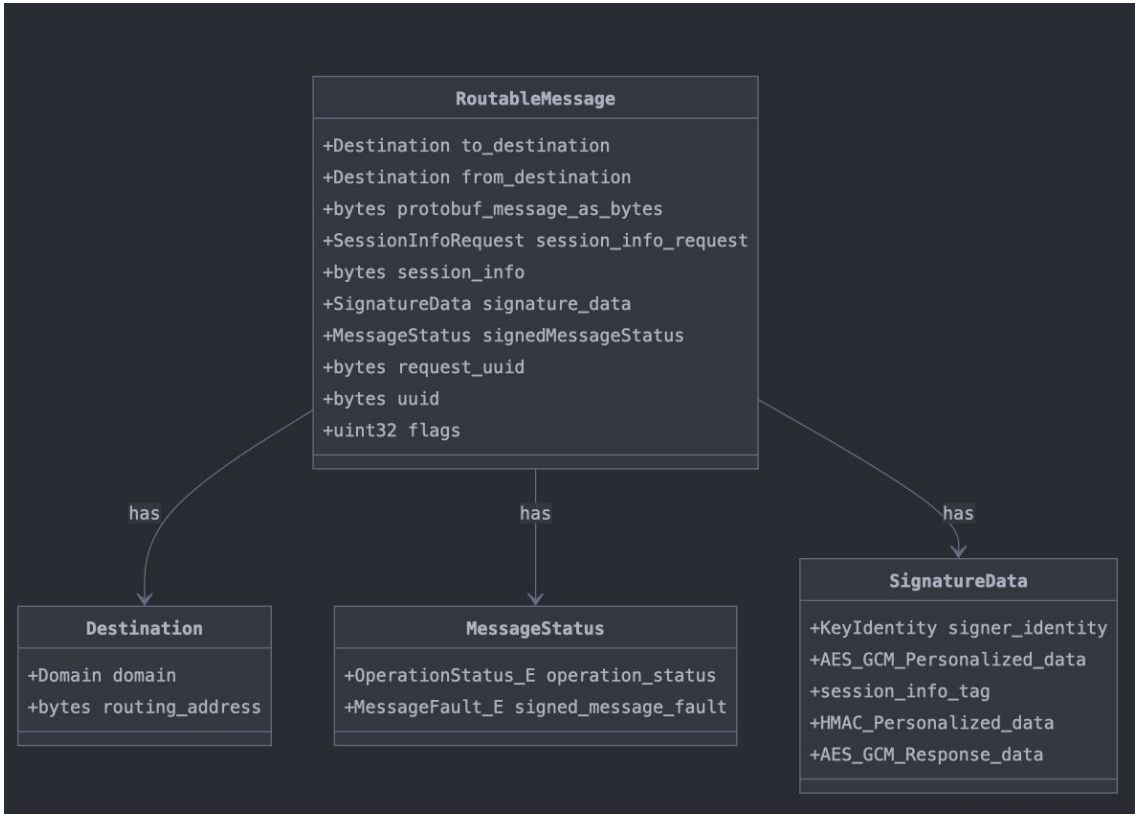






Tesla Vehicle Protocol: `UniversalMessage`

```
320208033a121210934f10691deda
826a7982e92c4fce83f52069685b9
b0a2886a80010a430a41045310b89
94bb511e99e44d245be0537447a6d
c73c51d6409cf9f548c31360e0fc5
ad80cc30c06d98e1e0c478f5cd850
4e2d5573625527b75177e471561a3
697b22a390a104c463f9cc0d3d269
06e982ed224adde6120c9b4d39f6f
7e8a105d3feeda5180325640a0000
2a10179ab82400df1623a6fec4435
3b728dd9a0310d5f3d9e45bfa6cc3
51e220ae0ce10698
```



UniversalMessage

nanopb/**nanopb**

Protocol Buffers with small code size

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to_destination = **32020803** (DOMAIN_INFOTAINMENT)

from_destination = **3a121210934f10691deda826a7982e92c4fce83f**

payload.protobuf_message_as_bytes = **52069685b9b0a288**

SignatureData: KeyIdentity + = **6a80010a430a41045310b8994bb511e99e44d245be0537447a6dc73c51d6409cf9f548c31360e0fc5ad80cc30c06d98e1e0c478f5cd8504e2d5573625527b75177e471561a3697b22a390a104c463f9cc0d3d26906e982ed224adde6120c9b4d39f6f7e8a105d3feeda5180325640a00002a10179ab82400df1623a6fec44353b728dd**

request_uuid = **9a0310d5f3d9e45bfa6cc351e220ae0ce10698**

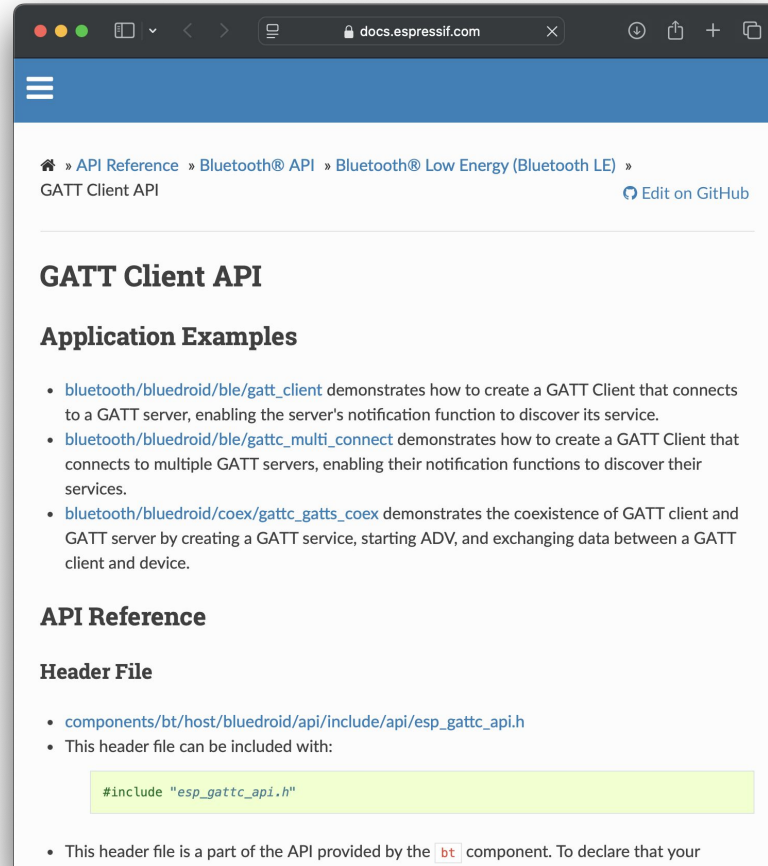
ESP BLE: `gattc_event_handler`

`ESP_GATTC_OPEN_EVT / ESP_GATTC_CLOSE_EVT`
Connection opened / closed event

`ESP_GATTC_REG_FOR_NOTIFY_EVT`
Register for receiving notifications from vehicle

`ESP_GATTC_NOTIFY_EVT`
Handle incoming data, can come in chunks!
vehicle_command: chunks of 20 bytes

`esp_ble_gattc_write_char`
Send data



Queueing messages

```
void TeslaBLEVehicle::loop()
{
  if (this->node_state != espbt::ClientState::ESTABLISHED)
  {
    if (!command_queue_.empty())
    {
      // clear command queue if not connected or on first boot (prevent restore value triggering commands)
      command_queue_.pop();
    }
    return;
  }

  process_ble_read_queue();
  process_response_queue();
  process_command_queue();
  process_ble_write_queue();
}
```

Command state machine

Change charging amps → Charging = INFOTAINMENT domain

Can only talk to INFOTAINMENT when car is awake

1. First need to wake up car
    a. If session info are outdated (epoch, key, counter) → Request new session info
    b. Wait for new session info
    c. Update session info key information
2. Wait for confirmation that car is awake
3. Send command
4. Wait for command confirmation

Built-in (up to 5) retries for robustness and comms failures

Want to learn more?

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