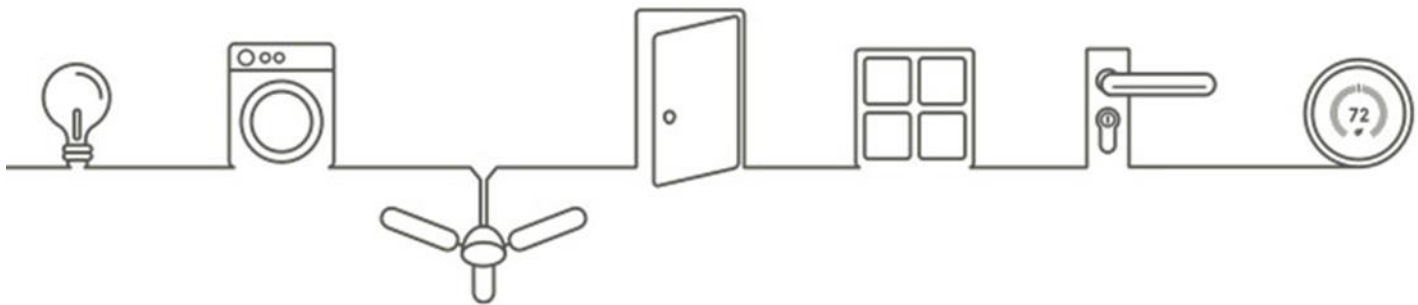




OpenThread

Nordic Semiconductor's Thread platform based on OpenThread

Krzysztof Loska

September 14th, 2017



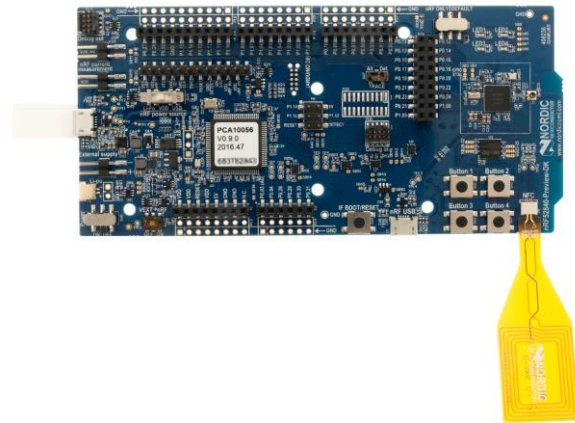
The background of the slide features a dark blue field with a bokeh effect of out-of-focus light circles. Overlaid on this is a pattern of binary digits (0s and 1s) in a lighter blue, monospace font, arranged in vertical columns that appear to be scrolling or falling from the top.

Nordic Thread platform

HW & SW

Nordic Semiconductor nRF52840 based solution

- Hardware
 - [Preview Development Kit](#) (code: NRF52840-PDK) [priced at \\$49](#)
 - [Engineering samples](#) available now, production scheduled for Q1 2018
- Software
 - OpenThread GitHub: [examples/platforms/nrf52840](#)
 - [nRF5 SDK for Thread](#)
- Unique Features:
 - Hardware-accelerated cryptography utilizing ARM® CryptoCell-310
 - Concurrent operations of Thread and Bluetooth 5 (with Long Range and 2Mbps features)
 - Built-in NFC tag
- [Docs at Infocenter](#)
- [Support at Developer Zone](#)



nRF5 SDK for Thread



- Pre-built OpenThread stack for nRF52840
- Support for many OpenThread configurations:
 - › Single-Chip, Thread-Only
 - › Single-Chip, Thread/Bluetooth LE switched and dynamic multiprotocol
 - › Network Co-Processor (NCP)
- Support for Device Firmware Update (DFU) over Thread
- Thread on-mesh commissioning with NFC example
- Fast security execution using the on-chip ARM® CryptoCell-310 cryptographic accelerator
- Border Router and cloud connectivity example
- Supported toolchains: GNU Toolchain, IAR Embedded Studio, ARM Keil (comming soon), Segger Embedded Studio (comming soon).
- Based on nRF5 SDK, inherits: peripheral drivers, BLE and NFC libraries and examples etc.
- PC tools: Thread Topology Monitor

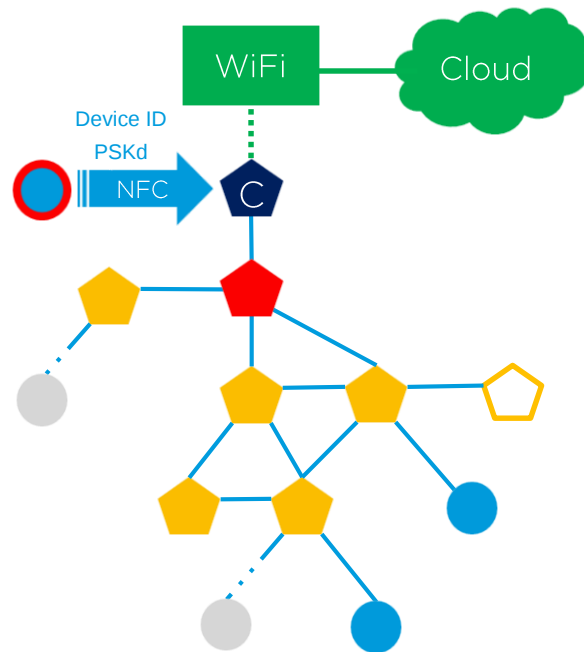
The background of the slide features a dark blue field with out-of-focus binary digits (0s and 1s) in a lighter blue color. On the right side, there is a pattern of overlapping, semi-transparent blue circles of varying sizes, creating a bokeh effect.

Thread commissioning

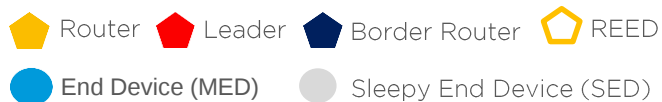
Using NFC and ARM® CryptoCell crypto accelerator

Touch-to-commission with NFC

- A commissioner must support some kind of interface (e.g. QR code, web user interface or NFC) to obtain Joiner's device ID and password.
- Touch-to-commission with NFC is the fastest, easiest and the most user friendly way of doing it.



Legend:



ARM® CryptoCell integration with mbedTLS

- ARM® CryptoCell integrated with mbedTLS accelerates cryptographic operations used by OpenThread: ECC, SHA-256 and AES ECB
- Time comparison of Thread Commissioning procedure:

	Commissioning (with Discovery)	DTLS Handshake
Without CryptoCell	37,68 s	32,88 s
With CryptoCell	6,31 s	1,51 s

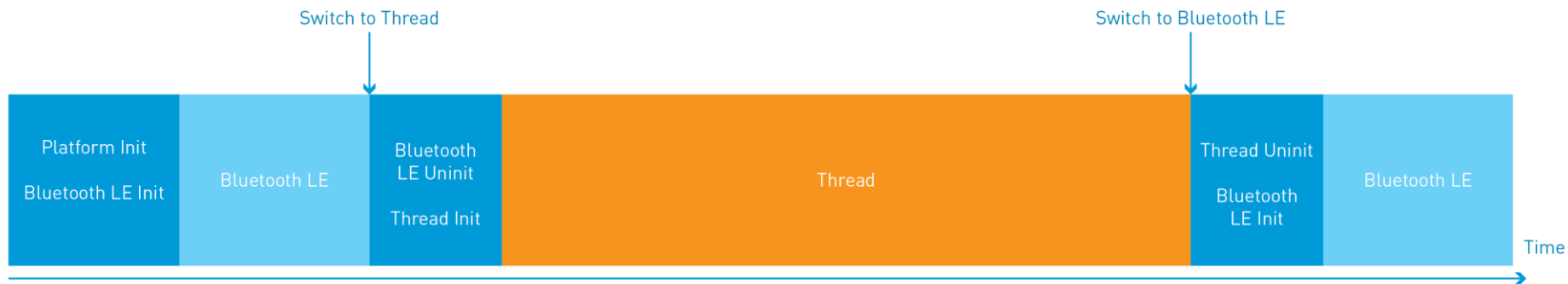
The background of the slide features a dark blue field with a bokeh effect of out-of-focus light circles. Overlaid on this is a pattern of binary digits (0s and 1s) in a lighter blue, monospace font, arranged in vertical columns that appear to be receding into the distance.

Multiprotocol solutions

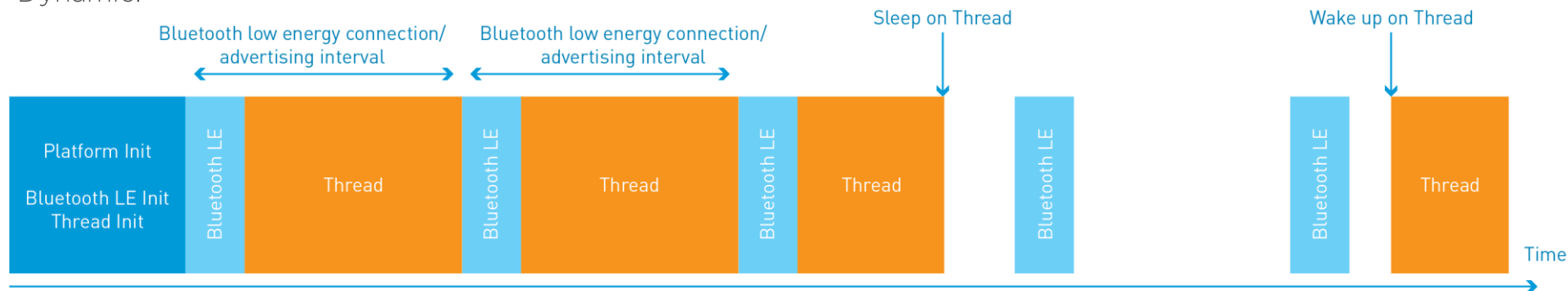
Switched and dynamic approach

Switched vs dynamic multiprotocol support

Switched:



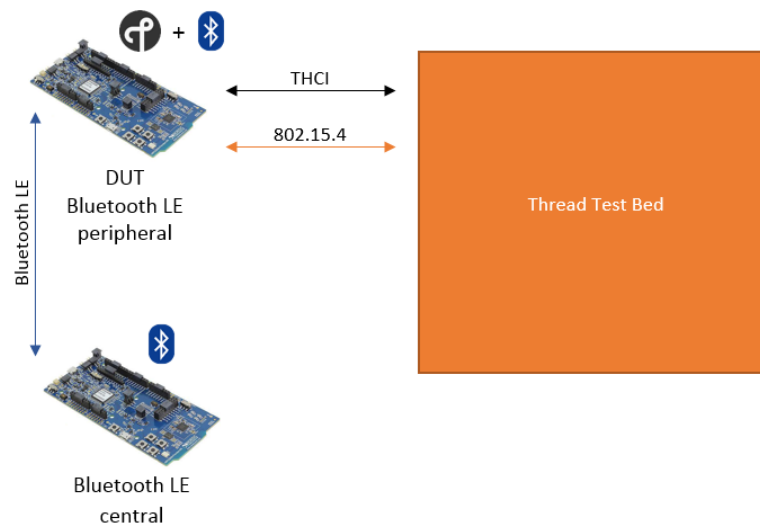
Dynamic:



Multiprotocol solutions comparison

- Switched multiprotocol
 - Only one protocol in use
 - Losing connections when switching protocols
 - Protocol switching is noticeable by user
- + Protocols do not interfere with each other
- Dynamic multiprotocol
 - + Multiple protocols concurrently running
 - + Preserving connections when protocols are switching
 - + Protocol switching is seamless for application user
 - One protocol may decrease performance of another protocol

Thread Certification - nRF52840 SoC



BLE operation	Thread timeslot	Effective radio activity
Connection - 200 ms		
Each 1s ~18B of ATT is sent by Peripheral	99,22%	96%
Each 1s ~18B of ATT is sent by Central		

Dynamic multiprotocol solution – simplicity on app layer

```
static void send_coap_frame (void)
{
    [...]

    message_info.mPeerPort = OT_DEFAULT_COAP_PORT;
    message_info.mPeerAddr = CLOUD_ADDRESS;

    otCoapSendRequest(mp_instance, p_req, &message_info, NULL, NULL);
}

int main(int argc, char *argv[])
{
    timer_init();
    thread_bsp_init();
    leds_init();

    thread_init();

    while (true)
    {
        otTaskletsProcess(mp_instance);
        PlatformProcessDrivers(mp_instance);

        if (!otTaskletsArePending(mp_instance))
        {
            __WFE();
        }
    }
}
```

OpenThread only – single PHY

```
static void send_coap_frame (void)
{
    [...]

    message_info.mPeerPort = OT_DEFAULT_COAP_PORT;
    message_info.mPeerAddr = CLOUD_ADDRESS;

    otCoapSendRequest(mp_instance, p_req, &message_info, NULL, NULL);
}

int main(int argc, char *argv[])
{
    timer_init();
    thread_bsp_init();
    leds_init();

    ble_init();
    thread_init();

    advertising_start();

    while (true)
    {
        otTaskletsProcess(mp_instance);
        PlatformProcessDrivers(mp_instance);

        if (!otTaskletsArePending(mp_instance))
        {
            sd_app_evt_wait();
        }
    }
}
```

OpenThread with Bluetooth LE – dynamic multiprotocol

The background of the slide features a dark blue field with a bokeh effect of out-of-focus light circles. Overlaid on this is a pattern of binary digits (0s and 1s) in a lighter blue, monospace font, arranged in vertical columns that appear to be receding into the distance.

PC tools

Thread Topology Monitor

Thread Topology Monitor



Questions?

krzysztof.loska@nordicsemi.no

