FHV
Vorarlberg University
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WiFi HaLow Smart Meter Adapter: First Steps Student Project

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Smart Meter in Austria

- Power Utility Provider are required to install Smart Meters for each customer
- 2024 – 95% of all households are equipped with a Smart Meter
- Automatic remote readings for each customer
- Smart Meter saves different statistics which can be accessed through integrated display
- M-Bus Customer Interface
  - Possibility to query data and process it for your own needs
  - Implementation not standardised and depends on provider

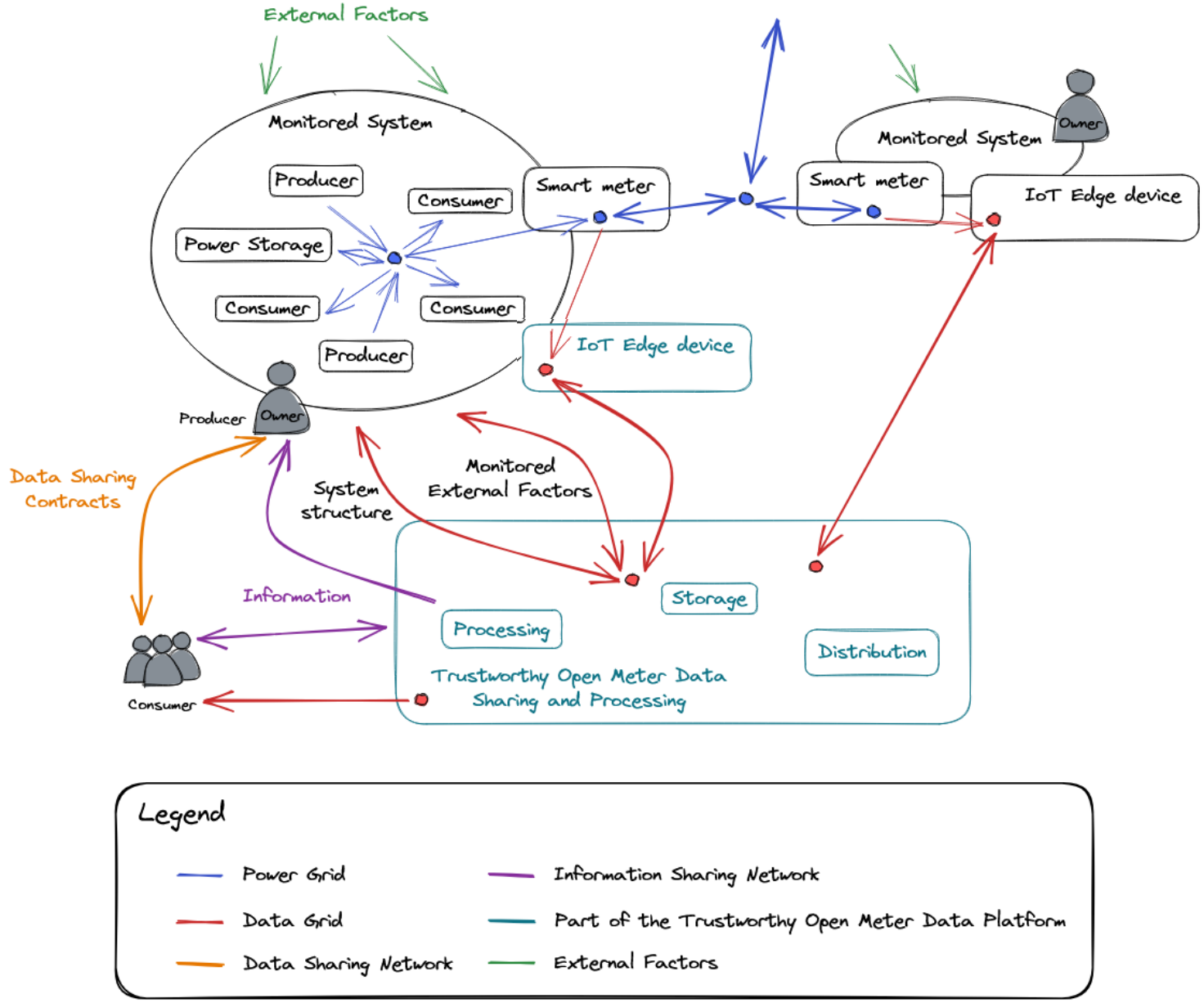
Project Starting Point

- Smart Meter with M-Bus interface
- Four teams (3-4 students per team)
- Each team chose an individual focus
  - Data Spaces
  - Gamification
  - AI

Data Spaces – Further Information

- Infrastructure for interoperable and sovereign data exchange
  - Owners of data have full control over their data
  - Policies to describe who can access the data under which conditions
- Monetarization of data
  - Producers can offer their data for a monetary value
  - Consumers can purchase data and use it for their use cases e.g. training of AI models
- Standardization →GAIA-X

Data Spaces – Further Information



Requirements IoT Edge Device

- Low Power Consumption
  - No outlet near the Smart Meter
  - M-Bus provides max. 4 Unit-Loads (overall 6mA)
- Good Radio Coverage
  - Smart Meter not always in WLAN range
- Device is usable by non-technical people

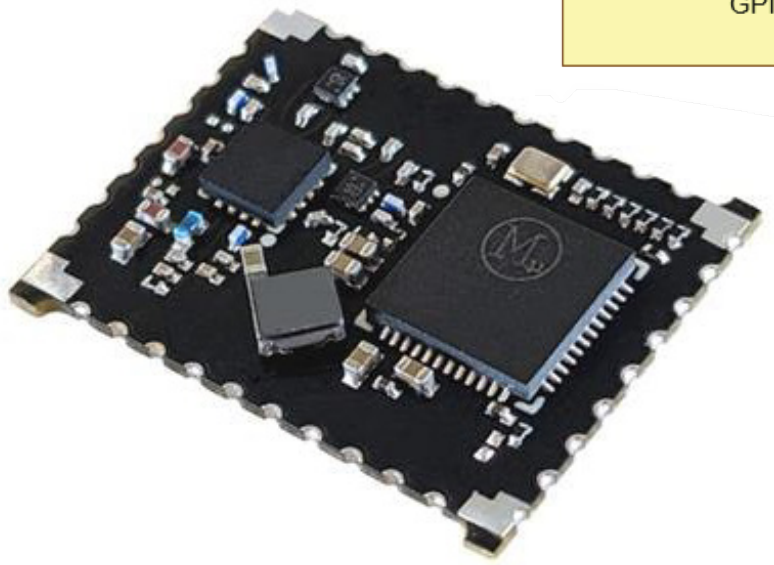
Possible Communication Technologies IoT Edge Device

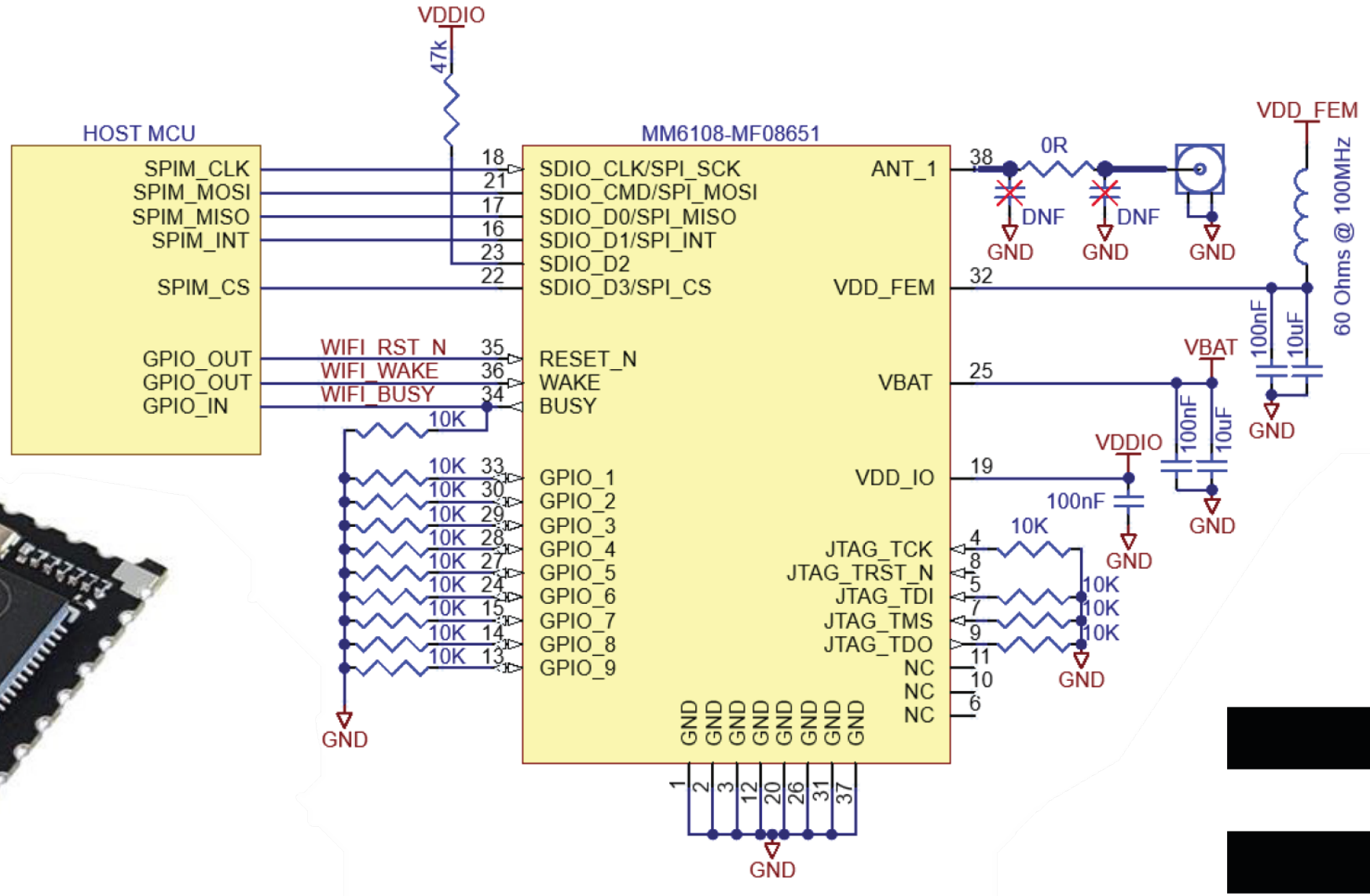
- WLAN – Short Range
- ZigBee – Gateway needed
- Matter – Not well established
- BLE – „Gateway“ needed
- LTE – Reoccurring Costs
- NB-IoT – Not well established
- LoRa WAN – Low Data Rate
- WiFi HaLow – Not well established

Chosen Technology: WiFi HaLow

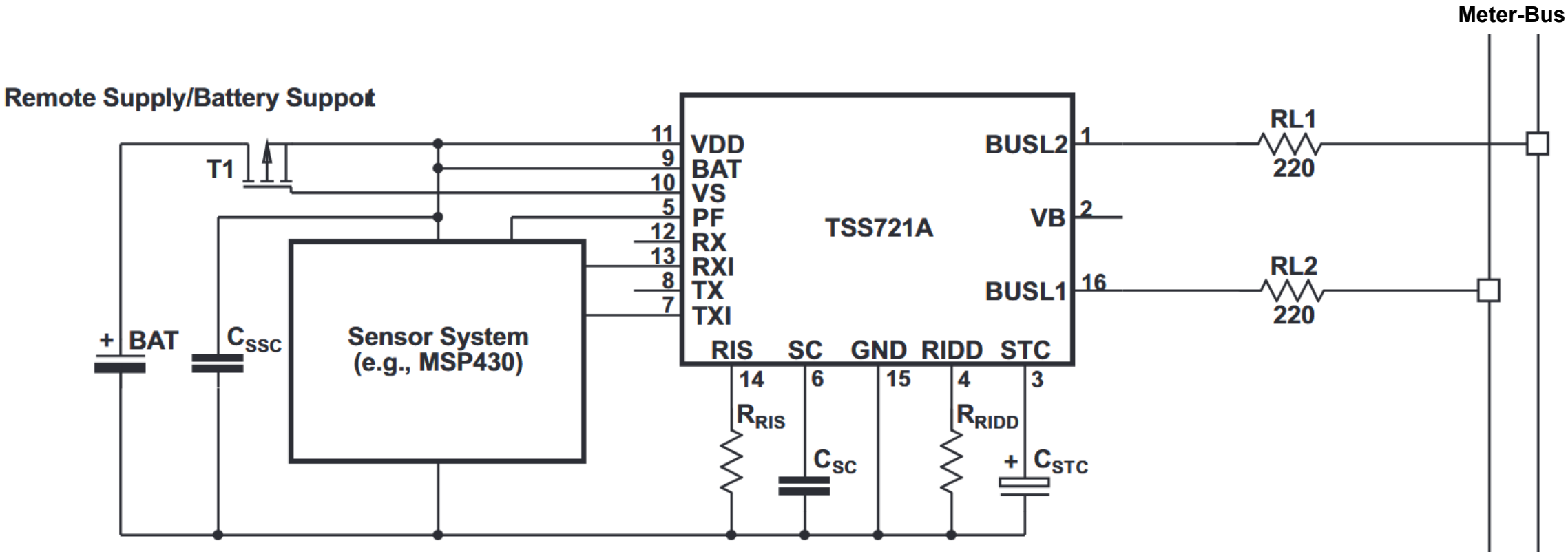
- Why WiFi HaLow?
  - “ABI Research estimates that the WiFi halow market will grow to 108 million devices by 2029”
  - Try out new Technology
- Why Morse Micro Module?
  - Driver
  - Availability
  - Most wide spread
- Microcontroller: MSP430FR
  - Low Power Consumption

Schematic Morse Micro

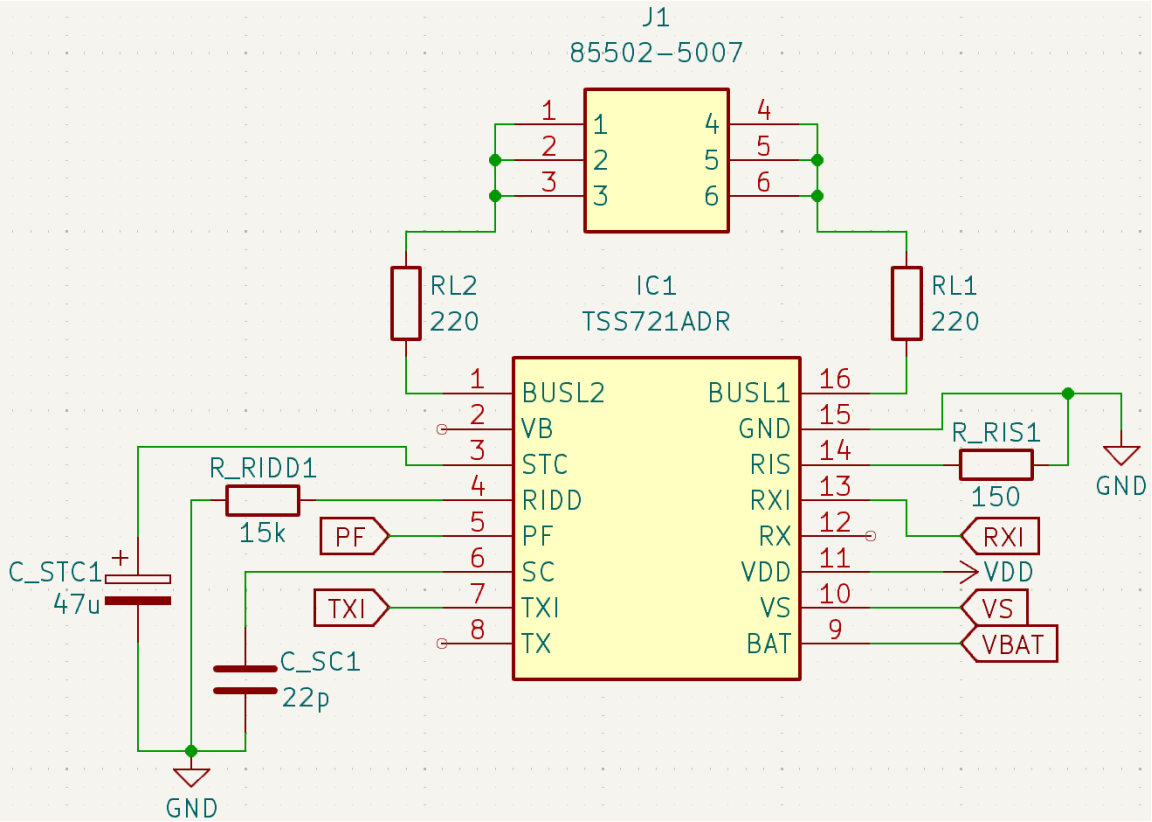


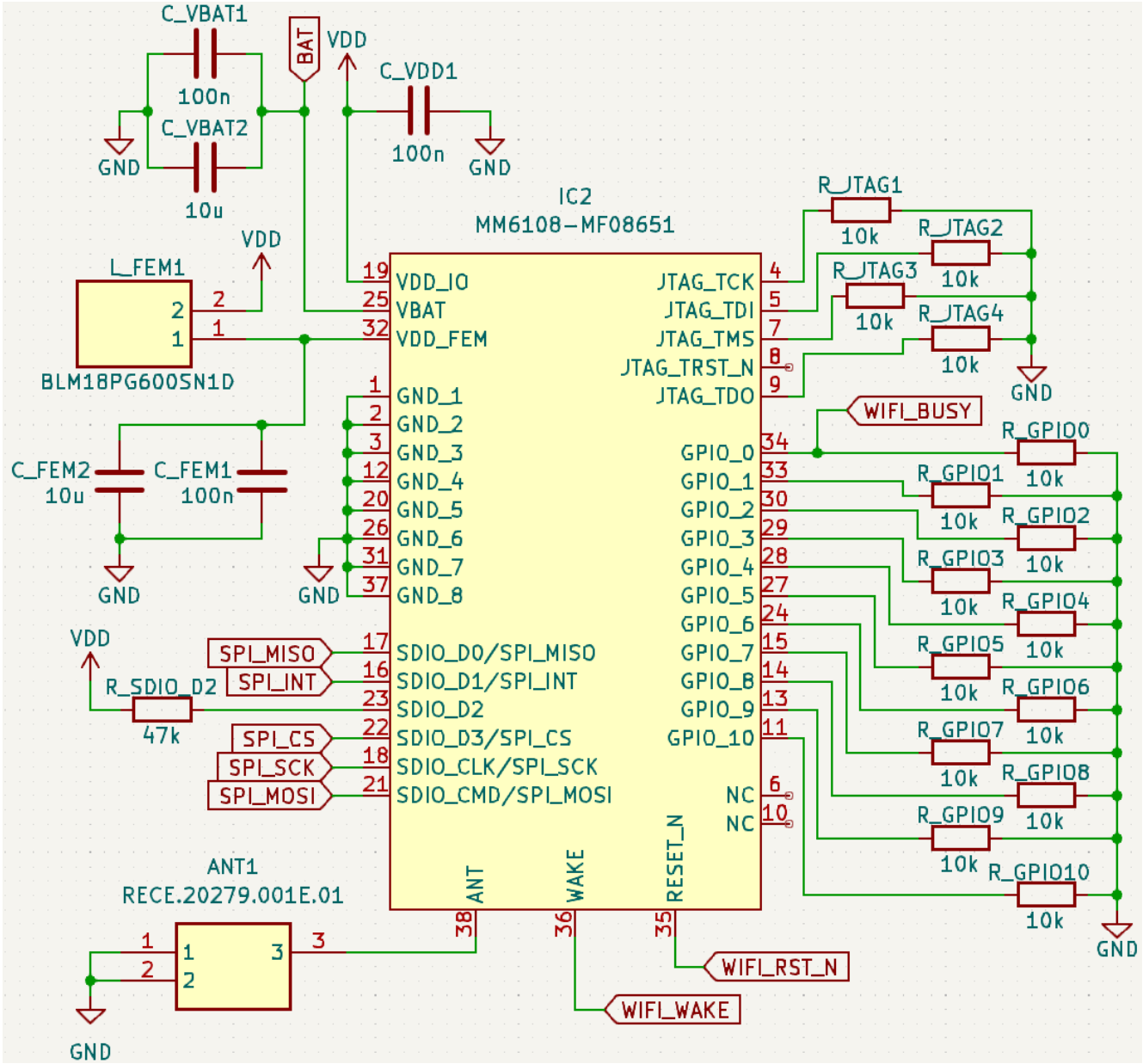


Schematic Tranceiver Chip M-Bus



Overall Schematic





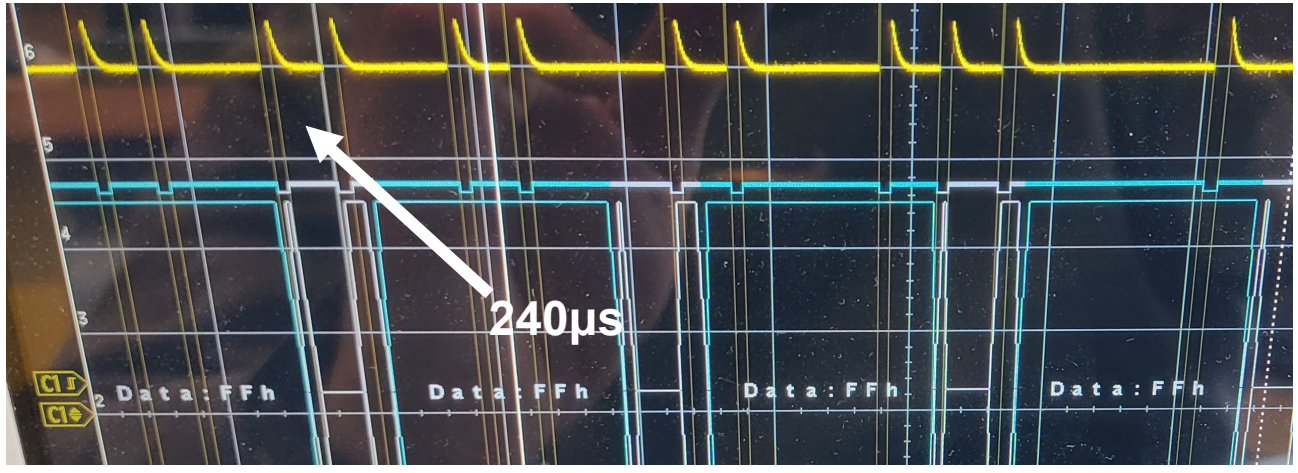
M-Bus Putting into Service

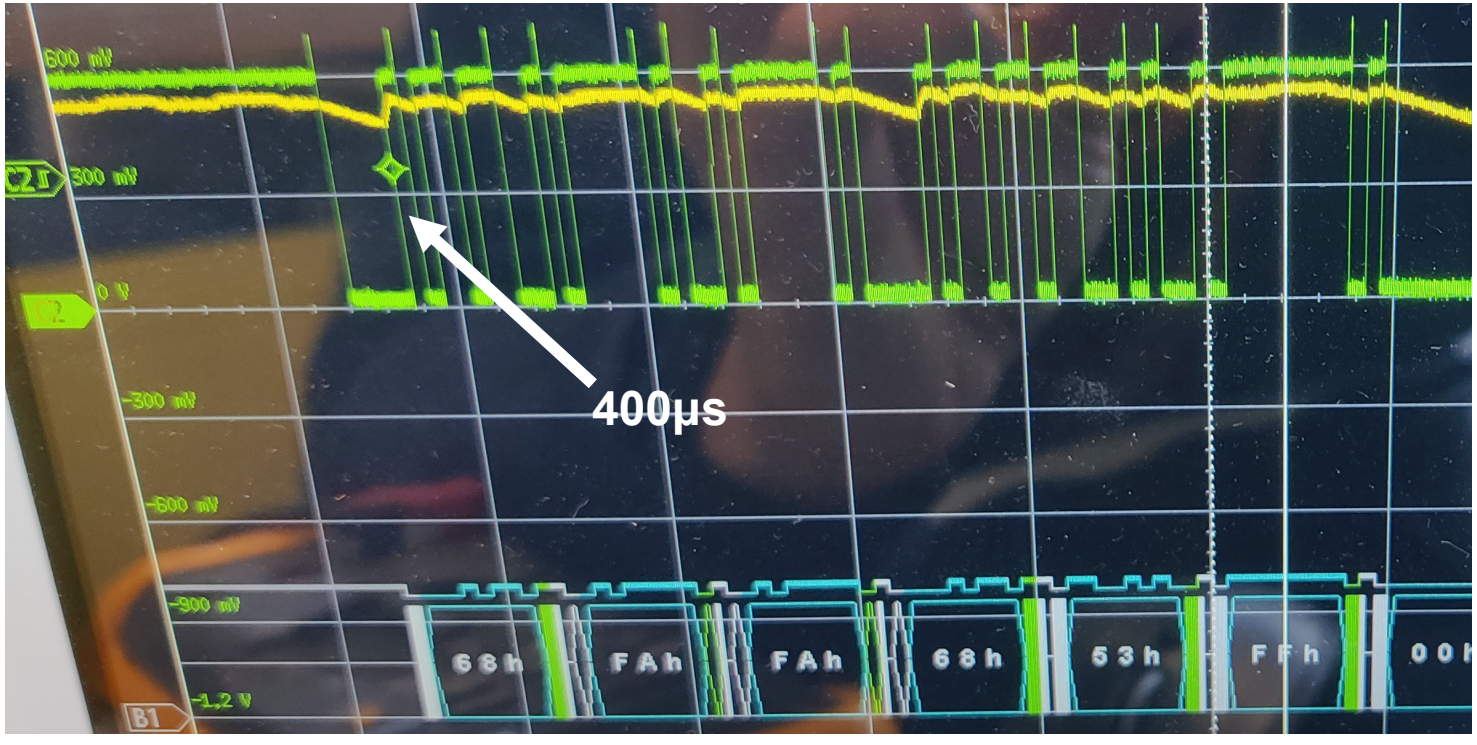
- Reading Data from Smart Meter using MBus and UART

Problems:

- Sparse Documentation by Power Utility Providers
  - Only High Level Description of provided Data
  - Documentation was faulty and incomplete in some cases
  - High variance depending on the provider
- Wrong Selection of Sampling Capacitor
  - Resulting in wrong Bit Timings

M-Bus Putting Into Service

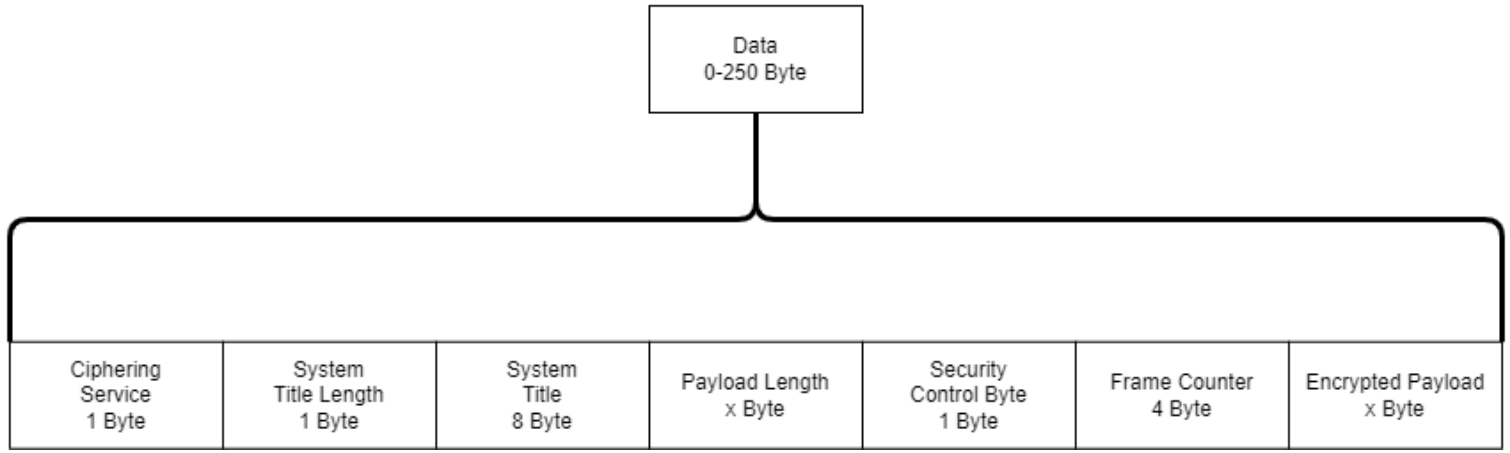




M-Bus Putting Into Service

- Payload is AES GCM encrypted
  - IV = System Title + Frame Counter
- Frame can also be fragmented into multiple packets
  - Indicated by the CI field

Start Character 1 Byte	L Field 1 Byte	L Field 1 Byte	Start Character 1 Byte	C Field 1 Byte	A Field 1 Byte	CI Field 1 Byte	STSAP 1 Byte	DTSAP 1 Byte	Data 0-250 Byte	Checksum 1 Byte	Stop Character 1 Byte



Decrypted Payload

0F8006870E0C07E5091B01092F0F00FF88800223090C07E5091B01092F0F00FF8880906010001080FF06000032890202
F00161E0906010002080FF06000000000202F00161E0906010001070FF06000000000202F00161B0906010002070FF
06000000000202F00161B0906010020070FF12092102020FF16230906010034070FF12000002020FF162309060100
480700FF12000002020FF16230906010001F0700FF12000002020FE16210906010033070FF12000002020FE16210906
0100470700FF12000002020FE16210906010000D0700FF1203E802020FD16FF090C31383132323030303030303039

Verzeichnis:

Datentyp	HEX	Konvertierte Darstellung	Kategorie
Octet String	07E5091B01092F0F00FF8880	27.09.2021 09:47:15+02:00	Zeitstempel
Octet String	0100010800FF	1.0.1.8.0.255	OBIS-Kennziffer
Unsinged Integer 32	00003289	12937	Wert
Integer 8	FF	$\times 10^{-1}$	Skalierung
Enum	23	35	Einheit
Octet String	31383132323030303030303039	181220000009	Zählernummer

Morse Micro Putting Into Service

- Wanted to write our own driver for the module

Why:

- Driver can be trailored to specific needs of our system

- Only necessary functions need to be implemented
  - Reduce required storage space

- Porting to new (less current intensive) systems can be easier

Morse Micro Putting Into Service

Problems:

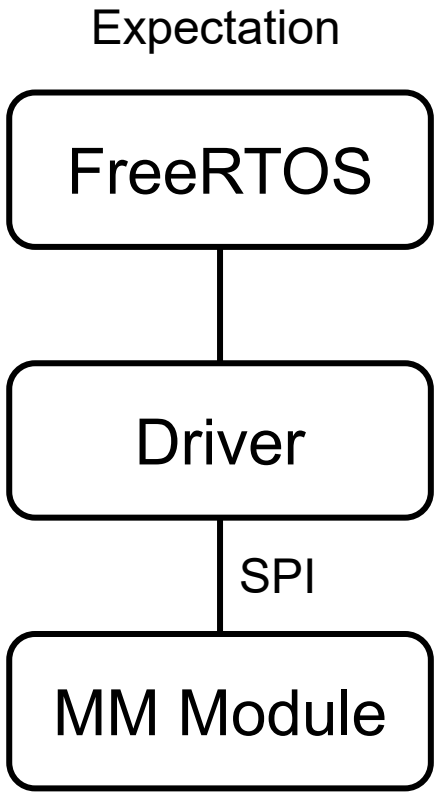
- No SPI command description available

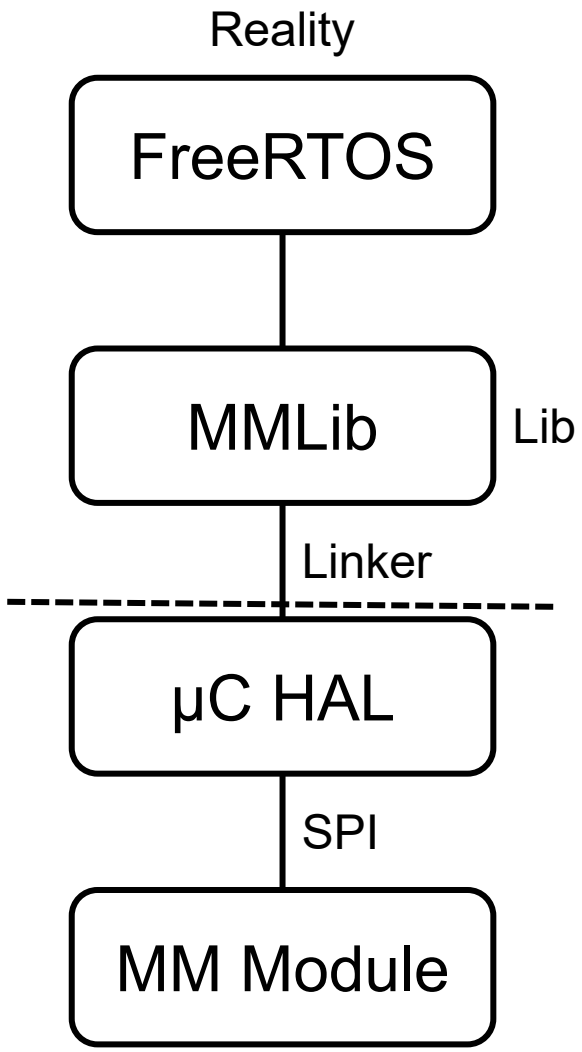
- Morse Micro provides evaluation kits with seperate MCUs
  - Their SDK targets these MCUs
  - MCUs then send SPI commands to module

- General FreeRTOS driver under development
  - Closed source at the moment

Morse Micro Putting Into Service

- Communication Layers





Conclusion

- Prior work has been done in student projects on implementation in Zigbee and BLE
  - Major Problem ➔ High Power Consumption
- This semesters project focused on implementation using WiFi HaLow
  - Time consuming implementation ➔ new technology
  - Sparse documentation by Morse Micro
- In general good documentation is important
  - As seen with Mbus and WiFi HaLow

Further Steps

- Fully integrate Morse Micro Library to work with new microcontroller
- Power Consumption and Radio Tests
- Maybe switch to new Morse Micro module (MM8108)

Thanks for your attention!

Questions?