



PARTNER
WEBINAR

 **Memfault**

NORDICTECH
WEBINARS



Building more reliable
Bluetooth LE products
with Memfault

Today's hosts

Heiko Behrens



Head of Product

Devon Yablonski



Partnerships

Ali Aljaani

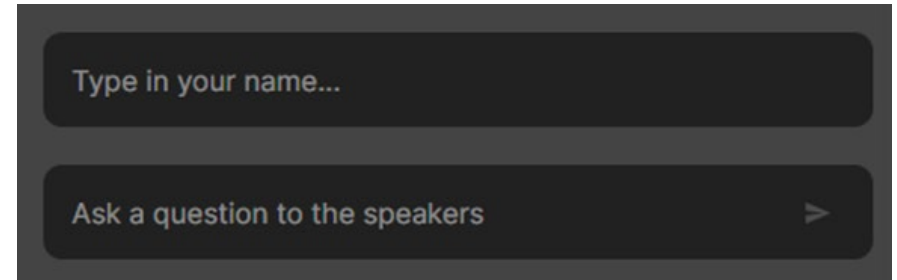


Developer Marketing
Manager

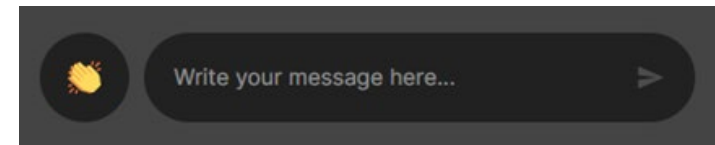


Practicalities

- Duration: ~ 45 min presentation, 15 min Q&A
- Questions are encouraged!
 - Please type questions in the top of the right sidebar
 - All questions are anonymous
 - We will answer them toward the end
- The chat is not anonymous and should not be used for questions
- If you have more questions:
 - Go to [DevZone](#) for Nordic-related questions
 - Go to <https://memfault.com/contact/> for help with Memfault platform
- Recording of the webinar will be available together with the presentation at webinars.nordicsemi.com/on-demand



A screenshot of a dark-themed sidebar interface. It features two input fields. The top field is labeled "Type in your name..." and the bottom field is labeled "Ask a question to the speakers" with a right-pointing arrow icon.



A screenshot of a dark-themed chat input field. It includes a circular profile picture icon on the left, a text input area labeled "Write your message here..." with a right-pointing arrow icon, and a small yellow starburst icon.

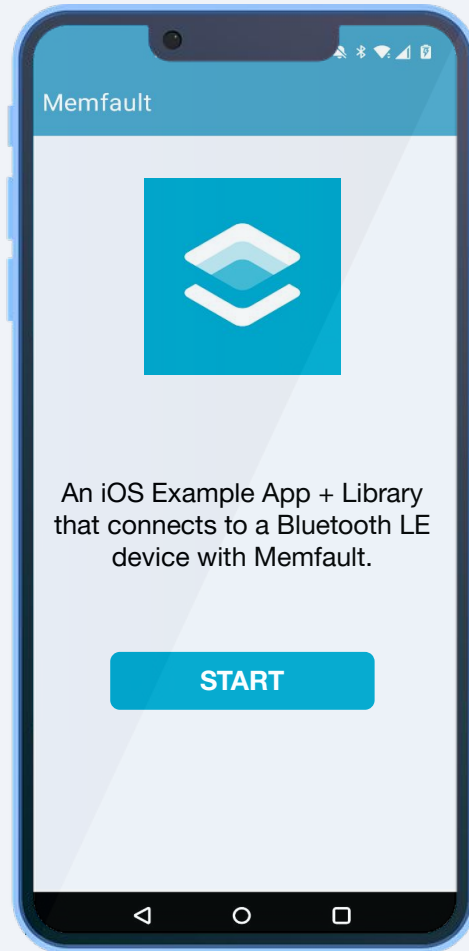


Memfault Partnership

- Enables our customers to ship devices with confidence.
- Deep insights into deployed devices' performance.
- Complete reliability platform
 - Monitor
 - Remote debug
 - Over-the-air updates
- nRF9160 SiP support added since nRF Connect SDK v1.6.0
- Now we have nRF52 and nRF53 Series support in nRF Connect SDK v2.1.0 (the focus of this webinar)



Today's Presentation



nRF Connect SDK now with Memfault for Bluetooth LE!

What is Memfault?

Memfault
for nRF52 & nRF53

Live Demo

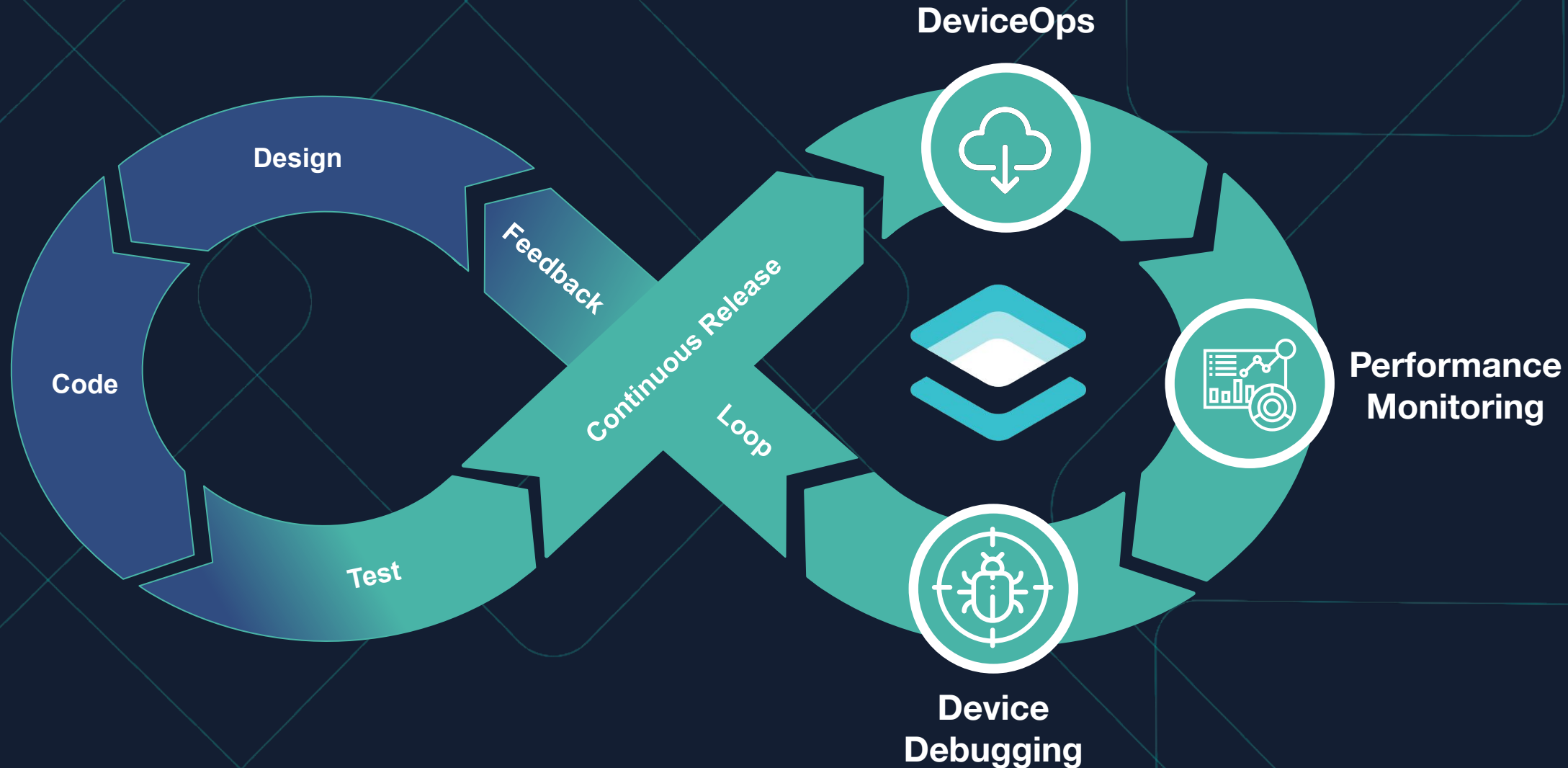
Q&A

We **empower** IoT device developers to build more **reliable** software

We believe that device reliability engineering gives developers a more scalable and sustainable process to transform the way they build and operate IoT and edge devices.



Memfault: Device Reliability Engineering



Issue Analysis At Scale

Detect problems



Automatically label and gain insights

Top Issues

	Issue	Devices	Traces
Assert	Assert at timeout_handler_exec	29556	
Assert	Assert at prv_recursive_crash	20404	
Hard Fault	Hard Fault at prv_crash_example	20672	
Assert	Assert at prv_check1	20852	
Assert	Assert at cli_execute	19712	

Memfault finds the **bugs you care about**

Debug Crashes 100% remotely

Memfault

Smart Sink / Issues

Mem Fault at compute_fft [Stack Overflow in accel-workq]

Resolve Merge

11 Merge

First Seen 2 days ago Last Seen 2 days ago Recent Traces 11,717 Devices Impacted 10,420

Details Recent traces Comments Merged issues

Device DEMOSERIALNUMBER
Cohort default
Software 1.0.0-md5+a1c641ba (main)
Hardware DEVBOARD

State Logs

Threads

- accel-workq (2) **STACK OVERFLOW** **RUNNING**
 - 0 compute_fft in .../src/fft.c at line 10
 - 1 sleep_algo_compute_sleep_time in .../src/sleep_algo.c at line 12
 - 2 process_accel_data_worker_task in .../src/accel_data.c at line 108
 - 3 z_work_q_main in .../zephyr/lib/os/work_q.c at line 32
 - 4 z_thread_entry in .../lib/os/thread_entry.c at line 29
 - 5 0xxxxxxxxx
- Thread 3 **SUSPENDED**
- idle (4) **READY**
- logging (5)
- net_mgmt (6)
- rx_workq (7) **BLOCKED**
- shell_uart (8) **BLOCKED**
- sysworkq (9) **BLOCKED**
- tx_workq (10) **BLOCKED**
- workqueue (11) **BLOCKED**

Exceptions Registers & Locals Globals & Statics Heap

Memory Viewer

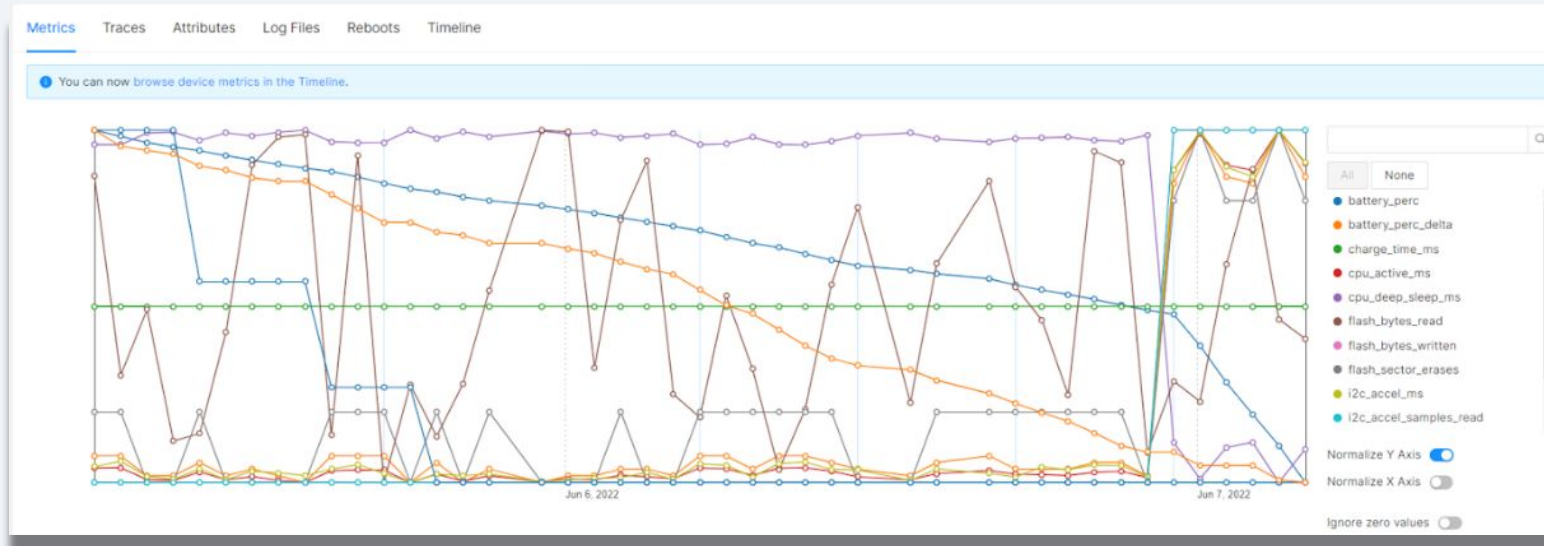
Find Address Regions

```
0x00000000 00 e1 00 20 95 9e 00 08 ... ..  
0x00000008 25 9e 00 08 81 9d 00 08 %... ..  
0x00000010 81 9d 00 08 81 9d 00 08 ... ..  
0x00000018 81 9d 00 08 81 9d 00 08 ... ..  
0x00000020 81 9d 00 08 81 9d 00 08 ... ..  
0x00000028 81 9d 00 08 9d 9b 00 08 ... ..  
0x00000030 81 9d 00 08 81 9d 00 08 ... ..  
0x00000038 41 9b 00 08 ed 95 00 08 A... ..  
0x00000040 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000048 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000050 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000058 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000060 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000068 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000070 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000078 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000080 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000088 6d 9e 00 08 6d 9e 00 08 m... m...  
0x00000090 6d 9e 00 08 6d 9e 00 08 m... m...
```

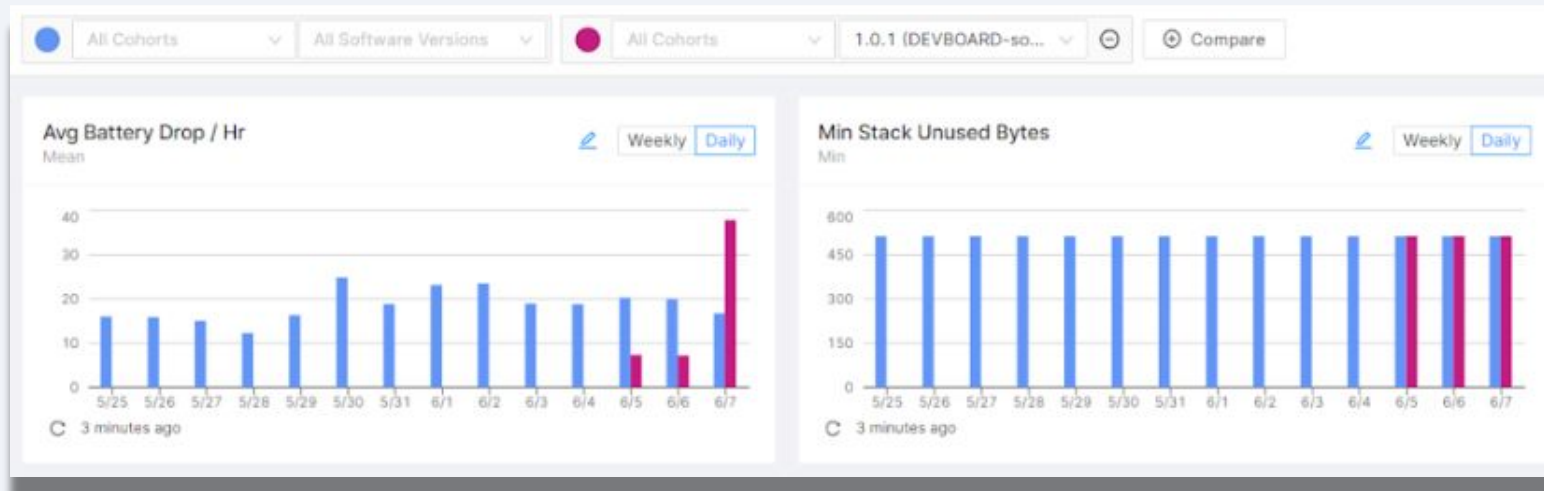
Memfault eliminates the need to recreate bugs

Metrics with 2 Lines of Code

Device Time Series Metrics



Fleet Aggregate Metrics with Version Comparisons



Proactive Issue Detection

Edit Alert Delete ×

*** Title**
Devices with Poor Signal

Description
Less than 80 dBm is a pretty poor connection with degraded behavior expected.

*** Notification Targets** [Manage available Notification Targets](#)
@chris ×

Enabled

Condition
Wifi_SignalStrength < -80

Scope
+ and condition

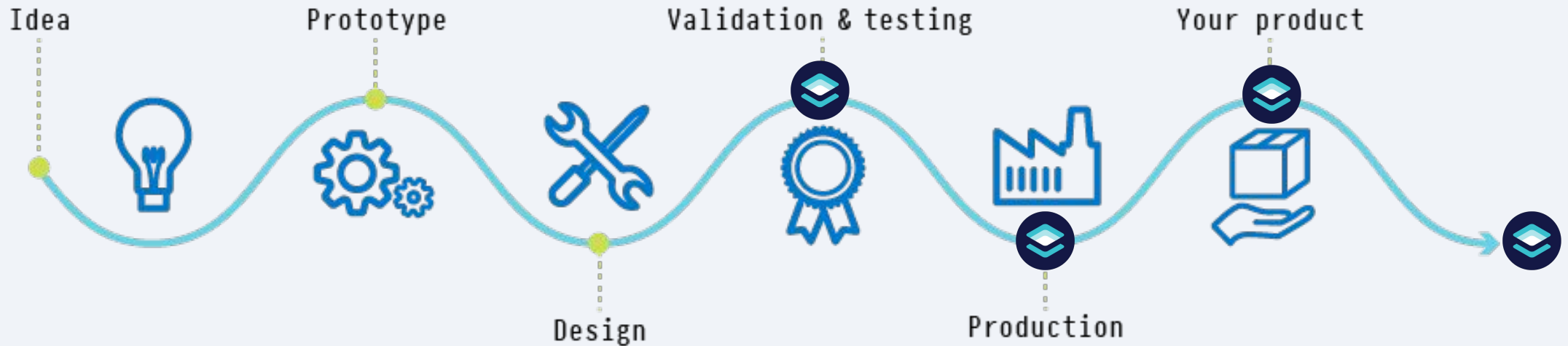
Cancel OK

Alerts

[+ Create Alert](#)

Alert	Devices impacted Last three days	Enabled	Type	Edit
High CPU Usage on Production Notifies @engineering Notification Group via email, and sends Slack and PagerDuty alerts	N/A	<input checked="" type="checkbox"/>	Fleet Alert	✎
Flash Sector Erase Count Too High Exceeded the warning limit for flash sector erases	21	<input checked="" type="checkbox"/>	Device Alert	✎
Heap Free Bytes Under Threshold Free heap space is below warning threshold	17	<input checked="" type="checkbox"/>	Device Alert	✎
Main Task Stack Free Space Under Threshold Free stack space in the main task is below warning threshold	22	<input checked="" type="checkbox"/>	Device Alert	✎
Battery Rapid Discharge Extremely rapid battery discharge	22	<input checked="" type="checkbox"/>	Device Alert	✎
Low Device Battery Alert Devices reporting low battery state of charge	21	<input checked="" type="checkbox"/>	Device Alert	✎

Memfault - Nordic Solution Partner



Memfault is included **for free in
nRF Connect SDK v1.6+ on any Nordic chipsets**

The idea started with Bluetooth



Memfault for **Bluetooth Device Reliability**



Designed to work with
Bluetooth Connected
IoT



Associate Member of
the Bluetooth SIG



Out-of-the-box support
for nRF52 & nRF53
devices

“Integrating Memfault into our Nordic chipsets allowed our team to access high quality field diagnostics data from our wearable technology and improve product performance.”

Bill Diken, Director of Embedded Engineering at Whoop



**Customers reduce the
number of resets per
device by 90%**

Our Customers



AIRTHINGS



Verkada

logitech

BOSE

LATCH



ENPHASE®

MOLEKULE



HEALTH & FITNESS



Owlet



samsara

flock safety

WHOOP®

SUNPOWER®

How does it work?

Life of a coredump

1

Device experiences an issue

```
void foo(void) {  
    void (*a_ptr)() = NULL;  
    a_ptr();  
}
```



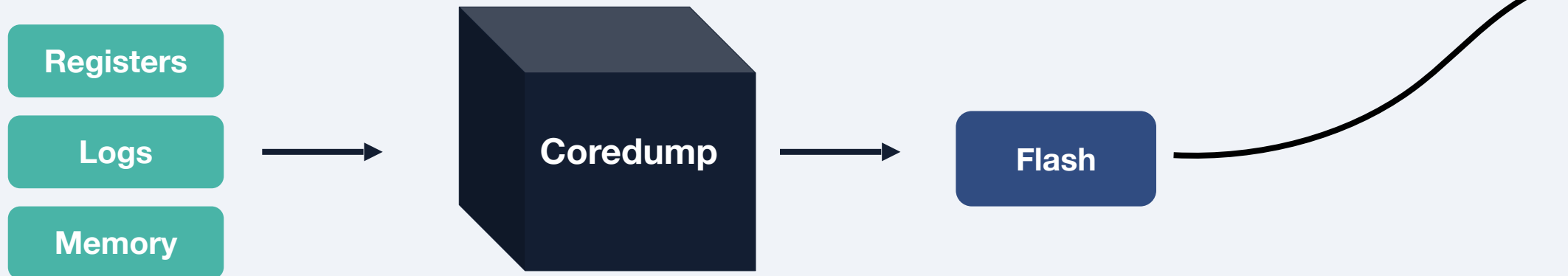
2

The Memfault SDK is invoked

```
void Hardfault_Handler() {  
    ...  
    memfault_fault_handler(regs, reason);  
}
```

3

Memfault saves useful data to non-volatile storage



Life of a coredump (cont'd)

4

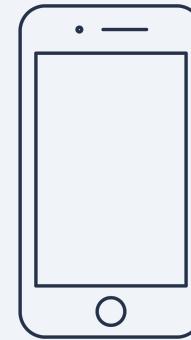
The data is broken into chunks



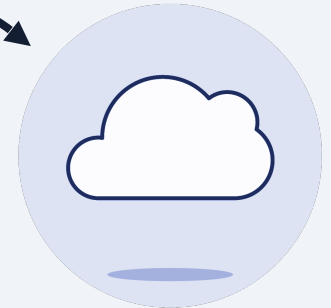
5

The chunks are sent to the Memfault cloud

Bluetooth LE



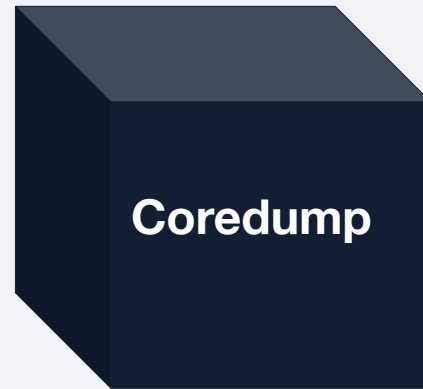
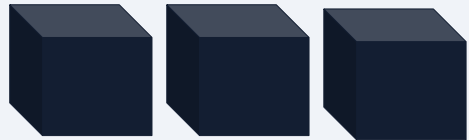
LTE



Life of a coredump (cont'd)

6

Memfault reassembles the data



7

Memfault then analyzes, symbolicates, and deduplicates it



Backtrace



Variables



Analysis



Life of a coredump (cont'd)

8

Memfault visualizes details, provides overviews, and enables monitoring via alerts

Mem Fault at compute_fft [Stack Overflow in accel-workq]

Resolve Merge

Details Recent traces Comments Merged issues First Seen Last Seen Recent Traces Devices Impacted

3 days ago a day ago 4 4

Device DEMOSERIALNUMBE2
Cohort default
Software 1.0.0-md5+a1c641ba (main)
Hardware DEVBOARD

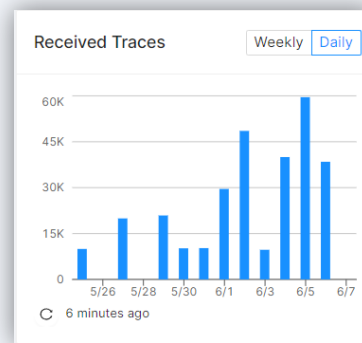
State Logs

Threads

- accel-workq (2) **STACK OVERFLOW** RUNNING
 - 0 compute_fft in ..._fft.c at line 10
 - 1 sleep_algo_compute_sleep_time in ..._sleep_algo.c at ...
 - 2 process_accel_data_worker_task in ..._accel_data.c at ...
 - 3 z_work_q_main in ..._zephyr/lib/os/work_q.c at line 32
 - 4 z_thread_entry in ..._lib/os/thread_entry.c at line 29
 - 5 0xa0000000
- Thread 3
 - idle (4)
 - logging (5)
 - net_mgmt (6)
 - rx_workq (7)
 - shell_uart (8)
 - sysworkq (9)
 - tx_workq (10)
 - workqueue (11)

Exceptions Registers & Locals **Globals & Statics** Heap ISR

eswifi_spi_poll_stack = k_thread_stack_element[1056] (-)
curr_tick = u64_1 106587
my_device = device_info (-)
my_work_q = k_work_q (-)
s_debug_log = uint8_t[2048] (-)
wifi_mgmt_mgmt_cb = net_mgmt_event_callback (-)
fdtable = fd_entry[4] (-)
buffered_cnt = atomic_t 0
dropped_cnt = atomic_t 0
initialized = atomic_t 1
list = log_list_t (-)
log_strdup_pool = k_mem_slab (-)
logging_thread = k_thread (-)
proc_tid = k_tid_t (-)
log_msg_pool = k_mem_slab (-)
freq = u32_t 1000
timestamp_div = u32_t 1
_ring_buffer_data_shell_transport_uart_rx_ringbuf = u8_t[64] (-)
_ring_buffer_data_shell_transport_uart_tx_ringbuf = u8_t[6] (-)
backend_cb_shell_uart_backend = log_backend_control_block (-)



Top Issues

Issue	Devices	Traces
Assert at timeout_handler_exec	29556	
Assert at prv_recursive_crash	20404	
Hard Fault at prv_crash_example	20672	
Assert at prv_check1	20852	
Assert at cli_execute	19712	

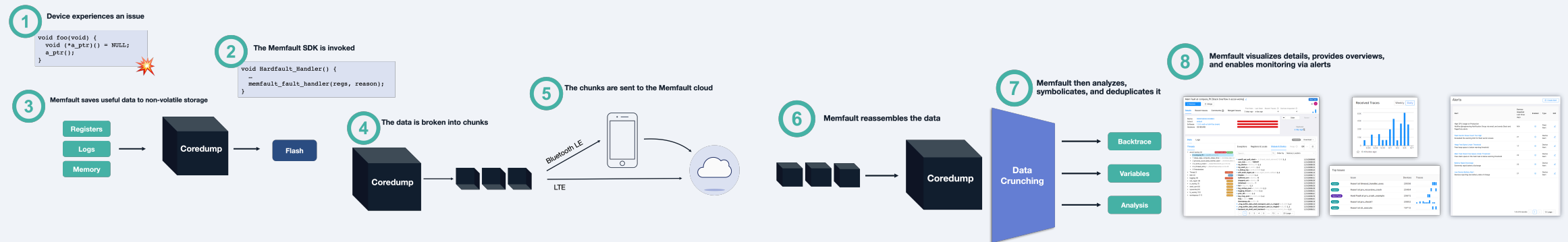
Alerts Create Alert

Alert	Devices Impacted Last three days	Enabled	Type	Edit
High CPU Usage on Production Notifies @engineering Notification Group via email, and sends Slack and PagerDuty alerts	N/A	ⓘ	Fleet Alert	✎
Flash Sector Erase Count Too High Exceeded the warning limit for flash sector erases	21	ⓘ	Device Alert	✎
Heap Free Bytes Under Threshold Free heap space is below warning threshold	17	ⓘ	Device Alert	✎
Main Task Stack Free Space Under Threshold Free stack space in the main task is below warning threshold	22	ⓘ	Device Alert	✎
Battery Rapid Discharge Extremely rapid battery discharge	22	ⓘ	Device Alert	✎
Low Device Battery Alert Devices reporting low battery state of charge	21	ⓘ	Device Alert	✎

1-6 of 6 records 1 10 / page

Memfault's Data Path

★ ...and what's new in nRF Connect SDK v2.1.0



Memfault + nRF Connect SDK

Connectivity

Memfault Platform



- ★ Memfault Diagnostic Service (MDS)
- ★ Nordic nRF Memfault App



Live Demo

Resources to get started on your own:

- [Create Memfault Account for up to 100 Devices Free](#)
- [Memfault nRF Connect SDK Integration Guide](#)
- [Sample from nRF Connect SDK v2.1.2 nRF](#)

Product Updates

Incremental System Updates via Memfault

Memfault Version Matrix / Cohorts: default

Details: Slug: default, Size: 80 devices, Name: default

Version Management: Distribution Settings

Device Distribution

Software Version	# Devices
2.0.0 (android-build)	62 (78%)
1.1.0 (android-build)	16 (20%)
1.0.0 (android-build)	2 (3%)

Current Deployment

Release: google/bullhead/bullhead:1.1.0/OPM7.18... Date: an hour ago
keys

Deployed by: Heiko Behrens Status: Done

Software Versions

Memfault Version Matrix / Cohorts: second_example

Details: Slug: second_example, Size: 97 devices, Name: second_example

Version Management: Distribution Settings

Future version: 25% staged

Current version	Target	2.0.0	2.1.0	2.2.0	Total
1.0.0 (android-build) (pvt)		2	0	0	2
1.1.0 (android-build) (pvt)		16	0	0	16
2.0.0 (android-build) (pvt)	2.1.0	0	62	0	62
2.1.0 (android-build) (pvt)	2.2.0	0	10	5	15
		18	72	5	95

Memfault Version Matrix / Fleet / Devices: Device D2E7A5D9E3080ACE

Details: Serial Number: D2E7A5D9E3080ACE, Nickname: not set, Hardware Version: pvt, Software Version: 2.1.0 (Update available)

Past Software Versions

Seen at	Software Type	Version
Not available	android-build	2.1.0
Not available	android-build	2.0.0
Not available	android-build	1.1.0
Not available	android-build	1.0.0

Future Releases

- 2.1.0 (android-build) - Current Software Version
- 2.2.0 - Next Release to be deployed

Inspect details View Cohort details

Issue: No Data

Notify Groups and External Systems via Memfault

* Notification Targets [Manage available Notification Targets](#)

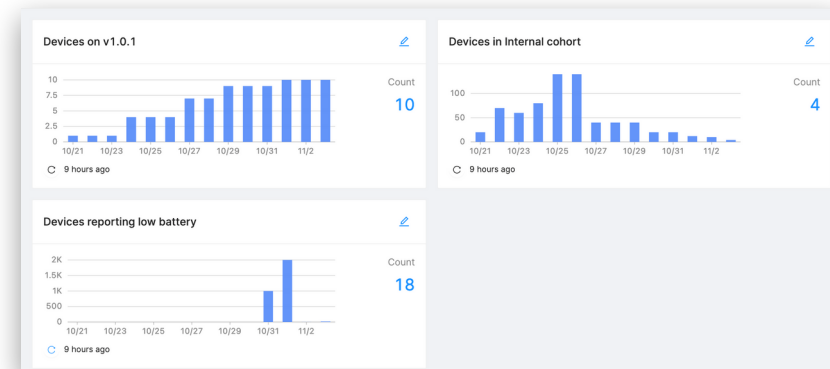
@allen x @device-qa-slack # x @prod-alerts-pager-duty # x
@qa-team (3) x

- @allen Allen Walker ✓
- @device-qa-slack Slack channel #device-qa # ✓
- @prod-alerts-pager-duty Production Alerts Pager Duty # ✓
- @qa-team QA Team (3) ✓
- @crystal Crystal Landry
- @david David Robinson
- @device-software-slack Slack channel #device-software #
- @engineering Engineering (5)

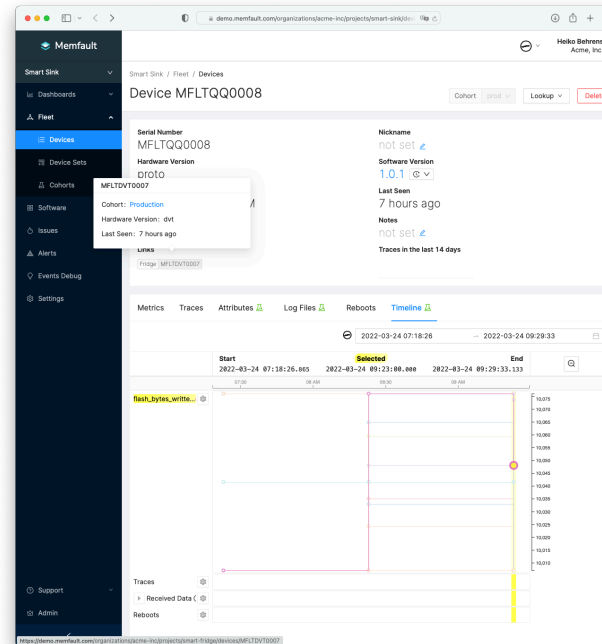
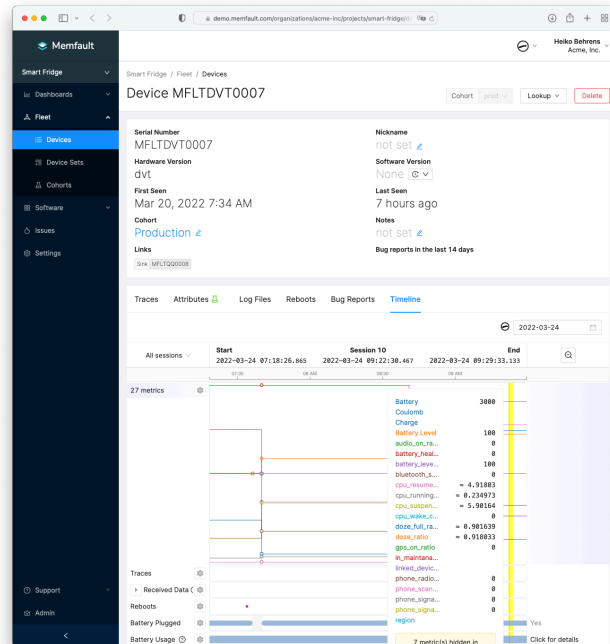
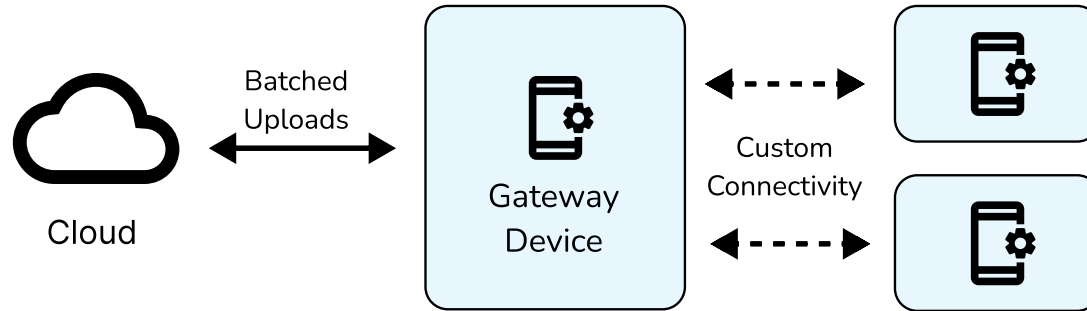
Device Attributes in Memfault

The screenshot shows the Memfault web interface for a specific device, MFLTDVT0001. The interface includes a sidebar with navigation options like Dashboards, Overview, Metrics, Fleet, and Settings. The main content area displays the device's serial number, hardware version, first seen date, and other metadata. Below this, there is a table of device attributes.

Attribute	Value	Last Update
audio_on_ratio	0	Thu, March 24, 2022 09:04:00.000 am
battery_health_not_good_ratio	0	Thu, March 24, 2022 09:04:00.000 am
battery_level_pct_avg	100	Thu, March 24, 2022 09:04:00.000 am
bluetooth_scan_ratio	0	Thu, March 24, 2022 09:04:00.000 am
cpu_resume_count_per_hour	2.903225806451613	Thu, March 24, 2022 09:04:00.000 am
cpu_running_ratio	0.008064516129032258	Thu, March 24, 2022 09:04:00.000 am
cpu_suspend_count_per_hour	3.870967741935484	Thu, March 24, 2022 09:04:00.000 am
cpu_wake_count_per_hour	0	Thu, March 24, 2022 09:04:00.000 am
doze_full_ratio	0.6290322580645161	Thu, March 24, 2022 09:04:00.000 am
doze_ratio	0.7741935483870968	Thu, March 24, 2022 09:04:00.000 am
gps_on_ratio	0	Thu, March 24, 2022 09:04:00.000 am
linked_device_sink	"MFLTXX0008"	Thu, March 24, 2022 10:07:31.709 am
phone_radio_active_ratio	0	Thu, March 24, 2022 09:04:00.000 am
phone_scanning_ratio	0	Thu, March 24, 2022 09:04:00.000 am



Linked Devices



Memfault Diagnostic Service (MDS)

[Home](#) » [Libraries](#) » [Bluetooth libraries and services](#) » Memfault Diagnostic Service (MDS)

[View page source](#)

Memfault Diagnostic Service (MDS)

The Bluetooth® LE GATT Memfault Diagnostic Service is a custom service that forwards diagnostic data collected by firmware through a Bluetooth gateway. The diagnostic data is collected by the [Memfault SDK](#) integrated with the nRF Connect SDK. For more details, see [Memfault](#).

The MDS is used in the [Bluetooth: Peripheral Memfault Diagnostic Service \(MDS\)](#) sample.

Service UUID

The 128-bit service UUID is **54220000-f6a5-4007-a371-722f4ebd8436**

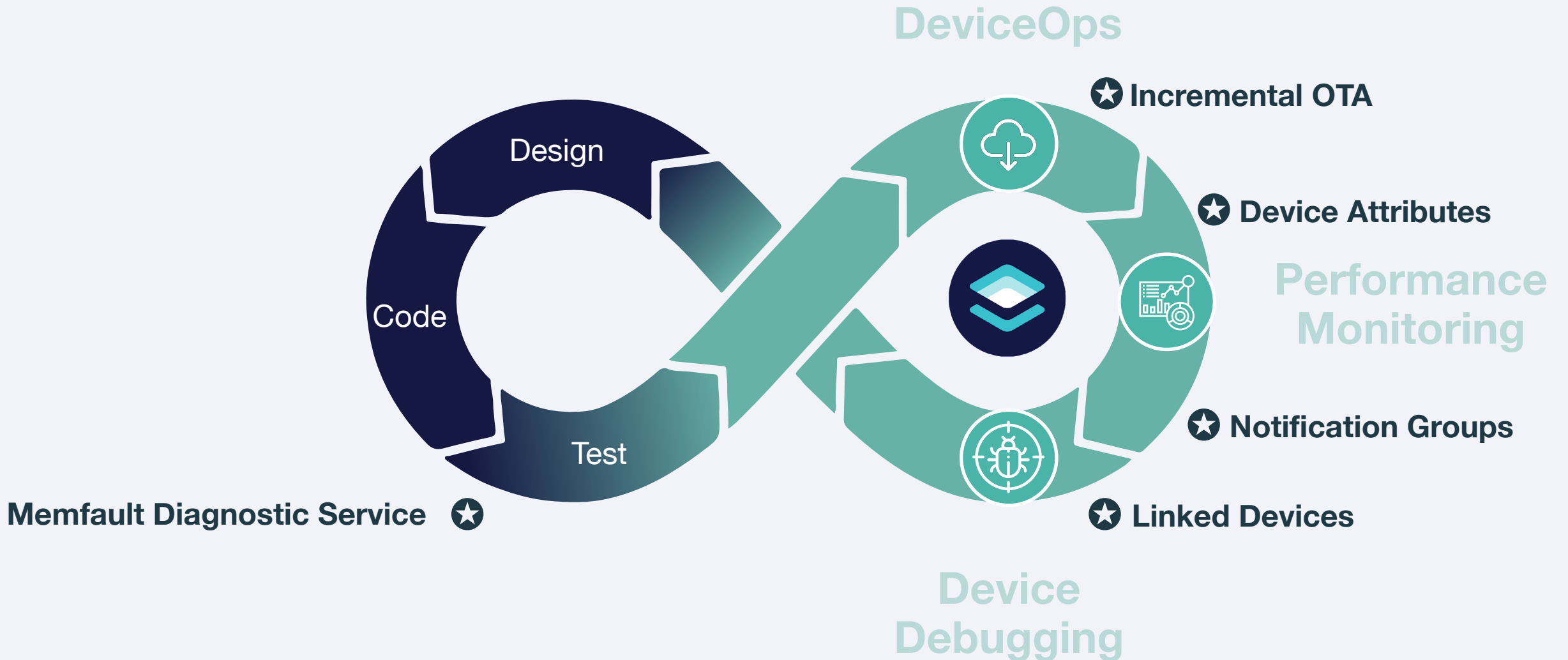
- [Service UUID](#)
- [Characteristics](#)
- [Configuration](#)
- [Implementation details](#)
- [Restricting access](#)
 - [Bluetooth privacy](#)
- [API documentation](#)

Characteristics

The MDS characteristics are described in detail in the [Memfault Diagnostic GATT Service](#) documentation. The service implementation available in the nRF Connect SDK follows these requirements.

Memfault: Device Reliability Engineering

★ ...selected highlights introduced since nRF Connect SDK 1.6




Get Started Today

Where do I start?

- Sign up for free at: <https://memfault.com/register/nrf>
- Nordic nRF Connect SDK Memfault bluetooth sample: https://developer.nordicsemi.com/nRF_Connect_SDK/doc/latest/nrf/samples/bluetooth/peripheral_mds/README.html
- Memfault docs: <https://docs.memfault.com/docs/mcu/nrf-connect-sdk-guide>
- Memfault SDK: <https://github.com/memfault/memfault-firmware-sdk>
- Contact us at support@memfault.com and sales@memfault.com
- Join the Interrupt Slack: <https://interrupt-slack.herokuapp.com/>

Memfault Supports nRF9160

PARTNER
WEBINAR

 **Memfault**

NORDICTECH
WEBINARS

Remotely debug, monitor,
and update Nordic-powered
IoT devices with Memfault

02/05 OPERATING MODE
01/05

Q&A

Register for upcoming Nordic Tech Webinars

www.nordicsemi.com/webinars