Rust on the nRF9160

Meeting Embedded

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Nordic nRF9160 SiP

The System-in-Package

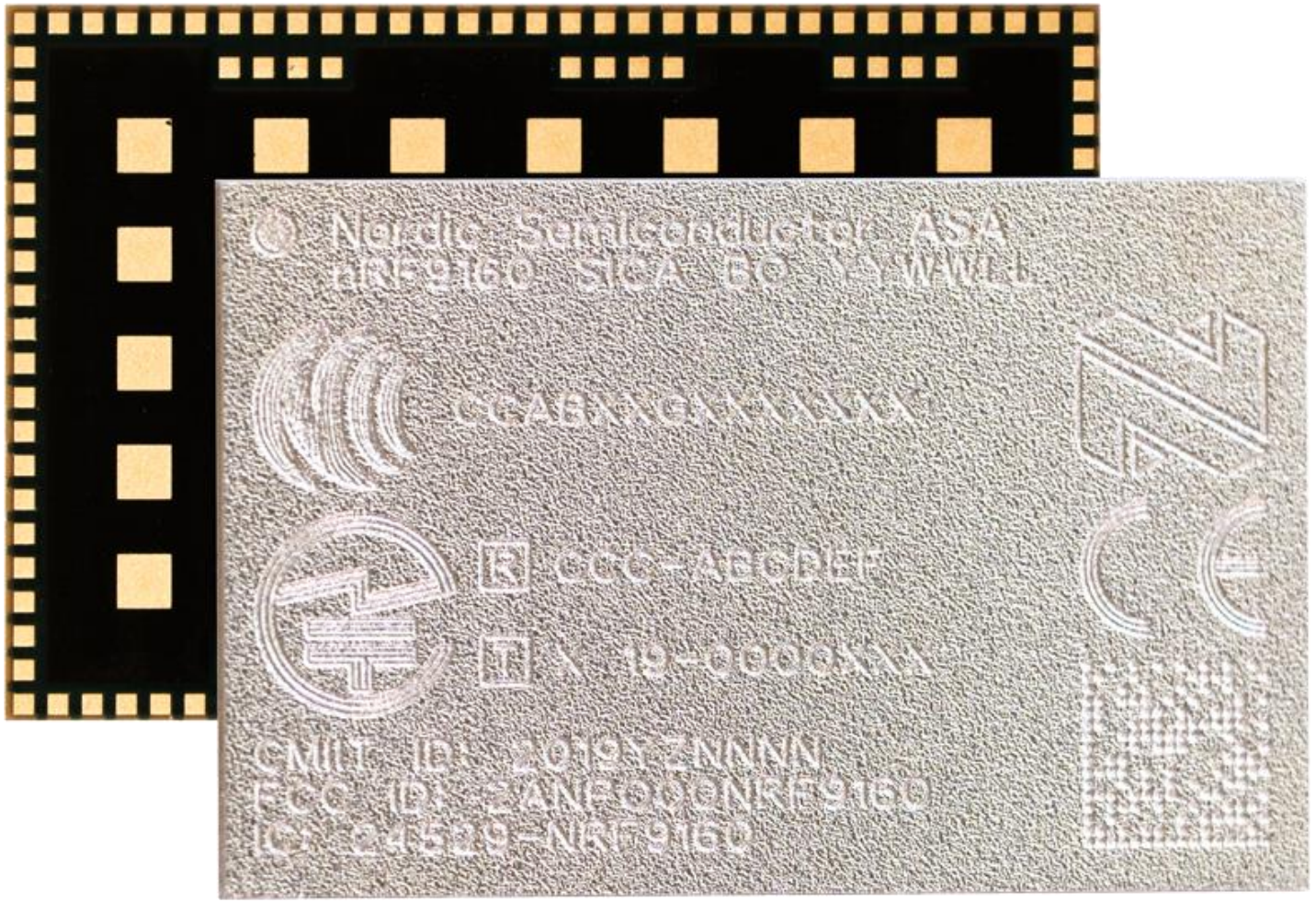
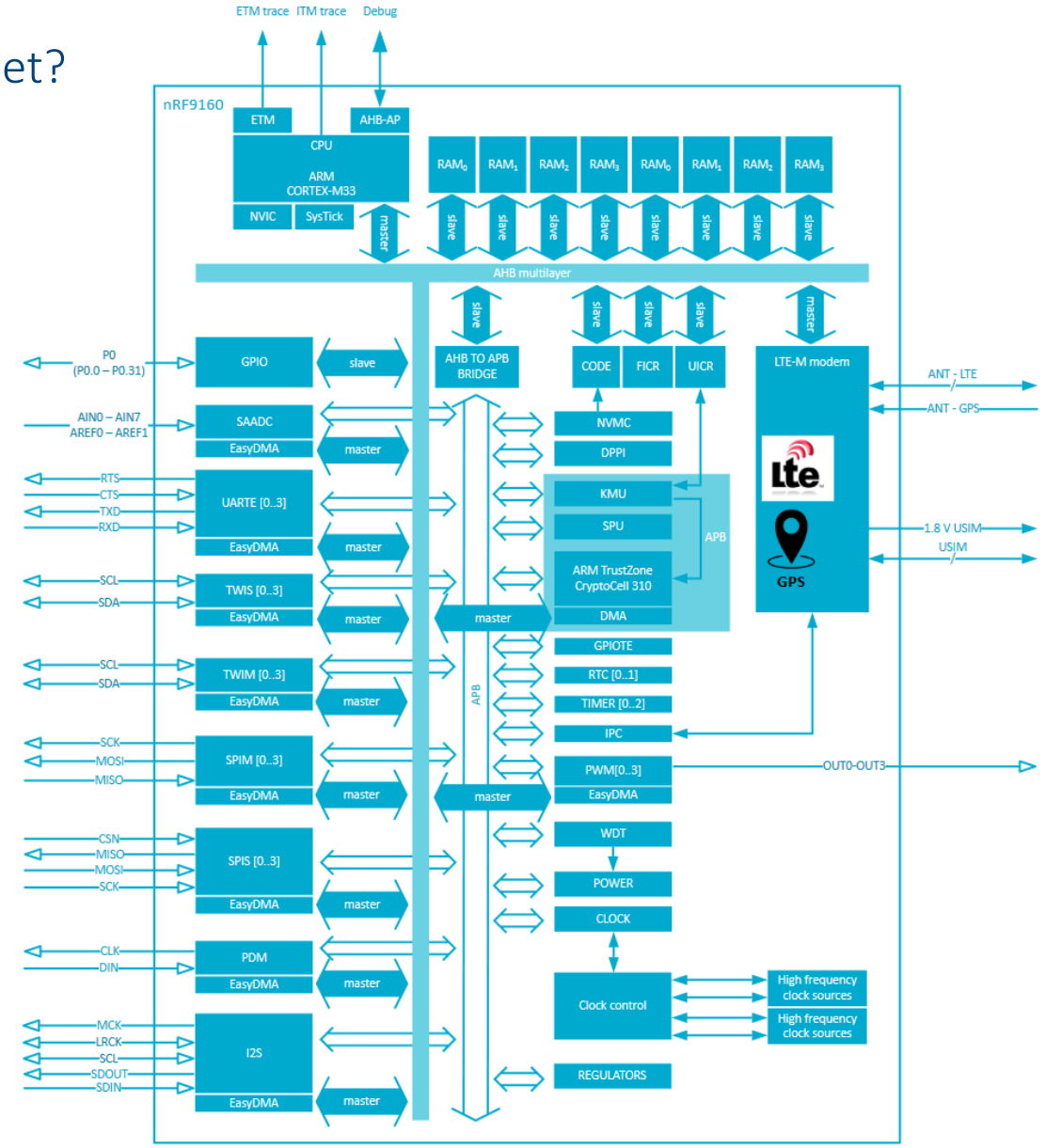


Image Copyright Nordic Semiconductor

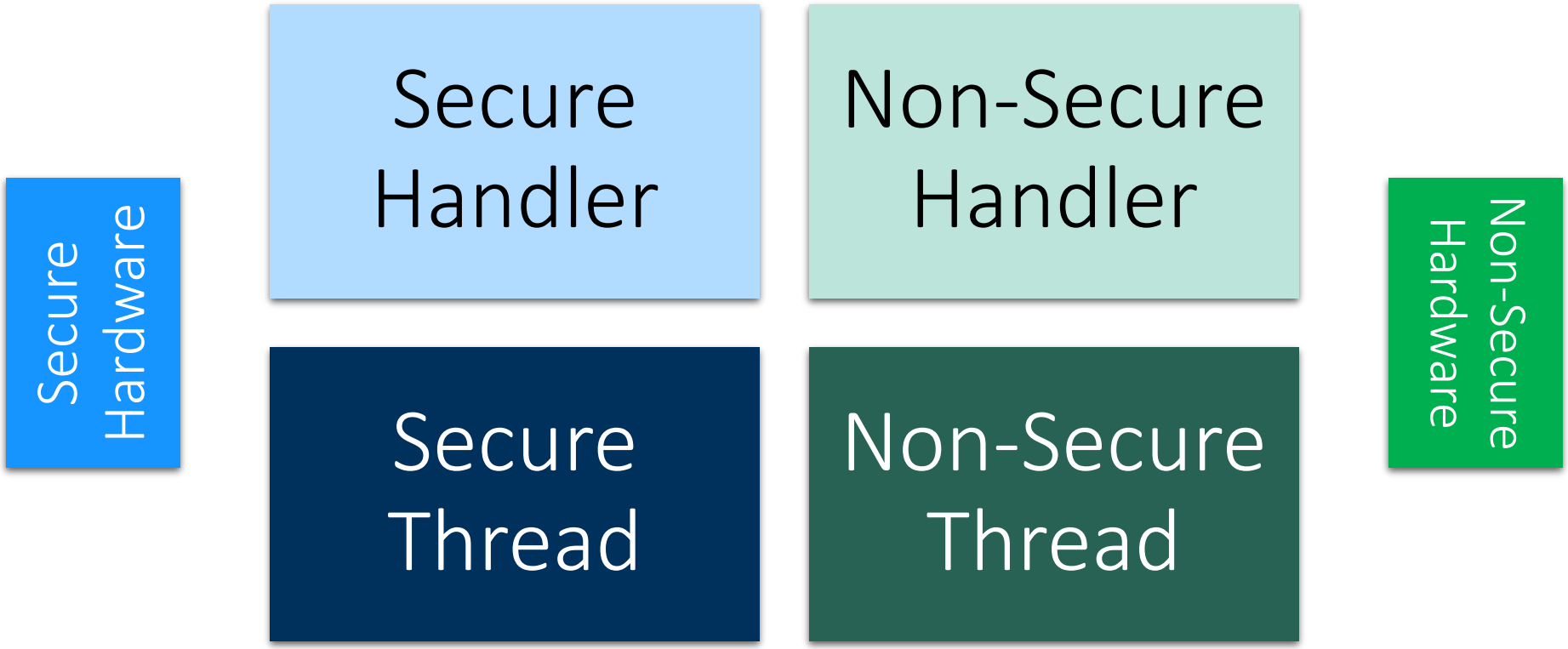
What do you get?



What do you get (in simple terms)?

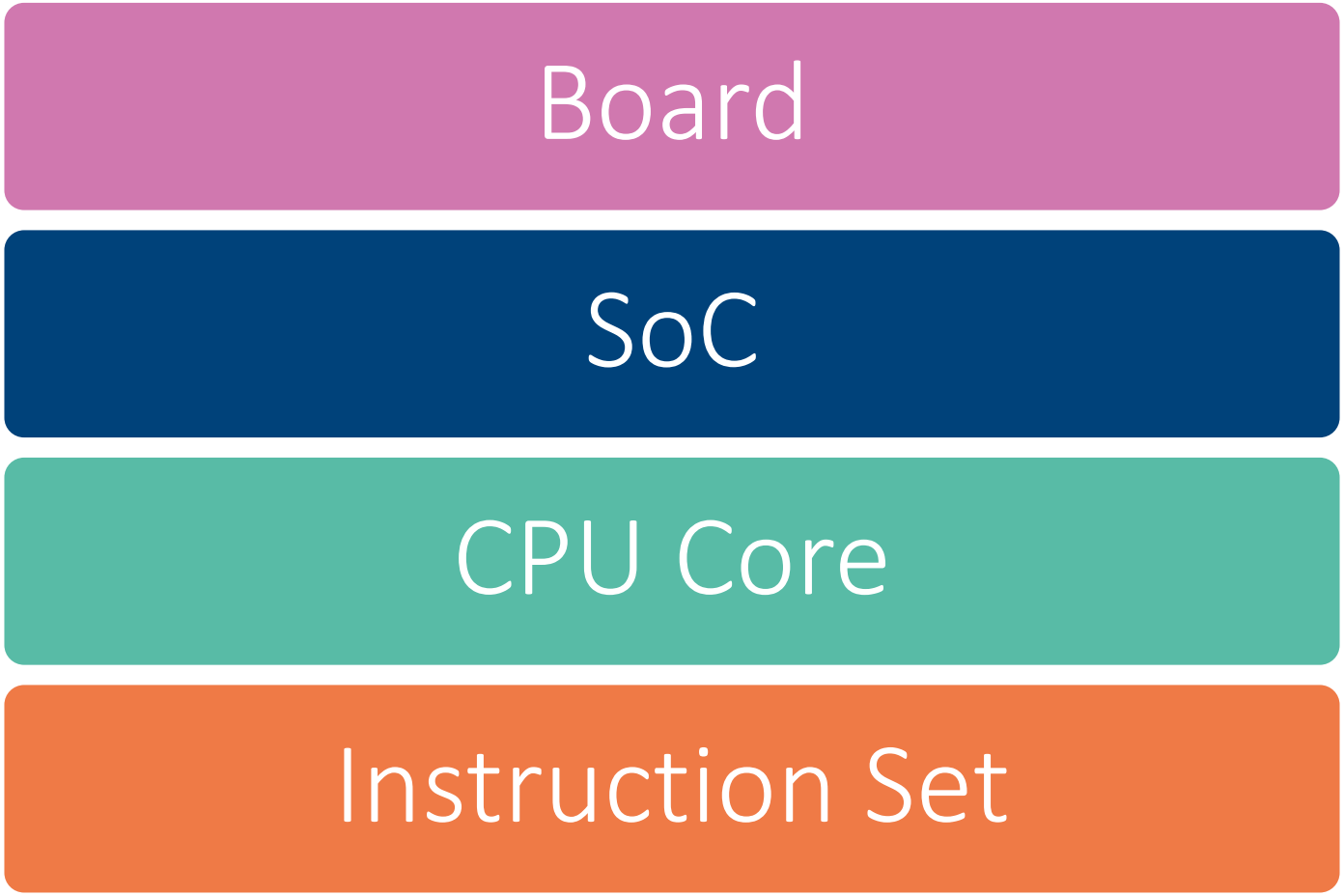
Cortex-M33 @ 64 MHz	256 KiB RAM / 1 MiB Flash	Standard Nordic Peripherals
GNSS Receiver	NB-IoT / LTE-M Baseband	SIM Interface
Mailbox / IPC	Power Supply	RF Frontend

Trust Zone M

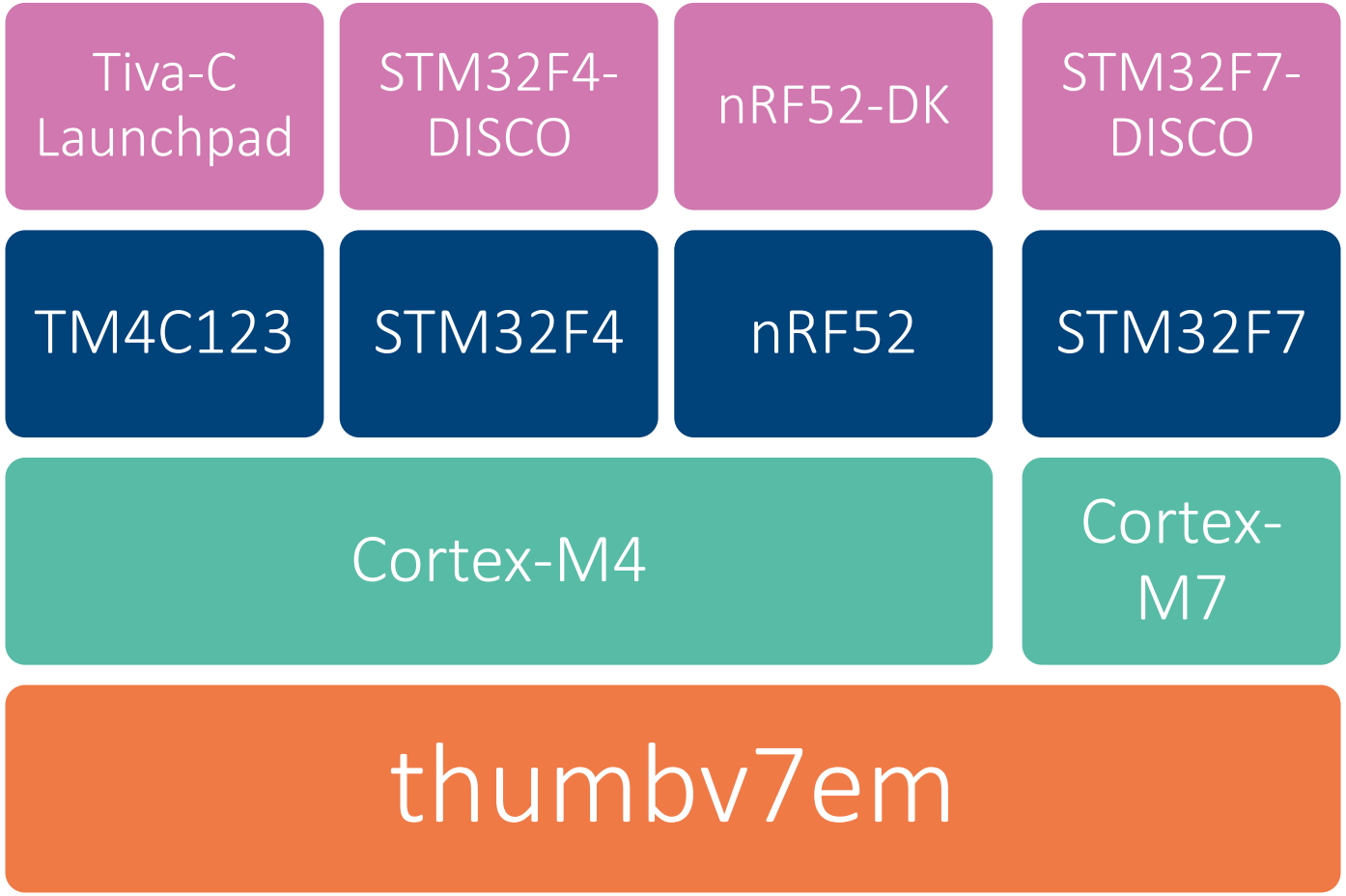


Embedded Rust

What you need



What we had



What we wanted to support

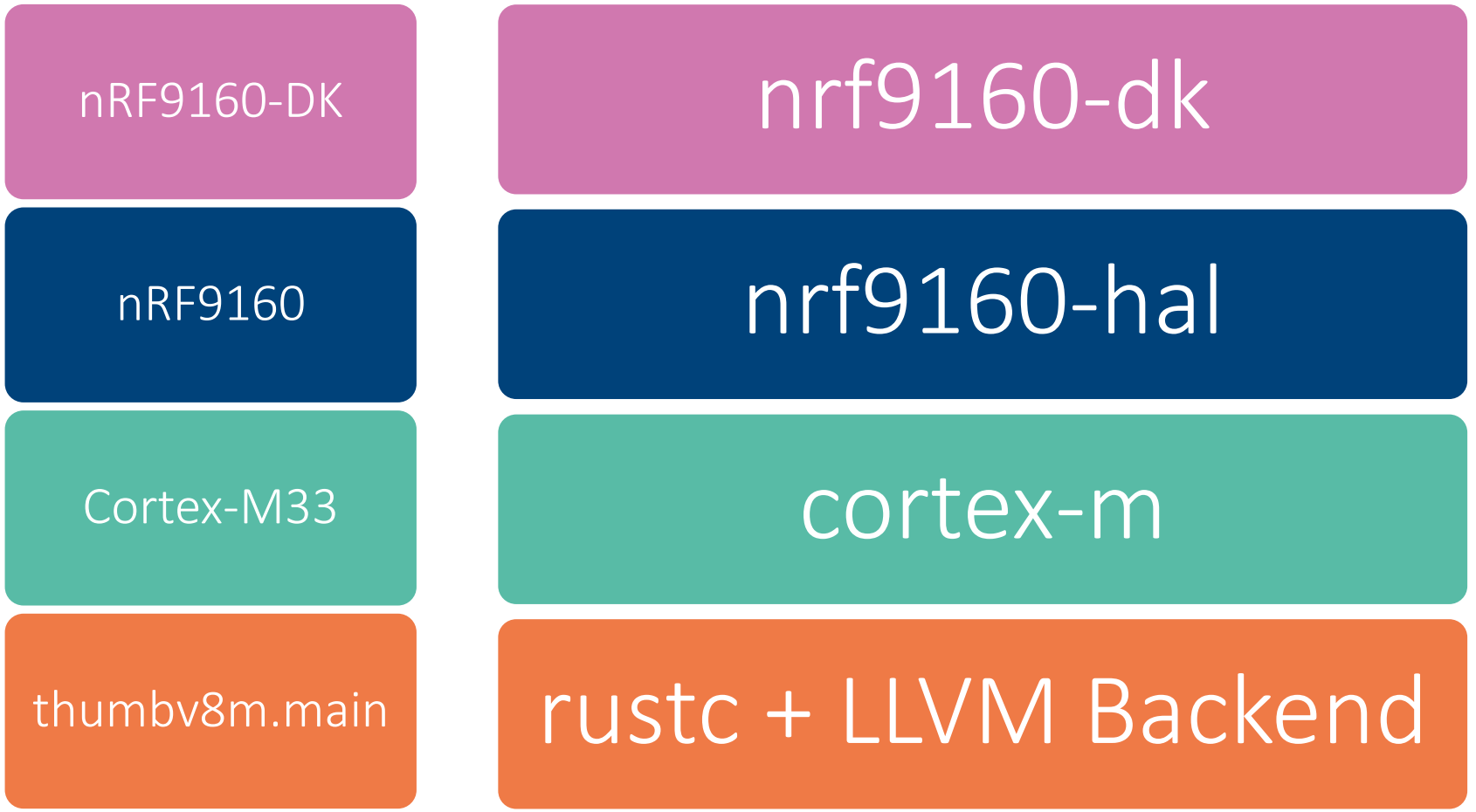
nRF9160-DK

nRF9160

Cortex-M33

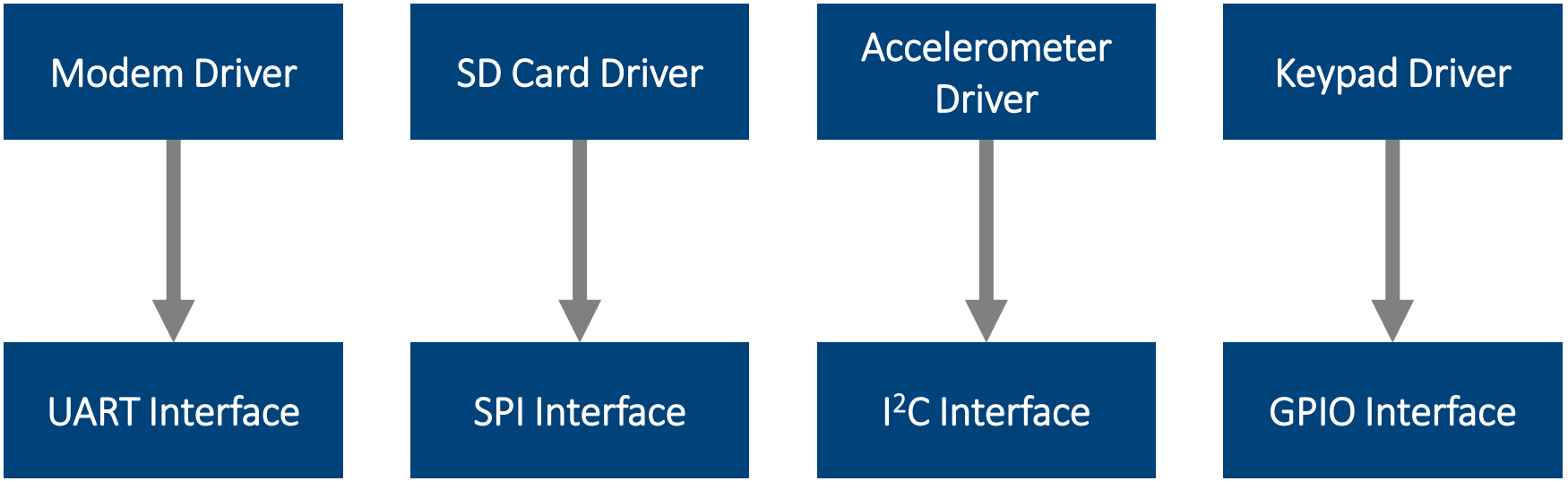
thumbv8m.main

What we did

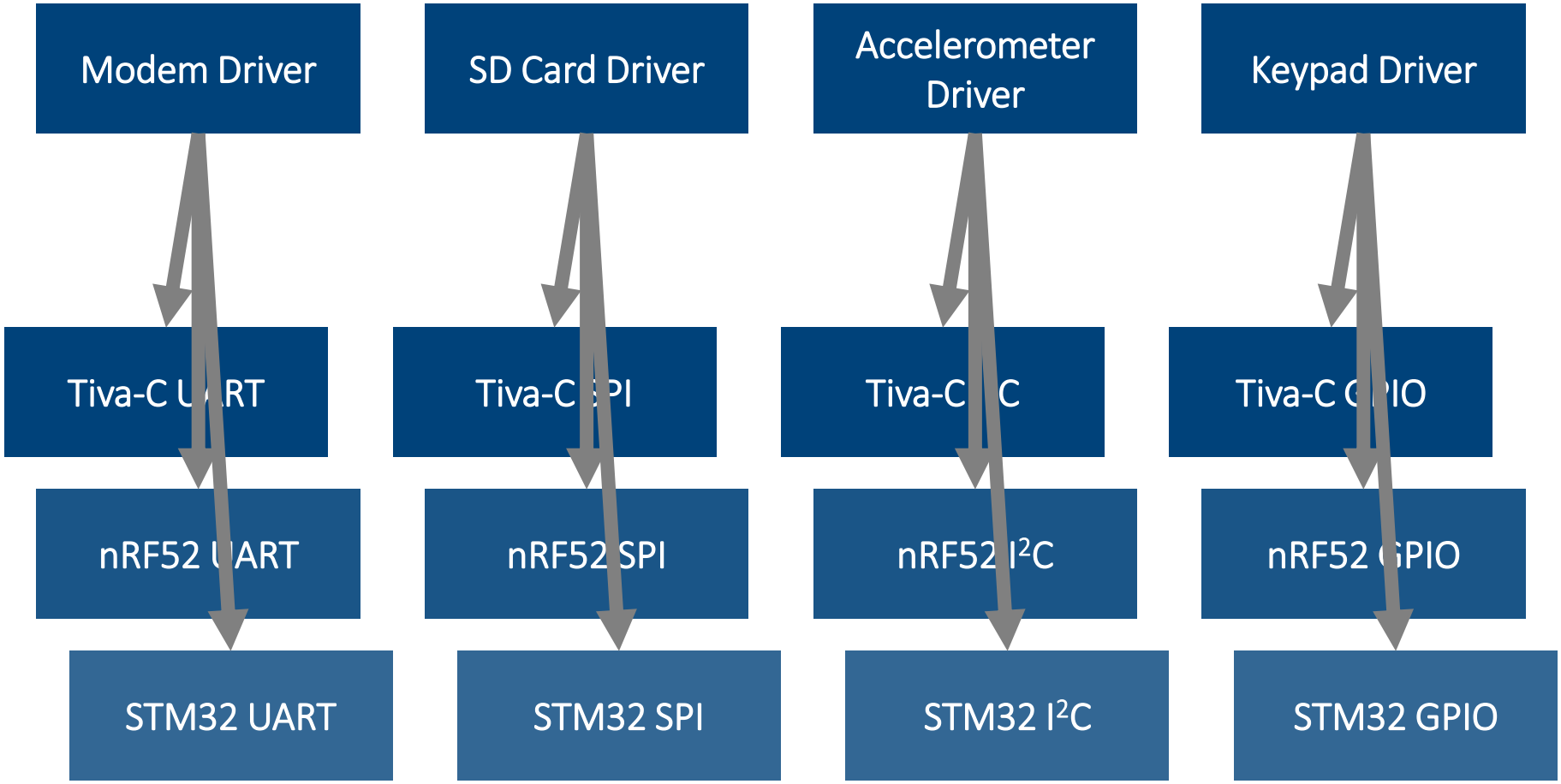


Embedded HAL

In a simple world…



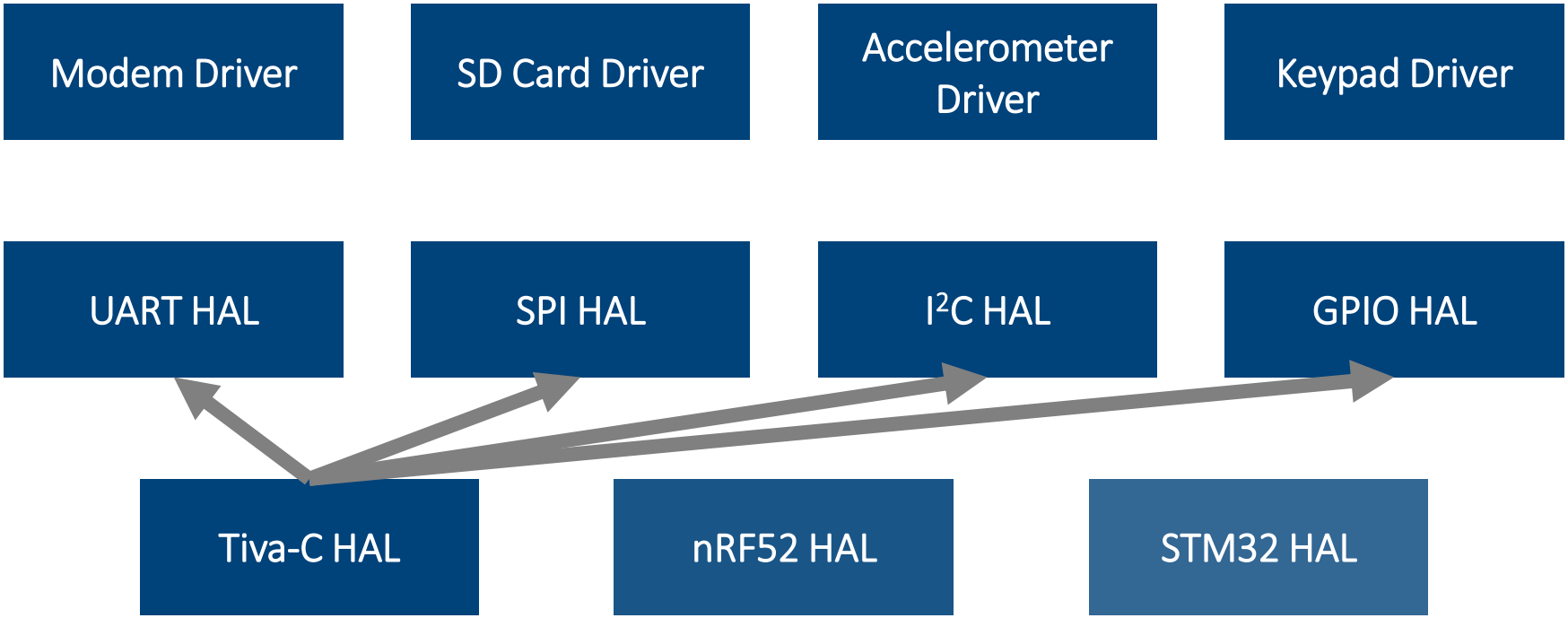
But microcontrollers don't have a lot in common…



Too many drivers!

Tiva-C Modem Driver	Tiva-C SD Card Driver	Tiva-C Accel' Driver	Tiva-C Keypad Driver
Tiva-C UART	Tiva-C SPI	Tiva-C I^2C	Tiva-C GPIO
STM32 Modem Driver	STM32 SD Card Driver	STM32 Accel' Driver	STM32 Keypad Driver
STM32 UART	STM32 SPI	STM32 I^2C	STM32 GPIO
nRF52 UART	nRF52 SPI	nRF52 I^2C	nRF52 GPIO
nRF52 Modem Driver	nRF52 SD Card Driver	nRF52 Accel' Driver	nRF52 Keypad Driver

Common Peripheral Abstractions



nRF9160 support

- We created nrf9160-hal
  - Upstreamed to nrf-rs
  - Exports parts of nrf52-common-hal

- The nrf52-common-hal uses nrf91 – a Peripheral Access Crate
  - Auto-generated with svd2rust

- Non-Secure now (maybe Secure Mode later)

What does the HAL look like?

```rust
//! Serial interface

use nb;

/// Read half of a serial interface
///
/// Some serial interfaces support different data sizes (8 bits, 9 bits, etc.);
/// This can be encoded in this trait via the `Word` type parameter.
pub trait Read<Word> {
     /// Read error
     type Error

     /// Reads a single word from the serial interface
     fn read(&mut self) -> nb::Result<Word, Self::Error>;
}

/// Write half of a serial interface
pub trait Write<Word> {
     /// Write error
     type Error

     /// Writes a single word to the serial interface
     fn write(&mut self, word: Word) -> nb::Result<(), Self::Error>;

     /// Ensures that none of the previously written words are still buffered
     fn flush(&mut self) -> nb::Result<(), Self::Error>;
}
```

Creating Safe Wrappers

Nordic's API

- Modem access is via proprietary C library
- Has a Berkley-socket style API
  - AT Commands
  - GNSS Data
  - TCP / TLS / UDP / DTLS
  - NRF_AF_INET / NRF_AF_INET6 / NRF_AF_LTE / NRF_AF_LOCAL
- Use integers as the socket ID
- Very easy to leak sockets!

Nordic's API

```
/**
 * @brief Function for creating a socket.
 *
 * @details API to create a socket that can be used for network communication
 * independently of lower protocol layers.
 *
 * @param[in] family    The protocol family of the network protocol to use.
 * @param[in] type      The protocol type to use for this socket.
 * @param[in] protocol  The transport protocol to use for this socket.
 *
 * @return A non-negative socket descriptor on success, or -1 on error.
 */
int nrf_socket(int family, int type, int protocol);
```

Nordic's API

```
int update(nrf_sockaddr_in* p_addr, const void* p_data, size_t data_len) {
    int fd = nrf_socket(NRF_AF_INET, NRF_IPPROTO_TCP, NRF_SOCK_STREAM);
    if (fd < 0) {
        return fd;
    }
    int error = nrf_connect(fd, (void*) p_addr, sizeof(*p_addr));
    if (error < 0) {
        return error;
    }
    error = nrf_send(fd, data, data_len, 0);
    if (error < 0) {
        return error;
    }
    error = nrf_close(fd);
    if (error < 0) {
        return error;
    }
    return 0;
}
```

Our Rust API

```
fn update(host: &str, port: u16, data: &[u8]) -> Result<(), Error> {
    let socket = TcpSocket::new()?;
    socket.connect(host, port)?;
    socket.send(data)?;
    ()
}
```

Our Rust API

```
fn update(
    host: &str,
    port: u16,
    data: &[u8]
) -> Result<(), Error> {
    let socket = TcpSocket::new()?;
    socket.connect(host, port)?;
    socket.send(data)?;
    ()
}
```

Our Demo

What can it do?

- Simple command-line interface
- You can manually send AT commands to the modem
- You can get a GPS fix
- You can open a TCP socket and send an HTTPS GET request

Where do I get it?

https://github.com/42-technology-ltd

https://crates.io/crates/nrfxlib

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1	Initial Issue	13 November 2019