



**WE  
& INTEGRATE  
ENABLE  
CONNECTIVITY**

# STANDARD PROTOCOL STACKS

PRODUCT OVERVIEW

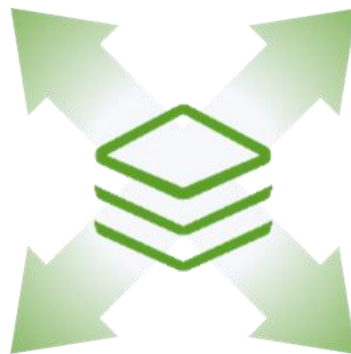
## PROTOCOL STACKS

### AS STANDARD VERSIONS

STACKFORCE's core business focuses on the development and implementation of Protocol Stacks for various IoT use cases. Our stacks support modern wireless communication technologies like the well-proven wireless M-Bus protocol and the Low Power Wide Area Network technologies mioty®, LoRaWAN® and Sigfox.

Our goal is to support the optimal connectivity of your IoT network.

Our stack solutions can be integrated directly to your products, as components to already existing or new to establish wireless networks.



## MAJOR USE OF PROTOCOL STACKS

Protocol Stacks allow devices like meters or sensors to communicate wirelessly and transmit data in combination with wireless networks such as LPWAN. So it is possible to send data over several kilometers.

Software-based communication can be used in any area. The application scenario determines the appropriate software. With our standard products we enable a simple and convenient introduction to equip your IoT network with connectivity.

### APPLICATION SCENARIOS:

- ✓ Meter remote readout (water, gas, electricity, heat,...)
- ✓ Leakage detection and alarming
- ✓ Condition monitoring
- ✓ Predictive maintenance
- ✓ Oil-/gas field exploration and monitoring
- ✓ Machine monitoring
- ✓ Infrastructure surveillance

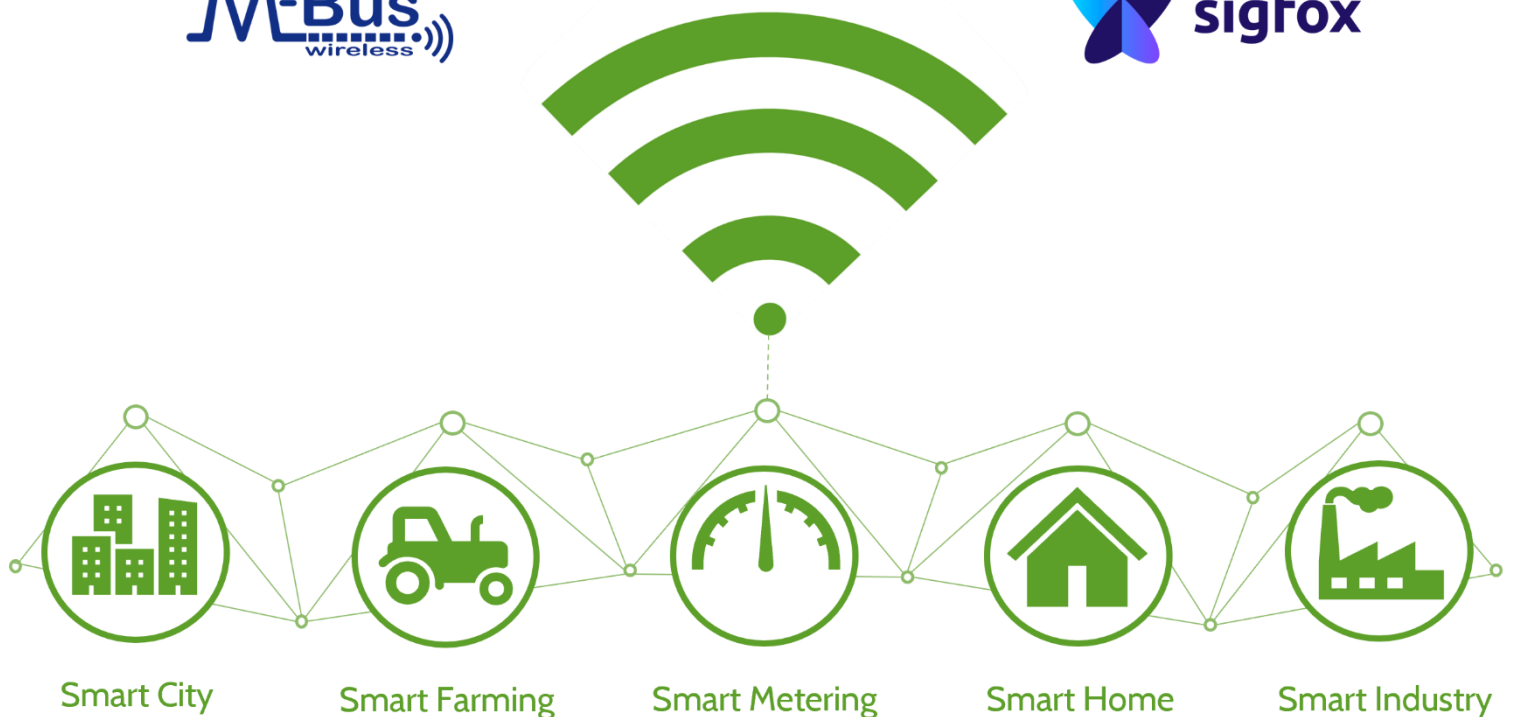


mioty

LoRaWAN

M-Bus  
wireless

sigfox



Smart City

Smart Farming

Smart Metering

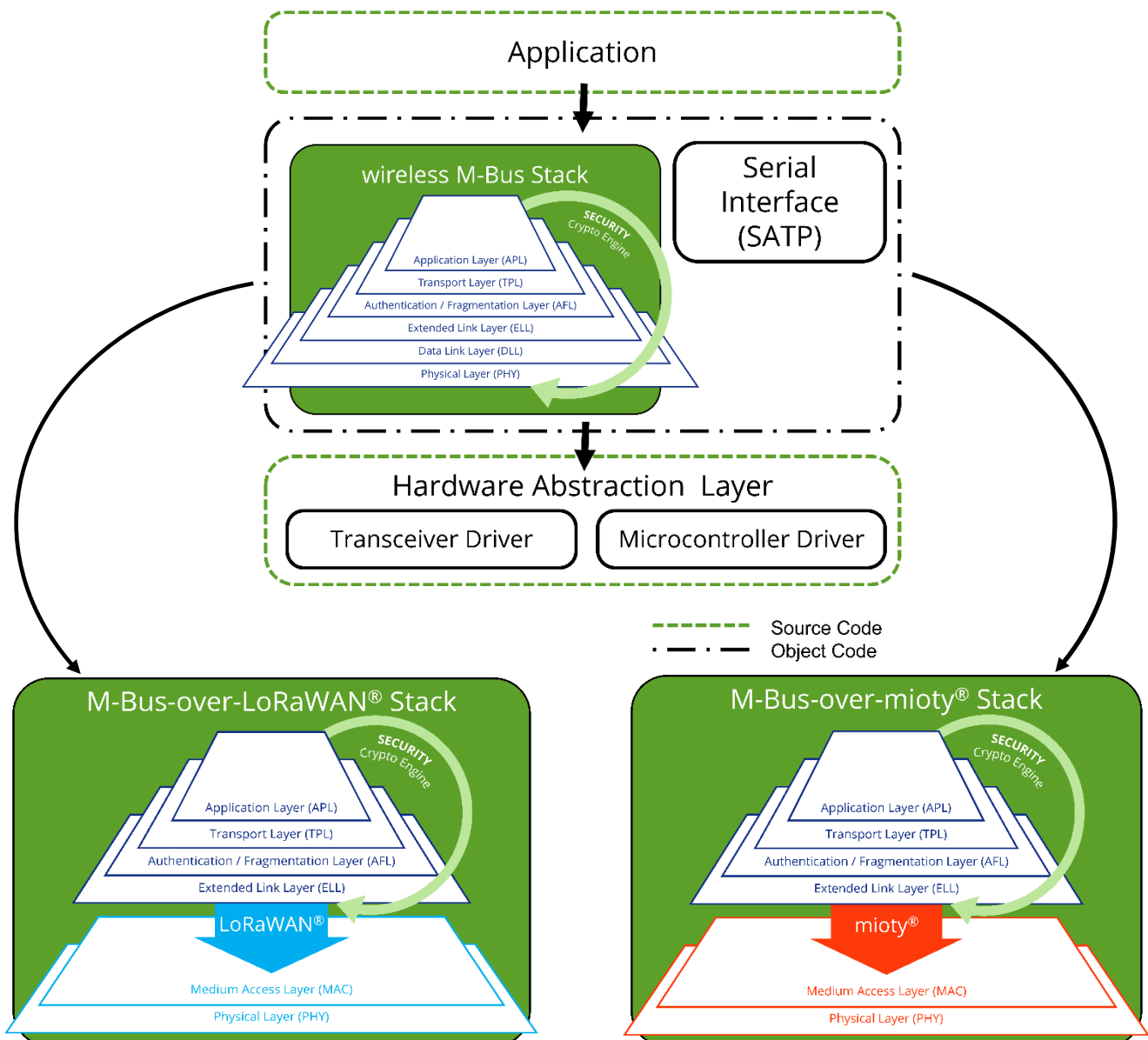
Smart Home

Smart Industry

## M-Bus<sub>wireless</sub> STACK ARCHITECTURE

Our wireless M-Bus Stack is not just available as the standard version, **compliant to EN 13757** or **OMS specification as meter or collector**, but also as derivatives in combination with **mioty®** (M-Bus-over-mioty® stack) or **LoRaWAN®** (M-Bus-over-LoRaWAN® stack). It is also possible to obtain variants of the stack addressing specific sub-standards, such as CIG UNI/TS, DSMR, ...

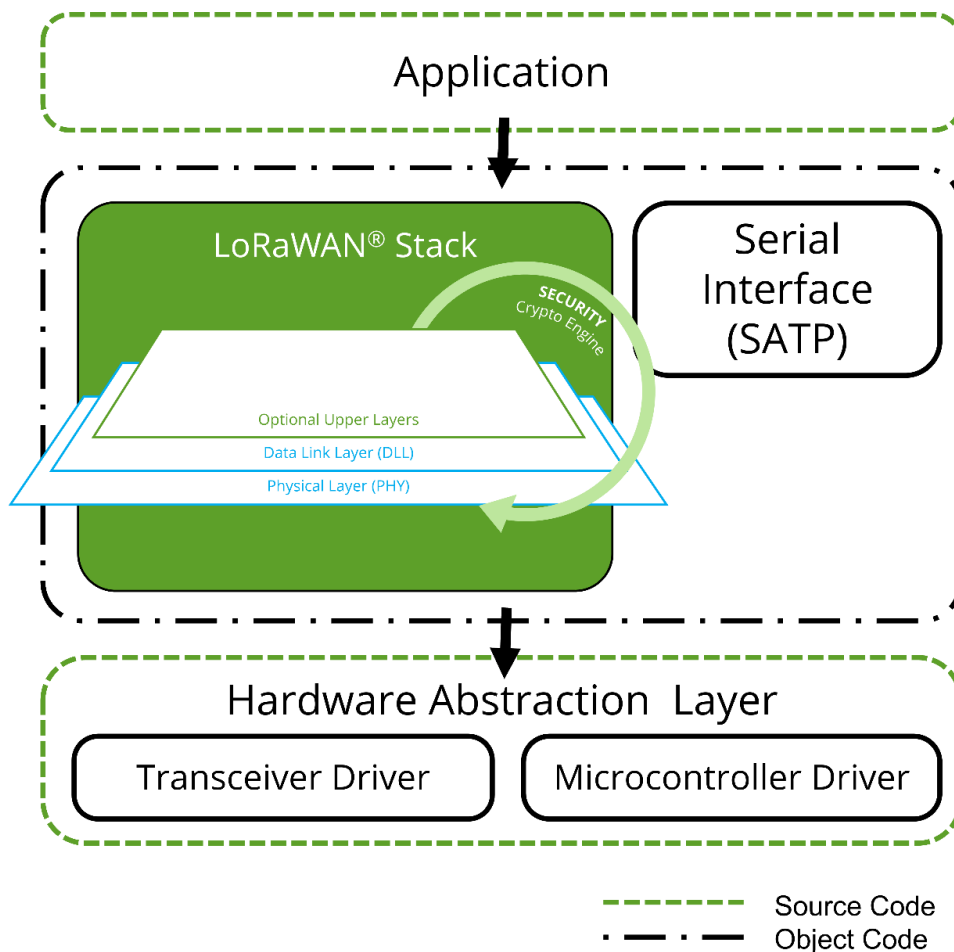
Therefore, you do not only benefit from the well-proven and popular wireless M-Bus protocol, but also from the advantages of the modern LPWAN (Low-Power Wide Area Network) technologies. They enable larger transmission ranges, which is especially of interest for applications like Smart Metering and Smart City.



## LoRaWAN<sup>®</sup> STACK ARCHITECTURE

The Industrial LoRaWAN<sup>®</sup> Protocol Stack is a more advanced development of the Open Source Long Range Wide Area Network (LoRaWAN<sup>®</sup>) stack. The Industrial LoRaWAN Protocol Stack is

designed for productive industrial use with high demands on safety and maximum performance – it is a guarantee of success for complex environments.

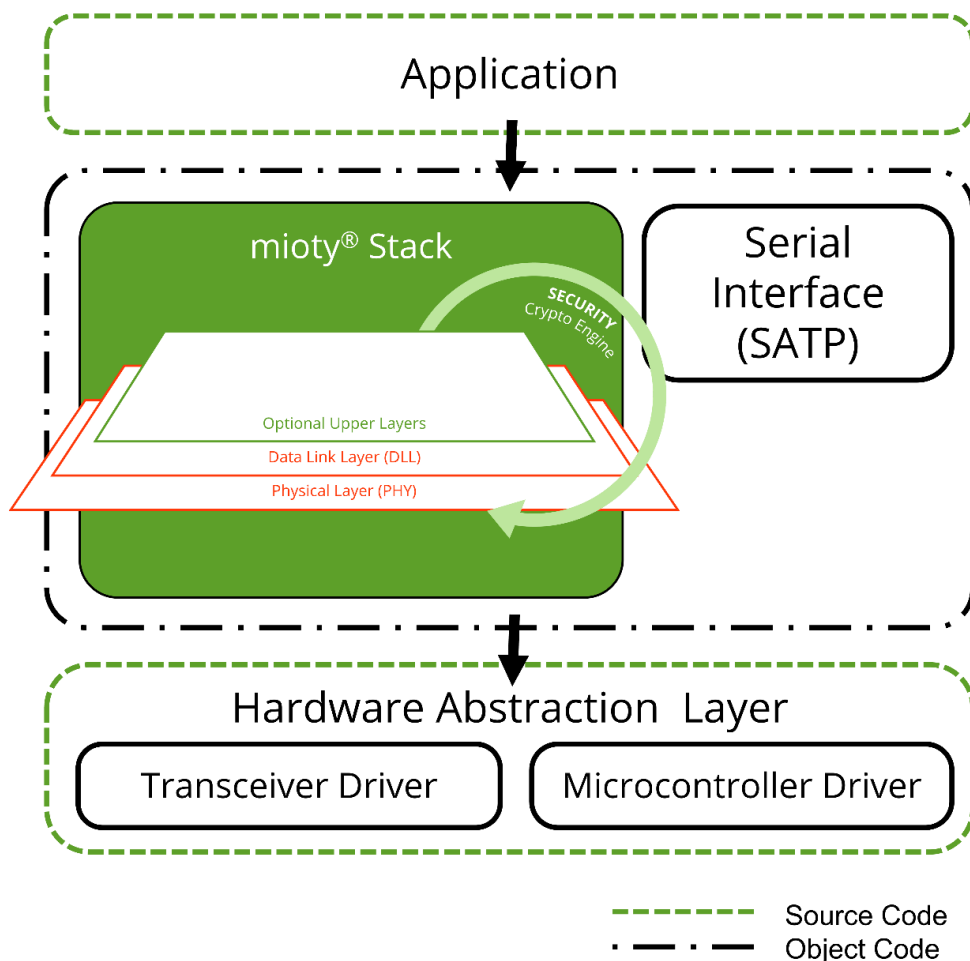


## **mioty** STACK ARCHITECTURE

The mioty® Protocol Stack is an extremely efficient and robust solution for both, common Low Power Wide Area Networks (LPWAN) and specialized industrial networks. It implements the miniaturized Internet of Things (IoT) system mioty®, developed by Fraunhofer IIS.

With the innovative technology of telegram splitting, it sets new standards to the field of wireless data transmission and is highly flexible in application areas.

The mioty® Protocol Stack is an implementation of ETSI Standard TS 103357, designed for operation of end points according to this standard.



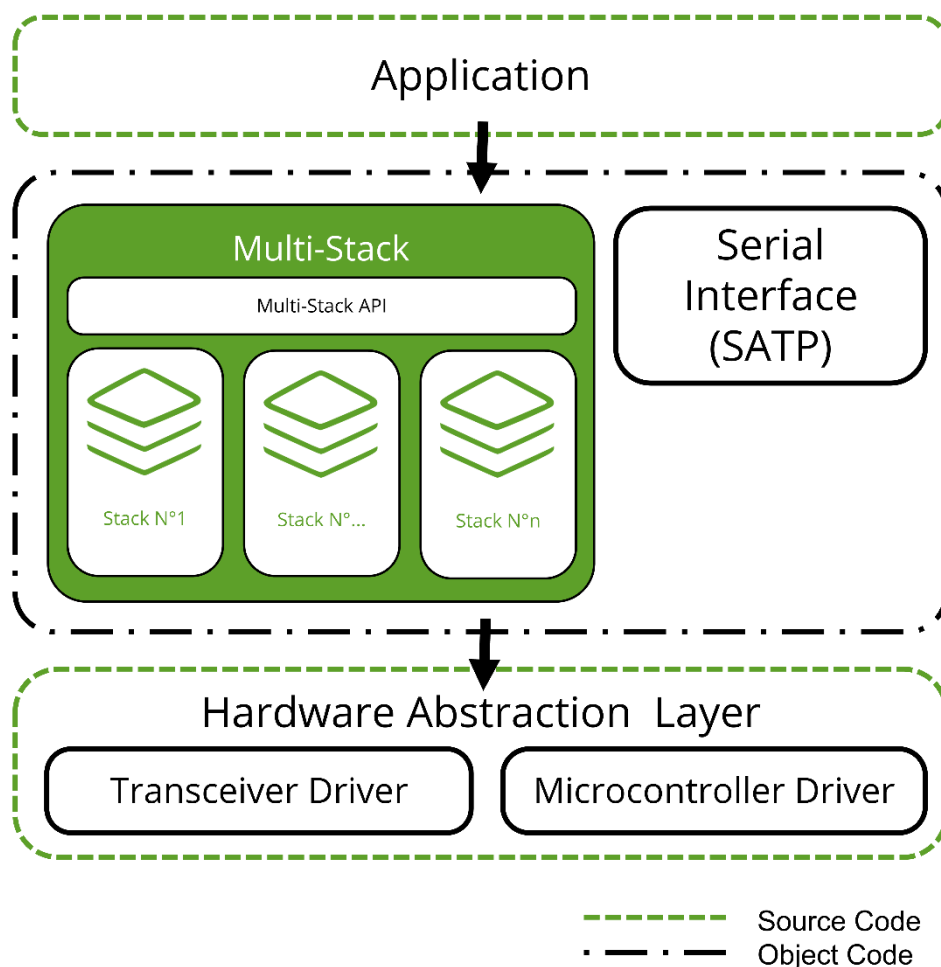
## MULTI STACK

### ONE INTEGRATION FOR MORE FLEXIBILITY

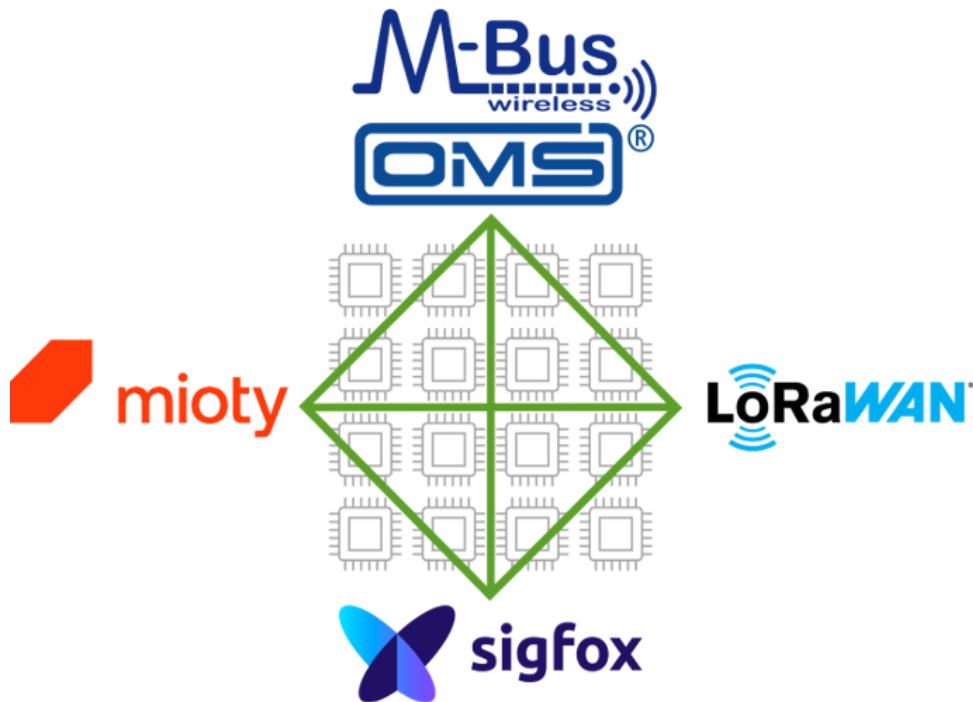
Flexibility and quick reaction are key elements for modern and efficient IoT networks. With our Multi-Stacks, we provide an innovative solution for combining several communication technologies for wireless data transmission in just one stack. Switch between wireless M-Bus and / or LPWAN technologies like mioty®, LoRaWAN® and Sigfox during runtime.

Perfectly adjusted to your requirements and done quite easily via our well-established Multi Stack API.

Therefore, you can not only benefit from the different advantages and features of the relevant technology, but also save development cost when only one stack integration is needed.



## ADVANTAGES OF THE MULTI STACKS



### MORE NETWORK COVERAGE

Not every radio network is available at every operation site. With the Multi Stack you can easily choose between several wireless networks. Therefore, the network coverage can be enhanced.



### MORE FEATURES

The advantages of different technologies are summed up, for example remote meter readout via the popular wM-Bus protocol and further data transmission over large distances via LPWAN technology.



### MORE EFFICIENCY

If data should be transmitted via several radio technologies in the same network, you can do this by using different controllers – or you can save resources by using just one Multi Stack.

## AVAILABILITY OF STANDARD STACKS

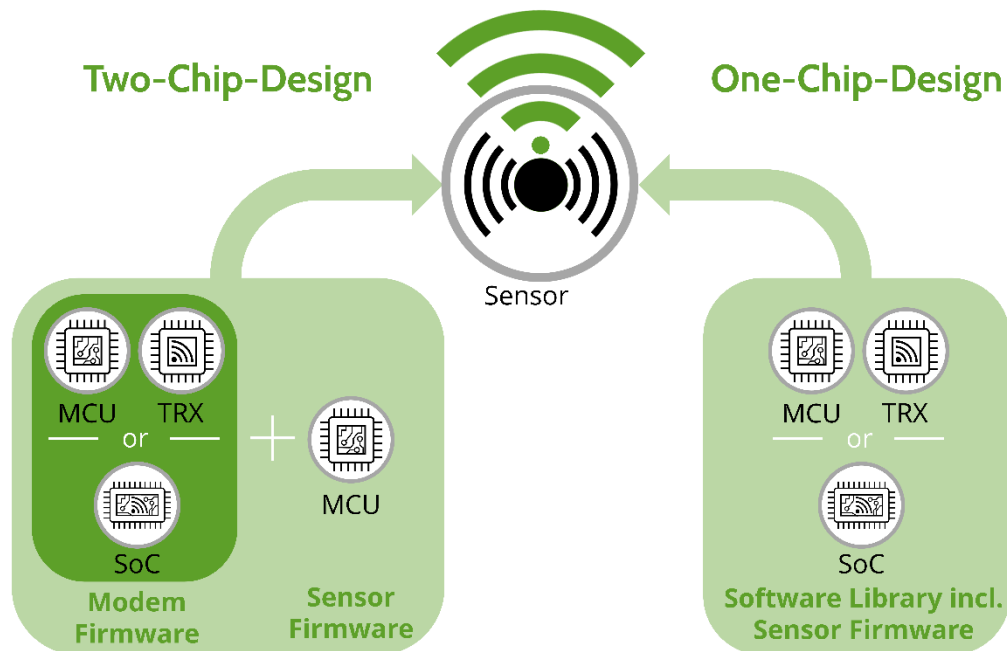
Type	wM-Bus for meters / slaves EN 13757 & OMS 4.1.2	wM-Bus for collectors / masters EN 13757 & OMS 4.1.2	mioty®	LoRaWAN®	Sigfox
Single	↑				
Single	↑↓				
Single		↑			
Single		↑↓			
Single			↑		
Single			↑↓		
Single				↓↑	
Dual	↑		↑		
Dual	↑↓		↑↓		
Dual		↑	↑		
Dual		↑↓	↑↓		
Dual	↑			↑↓	
Dual	↑↓			↑↓	
Dual		↑		↑↓	
Dual		↑↓		↑↓	
Dual			↑↓		↑↓
Dual				↑↓	↑↓
Triple	↑		↑	↑↓	
Triple			↑	↑↓	↑↓
Triple	↑↓		↑	↑↓	

↑ unidirectional communication    ↑↓ bidirectional communication

## ONE-CHIP VS. TWO-CHIP-DESIGN

In order to equip a device with a radio technology, it is important to pay attention to the details depending on the application. For example, if the device application is used on the same microcontroller as the communication software, the resources of the microcontroller and its periphery must also be shared among each other. This may be a disadvantage for very time-critical sensor applications. In general, there are three ways to run the application:

- ✓ with a Communication Module
- ✓ with the One-Chip-Design
- ✓ with the Two-Chip-Design



## COMMUNICATION MODULE

The communication module takes over the communication with the network of the chosen Technology. So, it is possible to equip an existing sensor circuit with a radio interface without major modifications if there is sufficient space available in the enclosure. The communication module is then connected to the sensor circuit via various interfaces, such as UART or SPI. If the communication module is selected, there are three options:

- ✓ use of a pre-programmed radio module,
- ✓ using the Protocol Stack as firmware in the modem version and
- ✓ using the Protocol Stack as a software library and developing custom firmware for the radio module.

The main advantage of this approach is the low development effort and the low risk of surprises when the device is certified.

## TWO-CHIP-DESIGN

An alternative to the communication module is the integration of a dedicated microcontroller together with a radio transceiver IC or a system-on-chip, which is used specifically for communication.

In terms of architecture, the two-chip approach is the same as the communication module, but this variant is more space- and cost-saving. On the software side, the two-chip approach is equally simple compared to using one communication module. However, the effort regarding the circuit is somewhat higher since a corresponding circuit board must be developed and thus the effort for product certification also increases.

## ONE-CHIP-DESIGN

The most integrated approach is the use of a technology compliant circuit on which the sensor application can be run. This variant requires only one module for the application and the communication software. A software library will be integrated into the own sensor firmware. With this library, the developer uses a complete implementation of the transmission protocol and controls the wireless transceiver IC or the wireless transceiver on the radio part of a system-on-chip.

The advantage of this approach are obviously the savings in hardware costs as well as in the minimal space requirement of the various options. However, the one-off costs for the development of this approach are significantly higher as a separate and often product-specific hardware design has to be developed.

## PROTOCOL STACK PACKAGE

The Protocol Stack Package is delivered with a pre-compiled stack library, hardware-specific drivers, a serial interface, a power management and the two app folders "Example" and "Modem".

While Example includes a suggestion of creating your own firmware, which shows how to integrate the stack library into your own application software, the app Modem allows you to create your own modem firmware using the supplied serial interface (e. g. UART, SPI, I2C, ...) and power management.

Therefore, it is possible to implement both chip architectures with the supplied Protocol Stack Package:

- ✓ To use the Protocol Stack within a One-Chip-Design (the Protocol Stack runs on the same microcontroller as the application), the app Example is required, and thus only the stack library.
- ✓ If you follow a Two-Chip-Design (the Protocol Stack is to run on a communication controller and the application is to run on a host controller), the app Modem can be accessed. This makes it possible to create your own firmware for the communication controller using the supplied serial interface and the power management. The Protocol Stack is then accessed via the host controller.



## TARGET HARDWARE



The available target hardware can be selected or a preferred one for porting specified.



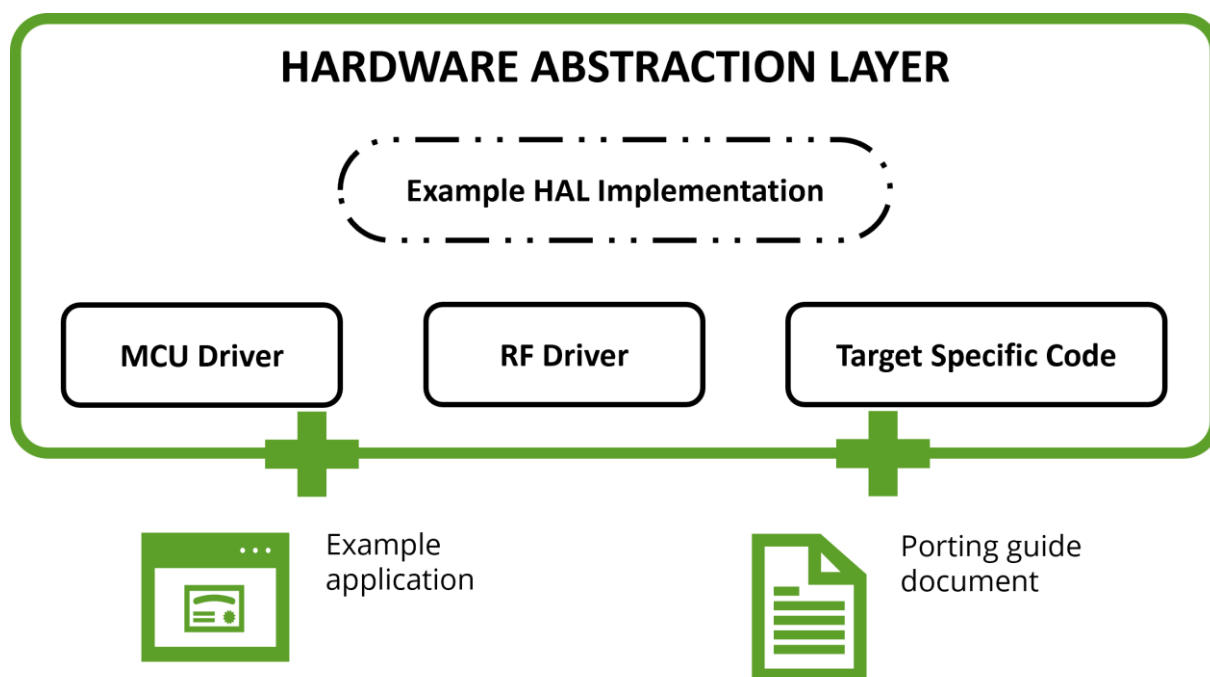
An example HAL implementation is provided for the corresponding target hardware.



A Porting guide document is available to support the target integration.



An example application is provided which is also used for the pre-certification process.



## MICROCONTROLLER AND SYSTEM-ON-CHIP

Standard Protocol Stacks are available for multiple hardware platforms, consisting of either:

- a microcontroller (MCU) in conjunction with a single chip radio resp. transceiver (TRX), or
- a system on chip (SOC) silicon.

For the mentioned hardware, the Protocol Stacks has been tested and optimized.

In general, any other hardware is possible to use. However, there is an additional effort to ensure the compatibility of the Protocol Stacks with the selected hardware. Therefore, STACKFORCE offers additional platforms.

## MICROCONTROLLER



### **STMicroelectronics**

STM2L0 family, STM32L4 family, STM32WL (M0 and M4 core)



### **Texas Instruments**

CC1310, CC1311, CC1350, CC1312, CC1352



### **Silicon Laboratories**

EFM32 Gecko family, EFR32FG14, EFR32FG23

## RADIO TRANSCEIVER



### **STMicroelectronics**

S2 LP



### **Semtech**

SX1272, SX1276, SX1261, SX1262, SX1268



### **Silicon Laboratories**

Si4461, Si4462, Si4463

## HOW TO GET STARTED?

For every project, STACKFORCE provides the ideal solution. We offer four different license packages for our Standard

Protocol Stacks. Just choose the licensing option which suits you best and you are ready to start.

Starter	Professional	Enterprise	Unlimited
<b>Commercial:</b> <i>Pre-paid royalties:</i> <ul style="list-style-type: none"> <li>100 copies</li> <li>500 copies</li> <li>1.000 copies</li> <li>5.000 copies</li> </ul>	<b>Commercial:</b> <i>Pre-paid royalties:</i> <ul style="list-style-type: none"> <li>10.000 copies</li> <li>50.000 copies</li> </ul>	<b>Commercial:</b> <i>Post-paid royalties:</i> <ul style="list-style-type: none"> <li>Upfront fee</li> <li>Quarterly reporting</li> </ul>	<b>Commercial:</b> <i>One-time fee only</i>
<b>Technical:</b> <ul style="list-style-type: none"> <li><i>Protocol Stack:</i> Object code</li> <li><i>RF Driver:</i> Object code</li> <li><i>HAL:</i> Source code</li> <li>Limited address range</li> </ul>	<b>Technical:</b> <ul style="list-style-type: none"> <li><i>Protocol Stack:</i> Object code</li> <li><i>RF Driver:</i> Object code</li> <li><i>HAL:</i> Source code</li> <li>Limited address range</li> </ul>	<b>Technical:</b> <ul style="list-style-type: none"> <li><i>Protocol Stack:</i> Object code</li> <li><i>RF Driver:</i> Object code</li> <li><i>HAL:</i> Source code</li> </ul>	<b>Technical:</b> <ul style="list-style-type: none"> <li><i>Protocol Stack:</i> Object code</li> <li><i>RF Driver:</i> Object code</li> <li><i>HAL:</i> Source code</li> </ul>
<b>Support &amp; Maintenance:</b> <ul style="list-style-type: none"> <li>No support included</li> <li>12 months of maintenance</li> </ul>	<b>Support &amp; Maintenance:</b> <ul style="list-style-type: none"> <li>1PD support within 12 months</li> <li>eMail support only</li> <li>Response time: &lt; 5 business days</li> <li>12 months of maintenance</li> </ul>	<b>Support &amp; Maintenance:</b> <ul style="list-style-type: none"> <li>1PD support within 12 months</li> <li>eMail support only</li> <li>Response time: &lt; 5 business days</li> <li>12 months of maintenance</li> </ul>	<b>Support &amp; Maintenance:</b> <ul style="list-style-type: none"> <li>2PD support within 12 months</li> <li>eMail &amp; phone support</li> <li>Response time: &lt; 2 business days</li> <li>12 months of maintenance</li> </ul>

full license conditions: <https://www.stackforce.de/application/files/3716/3471/9294/protocol-stack-license-packages.pdf>

## STANDARD STACK ADVANTAGES

- ✓ Due to a wide range of applications, the Standard Protocol Stacks are well tested and easy to integrate.
- ✓ Standard Protocol Stacks are available directly and ready to use.
- ✓ With license packages, software purchase is financially easy to plan and affordable for smaller companies.
- ✓ Standard Protocol Stacks have well-established and proven source codes.
- ✓ Updates can be implemented easily.
- ✓ Future-oriented communication standards are used.

**If adjustments are necessary, the support of our experienced team can be assigned for an additional fee**

## YOUR IOT PROJECT IS TOO INDIVIDUAL FOR OUR STANDARD SOLUTIONS?

Your IoT project is very special, because you need another combination of technologies, or your desired stack is not yet available for the platform you want? Just tell us your needs and we can also develop your personal Custom Stack fitting to your requirements and ideas. On request we offer for example:

- ✓ additional hardware drivers and porting to further hardware platforms
- ✓ adaptations and optimizations to hardware, e. g. application specific low-power operation
- ✓ customization and extensions of interfaces
- ✓ customization and extensions of protocol(s) itself
- ✓ support for additional protocols / specifications
- ✓ ...

For further information about our Standard and Custom Protocol Stacks, please contact STACKFORCE GmbH at [info@stackforce.de](mailto:info@stackforce.de).