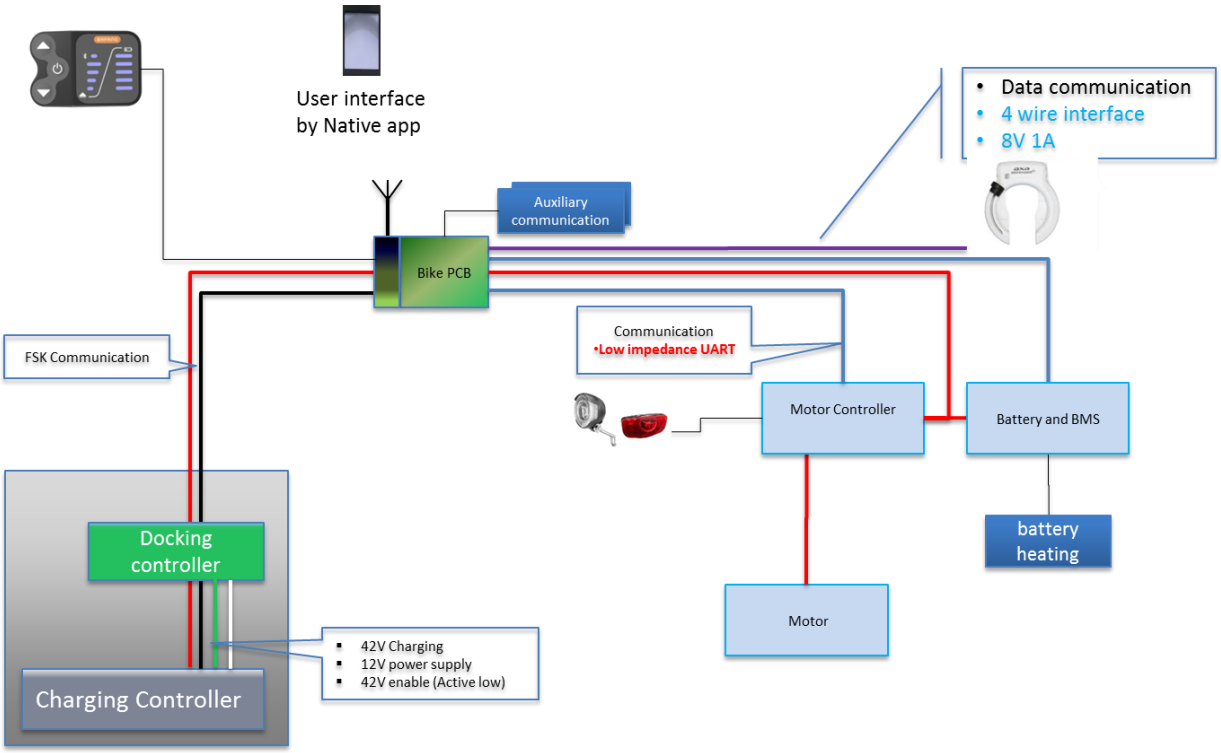
Appendix 2: Bike share system requirements to the BikePCB



System schematics: Motor controller and Battery BMS may communicate to bikePCB via UART (as above) or via Auxiliary communication (CAN Bus or USB).

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1. Background

This appendix is part of the system requirement specification for the project "Ny Sykel".

All technical and user requirements for the BikePCB are collected in this document.

This document is also part of the tender material. In this context the document is only to be seen as back ground information, hence the document does not specify any requirements to the provider of the bike.

1.1. Purpose

The purpose of the document is to serve as a requirement specification. Where description of features exists it is described as feature requirements. It shall not be seen as requirements to how the features should be implemented.

1.2. Definition of requirements in dialogue

The requirements shall be seen as minimum requirements. That is, if better or cheaper solutions can be identified then all project members has the right and duty to suggest reductions and / or enhancements.

1.3. Readers guide

NA.

1.4. Definitions

See main document.

1.5. References

See main document.

2. BikePCB, Hardware requirements

The bikePCB shall reside on an ebike. The humid outdoor environment and the nature of the vehicle shall be taken into consideration.

2.1. Power consumption

Power consumption is not critical when the bike is moving. However, when the bike is parked (on kick stand and locked) then it is important that the power consumption is absolutely low.

2.1.1 DC-DC converter

The Bike PCB must implement a power efficient power supply. The controller will provide 36V max. 1A

Note that high peek current is required for most bike locks (when the servo motor starts the (short) peak is typically 300-1000 mA). This is also the case for the selected Lock: Axa eRental.

2.1.2 Low power consumption by design

The design documentation must specify the expected power consumption in power save 1 and 2 as specified in section: 4.5 Power management.

2.2. General configuration

OS, CPU, RAM; ROM to be specified.

2.3. RTC

Real time Clock or other means is required.

2.4. GPS

Standard GPS receiver shall be included.

2.5. GSM 4G

It is preferable if eSIM is used. Alternatively both eSIM and normal SIM socket must be supported.

2.6. BLE

Bluetooth may be used for communication and also for identification of lost bikes.

2.7. Wifi

Wifi is not mandatory.

2.8. LoRa

LoRa is not mandatory.

2.9. Void

NFC / Contactless card reader shall not be included in the design.

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2.10. eBike interface Bafang controller protocol

The interface to the Bafang controller shall be established using the display port. However, the display shall still be used. The BikePCB must therefore also interface to the display. The BikePCB must therefore be installed between the display and the controller.

2.10.1 Display

The display to be used is shown below. See also illustration in start of the document.

2.10.2 Display and controller connection

The connector used is Higo connector type: Mini B Male/Female cable connector. The connector is also delivered as a panel mount version.

http://www.higoconnector.com/products/z209bm-p-00-a0-1000/K999K

2.10.3 Battery level

Battery level must be used to status messages. Furthermore, the display must be updated accordingly (Right bars).

2.10.4 Temperature Level (alarm) Void

This is not a hardware requirement.

2.10.5 Assist level

Assist level changes may be initiated by the central system. This happen typically when the bike is undocked. The user may also change the assist level.

In any case assist level changes must always be updated on the display when the bike is on trip (Left bars).

2.11. BikePCB interface to DP

Stavanger wants to charge the bikes in the existing charging infra structure. The bike is automatically locked when entered into the docking point. In order to release the bike, the bikePCB needs to communicate with the Docking point via FSK on a powerline interface (EN 50065 alike).

The interface is described in the document: [3] Open interface – Docking point

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The interface will be established using the Kimaldi board supporting Arduino Rev 3 Uno Shield standard.

2.12. Bike lock interface

Axa eRental bike lock.

Further information may be found in the interface specification: [5] Axa lock documentation (Referenced documents).

2.13. CAN bus interface

CAN Bus may be implemented for two reasons: Future motor controllers may have CAN bus interface. It may be interesting to connect other interfaces to the bikePCB e.g. a pollution sensor board.

Note: The CANbus devices may also foresee to have a power requirement. A major pollution sensor operates at 5V. Peak current needed 1A, Nominal 500mA.

If shared power supply for USB and CanBus it shall be possible to switch the power on and off by the firmware. Please describe planned functionality.

2.14. Kick stand or a accelerometer

There will be no kickstand. The bikePCB will implement an accelerometer. BikePCB will implement functions to detect kickstand position using the accelerometer (angle or specific movement).

This function is to avoid the bike being locked without set on kick stand. It is believed that it is possible to detect that the bike is put on kick stand using a 3D accelerometers.

The accelerometers may also detect if the bike fall over.

Furthermore, the accelerometers may also be used to detect bad driver behaviour.

2.15. USB interface

The bikePCB shall also implement USB interface with charging function (nominal max. 1A).

3. Environment requirements

3.1. Temperatur

-20°C~+50°C

3.2. Drop

MIL STD-810G, Method 516.6; Procedure IV;

26 drops with stylus from 1.8 m onto wood;

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3.3. Thermalshcok
MIL STD-810G, Method 503.5, Procedure-I-C; -40°C~71°C

3.4. Shock
MIL STD-810G, Method 516.6; Procedure I for Ground Equipment(40G /11ms / sawtooth)

3.5. Vibration (Operating)
MIL STD-810G, Method 514.6; Procedure I, C-1/ C-3 & E-1

3.6. IP rating
IP 65 TBD

3.7. CE marking
The product shall be CE marked.

The Relevant documentation necessary for CE marking shall be provided.

3.8. Physical dimensions
The bike has a room available that is: 33 x 53 x 115+ mm. Dimensions shall be included the protection of the circuit board components and connectors.

Note: The antennas must be in one end (33*53 mm) the connectors in the other end.

4. Functional requirements

4.1. GPS position when wake up
In order to retrieve a fast position after hardware weak-up, last known position must be stored locally and used at power up as parameters to the GPS.

4.2. Position information also when parked
It is mandatory that the bike is able to wake up on a frequent manner and send a GPS position. The frequency must be a parameter. Typical value: 6 Hours.

4.3. GSM reconnect
If the GSM communication is lost then the modem shall automatically try to reconnect. Unsuccessful attempt shall be locked, however only one record shall be send to central system (with a counter off unsuccessful attempt since last log).

4.4. BLE, I am lost, providing status..
If the GSM communication is lost then the BLE may be used to get id transfer to other live bikes.

The BLE may also be used in the power up situation providing additional information to the user. As in this case it is likely that there exist a user bike relation.

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4.5. Power management

The BikePCB must control that the bike is never discharged too much. Parameters must be defined to specify the following low battery levels:

1. User low level: Warning to the user that there is only x Km left with motor assistance. Entering this level the event must be reported to the central system. In order to initiate user alert.

2. Motor switch off (Set assist level to 0). Entering this level the event must be reported to the central system. In this level the BikePCB continue to send position to central system.

   The eBike motor controller normally does this, as described below in "Battery switch off". However, in a eBike share system we need to have battery power left for position reporting.

3. BikePCB Power safe. Entering this level the event must be reported to the central system. In this level the BikePCB continue to send position to central system but with a very low frequency (e.g. every 6 hours). The BikePCB must go into sleep mode when not sending position.

4. Battery switch off: This is typically defined and managed by the battery management system to protect the battery.

5. Service mode: When the bike is undocked in service mode the bikePCB must bring the bike in to lowest power consumption possible after a {timer parameter} of minutes.

6. Service mode, ping: However, it is mandatory that the bike is able to wake up on a frequent manner and send a GPS position. The frequency must be a parameter. Typical value: 24 Hours.

7. Power down. If supported by the controller, the system must have a battery power down function. The Phylion battery system does support a power off command (The function switching off 36V / on 36V is available; the command (0xF2/0xF3) to switch on/off 36V). The software design must support this as a save power down is desired on the long term (Other battery systems). Power Down will happen automatically, and might be difficult to forecast – especially on old batteries. If feasible, it would be of added value, to store local information about unexpected power down and then provide this information to the central system at next power on.

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4.6. Wake by event
The following events has been defined.

4.6.1 Wake by accelerometer
The system must implement a wake by accelerometer. This is used to detect a user interaction required. The start-up in this situation must be carried out as fast as possible. The start-up procedure must also include a ping to the BO to enhance the App UI.

4.6.2 Wake by power button
Furthermore, it shall also be possible to wake the Bike using the I/O symbol on the Display.

4.6.3 Wake by 42 V charging
When the bike is entered into a charging point then 42 V is applied automatically. The bike must wake and ensure battery power to Kimaldi piggy back.

4.7. Bike light control
The BikePCB must control the light switch on and off. Furthermore, a blink function shall be implemented. This function might be needed as a one blink and a blink in e.g. 10 seconds. It may be used as a UI acknowledgement function or as a "find bike with most battery", "Find defect bike" etc.

The blink function shall also blink the diodes on the display.

The blink frequency shall be 0.25 Hz. That is 2 sec light and 2 Sec off.

4.8. Firmware update (bikePCB)
It shall be possible to download firmware and update the firmware over the air.

4.8.1 Firmware upload to Kimaldi piggyback
It shall be possible to download Kimaldi firmware and update the piggy back over the air.

4.9. Firmware update of docking point
It shall be possible to download docking point firmware to the BikePCB and remotely update firmware in the docking point where the bike is parked.

4.10. Docking point commands
The following docking point commands must be supported.

- Accept Docking
- Get docking point ID, SW version, slave controller status etc.

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- Set time
- Start charging, Start Unconditional charging
- Stop charging
- Undock(SLAVE_MAKE_UNDOCK_1), Undock (SLAVE_MAKE_UNDOCK_ONE_SENSOR), Service undock.

4.11. Status messages to central system

A number of stratus messages will be defined by the interface document. Such as but not limited to:

- Battery temperature
- Battery cell tension
- Controller over temperature and other alarms,
- Etc.

4.12. Secure air based tires - Tire Pressure TPMS

BLE communication with standard Bluetooth TPMS.

The most logical way to secure air based tires against flat tire vandalism is to secure that the air cannot be let out.

Sources:

https://en.wikipedia.org/wiki/Tire-pressure_monitoring_system

4.13. Light

The light must be on while the bike is on trip and not locked. However, it the bike goes into sleep mode light might be switched off.

5. Document information

Version	Date	Issued by	Status	Purpose of update
1.1	1. Mar 18	PSA	Draft	Changes to specification for the tender.
1.2	14. Mar 18	PSA	Final	Proof reading.
1.3	23 Mar 18	EF	Final	Proof reading.