

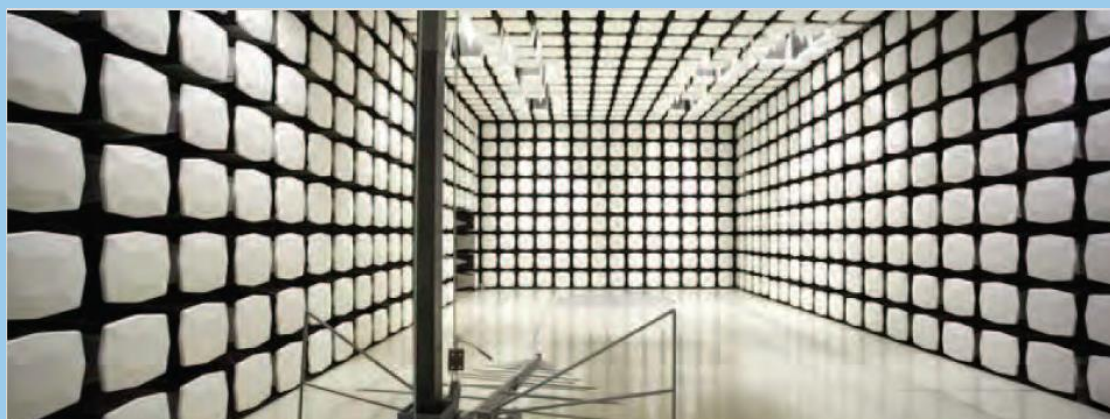


OrthAlign

Lantern Refresh Surgical Assistant (LSA)

Software Bill of Materials

Report # ORTH0042.3 Issue Date: June 2, 2026



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REVISION HISTORY

Revision Number	Description	Date	Page Number
00	Original		

SOFTWARE BILL OF MATERIALS

Client and Equipment under Test (EUT) Information

Company Name:	OthAlign
Attendee or Company Contact:	Larry Varnado
Work Order:	ORTH0042
Date:	5/20/2026

Product Overview

Simple and efficient joint technology for total hip, total knee, revision knee, and partial knee replacements.

EUT Name:	Lantern Refresh Surgical Assistant (LSA)
Model/Part Number:	502000-03
Serial Number:	N/A

Scope of Software Inspection

Element has been asked to provide documentation of the software contained on the client equipment to support the obligation that manufacturers not place equipment on the U.S. market if the equipment contains software produced or provided by an entity on the covered list.

<https://www.fcc.gov/supplychain/coveredlist>

This analysis is limited to the equipment provided for inspection.

Software Inspection Method

The selected items below apply to this inspection.

- ☐ A production model of the EUT was provided for a physical inspection of the software.
- ☐ A pre-production model of the EUT containing production software was provided for a physical inspection of the software.
- ☒ The software inspection was completed through a remote meeting with the client demonstrating the production software of the EUT.
- ☐ The software inspection was completed through documentation submitted by the client and appended to this letter.

Software Bill of Materials (SBOM)

The software inspection:

- ☒ considered all software items installed on the EUT as outlined by the manufacturer.
- ☐ was limited to items related to cybersecurity and anti-virus as defined by the manufacturer.
- ☐ was NOT performed as the manufacturer states that the EUT is inherently compliant.

SOFTWARE BILL OF MATERIALS

SW0100 Navigation Unit PC Firmware Human Readable SBOM with Support Information

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
SW0100 Navigation Unit PIC Firmware	OrthAlign	1.0.1	Primary	none	Active

SW0104 Reference Sensor DSP Firmware Human-Readable SBOM with Support Information

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
SW0104 Reference Sensor DSP IC Firmware	OrthAlign	7.1.0	Primary	none	Active
uC-CPU for SHARC	Analog Devices, Inc	1.30.01	Included in	pkg:generic/analog_devices_ inc/uccpu@1.30.01	Unknown
uC-LIB for SHARC	Analog Devices, Inc	1.38.01	Included in	pkg:generic/analog_devices_ inc/uclib@1.38.01	Unknown
uCOS-III for SHARC	Analog Devices, Inc	2.7.0	Included in	pkg:generic/analog_devices_ inc/ucos-iii@2.7.0	Unknown

SOFTWARE BILL OF MATERIALS

SW0105 Reference Sensor BLE SoC Firmware Human-Readable SBOM with Support Information

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
SW0105 Reference Sensor BLE SoC Firmware	OrthAlign	5.3.0	Primary	none	Active
nrf51422_xxac	OrthAlign	5.3.0	Included in	none	Active
s130_nrf51_2.0.1_softdevice	Nordic Semiconductor	2.0.1	Included in	cpe:2.3:a:nordicsemi:s130_softdevice:2.0.1:*.~*~*~*~*~*~*, pkg:generic/nordicsemiconductor/s130_nrf51_softdevice@2.0.1	Deprecated

SW101 Navigation Unit Operating System Human-readable SBOM with Support Information

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
Linux Kernel	Linux Foundation	4.9.17	Included in	cpe:2.3:o:linux:linux_kernel:4.9.17:*.~*~*~*~*~*~*	Active
SW0101 Navigation Unit Operating System	OrthAlign	7.1.2r39	Primary	none	Active

SOFTWARE BILL OF MATERIALS

SW0102 Navigation Unit Application Human-Readable SBOM with Support Information

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
activity	androidx.activity	1.8.1	Included in	pkg:maven/androidx.activity/activity@1.8.1	Active
activity-ktx	androidx.activity	1.8.1	Included in	pkg:maven/androidx.activity/activity-ktx@1.8.1	Active
appcompat	androidx.appcompat	1.7.0	Included in	pkg:maven/androidx.appcompat/appcompat@1.7.0	Active
cardview	androidx.cardview	1.0.0	Included in	pkg:maven/androidx.cardview/cardview@1.0.0	Active
constraintlayout	androidx.constraintlayout	2.2.0	Included in	pkg:maven/androidx.constraintlayout/constraintlayout@2.2.0	Active
dagger	com.google.dagger	2.47 / 2.48	Included in	pkg:maven/com.google.dagger/dagger	Active
dagger-compiler	com.google.dagger	2.47	Included in	pkg:maven/com.google.dagger/dagger-compiler@2.47	Active
databinding-adapters	androidx.databinding	8.11.0	Included in	pkg:maven/androidx.databinding/databinding-adapters@8.11.0	Active
databinding-common	androidx.databinding	8.11.0	Included in	pkg:maven/androidx.databinding/databinding-common@8.11.0	Active
databinding-compiler	androidx.databinding	8.11.0	Included in	pkg:maven/androidx.databinding/databinding-compiler@8.11.0	Active
databinding-runtime	androidx.databinding	8.11.0	Included in	pkg:maven/androidx.databinding/databinding-runtime@8.11.0	Active
eventbus	org.greenrobot	3.3.1	Included in	pkg:maven/org.greenrobot/eventbus@3.3.1	Active
glide	com.github.bumptech.glide	4.15.1	Included in	pkg:maven/com.github.bumptech.glide/glide@4.15.1	Active

SOFTWARE BILL OF MATERIALS

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
gpiolib-2.1.1-debug	harvey_nav	unspecified	Included in	pkg:maven/harvey_nav/gpiolib-2.1.1-debug	Unknown
gpiolib-2.1.1-release	harvey_nav	unspecified	Included in	pkg:maven/harvey_nav/gpiolib-2.1.1-release	Unknown
gson	com.google.code.gson	2.x	Included in	pkg:maven/com.google.code.gson/gson	Active
hara-ddiclient	eclipse hara	commit	Included in	pkg:maven/com.github.eclipse-hara.hara-ddiclient	Active
hilt-android	com.google.dagger	2.47	Included in	pkg:maven/com.google.dagger/hilt-android@2.47	Active
hilt-compiler	com.google.dagger	2.47	Included in	pkg:maven/com.google.dagger/hilt-compiler@2.47	Active
jna	net.java.dev.jna	5.x	Included in	pkg:maven/net.java.dev.jna/jna	Active
lifecycle-livedata	androidx.lifecycle	2.7.0	Included in	pkg:maven/androidx.lifecycle/lifecycle-livedata@2.7.0	Active
lifecycle-viewmodel	androidx.lifecycle	2.7.0	Included in	pkg:maven/androidx.lifecycle/lifecycle-viewmodel@2.7.0	Active
material	com.google.android.material	1.11.0	Included in	pkg:maven/com.google.android.material/material@1.11.0	Active
navigation-fragment	androidx.navigation	2.7.7	Included in	pkg:maven/androidx.navigation/navigation-fragment@2.7.7	Active
navigation-runtime	androidx.navigation	2.7.7	Included in	pkg:maven/androidx.navigation/navigation-runtime@2.7.7	Active
navigation-ui	androidx.navigation	2.7.7	Included in	pkg:maven/androidx.navigation/navigation-ui@2.7.7	Active

SOFTWARE BILL OF MATERIALS

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
preference	androidx.preference	1.2.1	Included in	pkg:maven/androidx.preference/preference@1.2.1	Active
reactivewifi-rx2	com.github.pwittchen	0.3.0	Included in	pkg:maven/com.github.pwittchen/reactivewifi-rx2@0.3.0	Active
recyclerview	androidx.recyclerview	1.3.2	Included in	pkg:maven/androidx.recyclerview/recyclerview@1.3.2	Active
retrofit	com.squareup.retrofit2	2.9.0	Included in	pkg:maven/com.squareup.retrofit2/retrofit@2.9.0	Active
rxandroid	io.reactivex	2.x / 3.x	Included in	pkg:maven/io.reactivex.rxjava	Active
rxandroidble	com.polidea	1.17.2	Included in	pkg:maven/com.polidea.rxandroidble3/rxandroidble@1.17.2	Active
rxbinding	com.jakewharton	4.0.0	Included in	pkg:maven/com.jakewharton.rxbinding4/rxbinding@4.0.0	Active
rxjava	io.reactivex	2.x / 3.x	Included in	pkg:maven/io.reactivex.rxjava	Active
SW0102 Navigation Unit Application	OrthAlign	5.0.2	Primary	none	Active
truetime-android	com.github.instacart	3.5	Included in	pkg:maven/com.github.instacart/truetime-android@3.5	Active
uf-android-client	com.github.kynetics	v1.6.1	Included in	pkg:maven/com.github.kynetics/uf-android-client@v1.6.1	Active
viewbinding	androidx.databinding	8.11.0	Included in	pkg:maven/androidx.databinding/viewbinding@8.11.0	Active
viewpager2	androidx.viewpager2	1.1.0	Included in	pkg:maven/androidx.viewpager2/viewpager2@1.1.0	Active

SOFTWARE BILL OF MATERIALS

SW0135 Femur Sensor firmware Human-Readable SBOM with Support Information

Component Name	Supplier Name	Used Version	Relationship	Unique Identifier	Support Status
Lantern-Hip-Sensor	OrthAlign, Inc.	1.2.0	Primary	none	Active
mcuboot	mcu-tools	v1.9.99-ncs1-rc2	Included in	pkg:github/nrfconnect/sdk-mcuboot@v1.9.99-ncs1-rc2	Active
tinycrypt	Intel Corporation	0.2.8	Included in	pkg:github/intel/tinycrypt@v0.2.8	Unsupported
segger	SEGGER Microcontroller Systems	3.30	Included in	pkg:github/zephyrproject-rtos/segger@3a52ab222133193802d3c3b4d21730b9b1f1d2f6	Active
nordic	Nordic Semiconductor	2.8.0	Included in	pkg:github/NordicSemiconductor/nrfx@v2.8.0	Active
nrf	Nordic Semiconductor	2.0.0	Included in	pkg:github/nrfconnect/sdk-nrf@v2.0.0	Active
zephyr	Zephyr Project	v3.0.99-ncs1-rc2	Included in	pkg:github/nrfconnect/sdk-zephyr@v3.0.99-ncs1-rc2	Active

The information above is accurate to the best of our knowledge based on the explanations and evidence provided to Element by the manufacturer. The results apply only to the sample inspected as identified above.

SOFTWARE BILL OF MATERIALS

Client provided details:

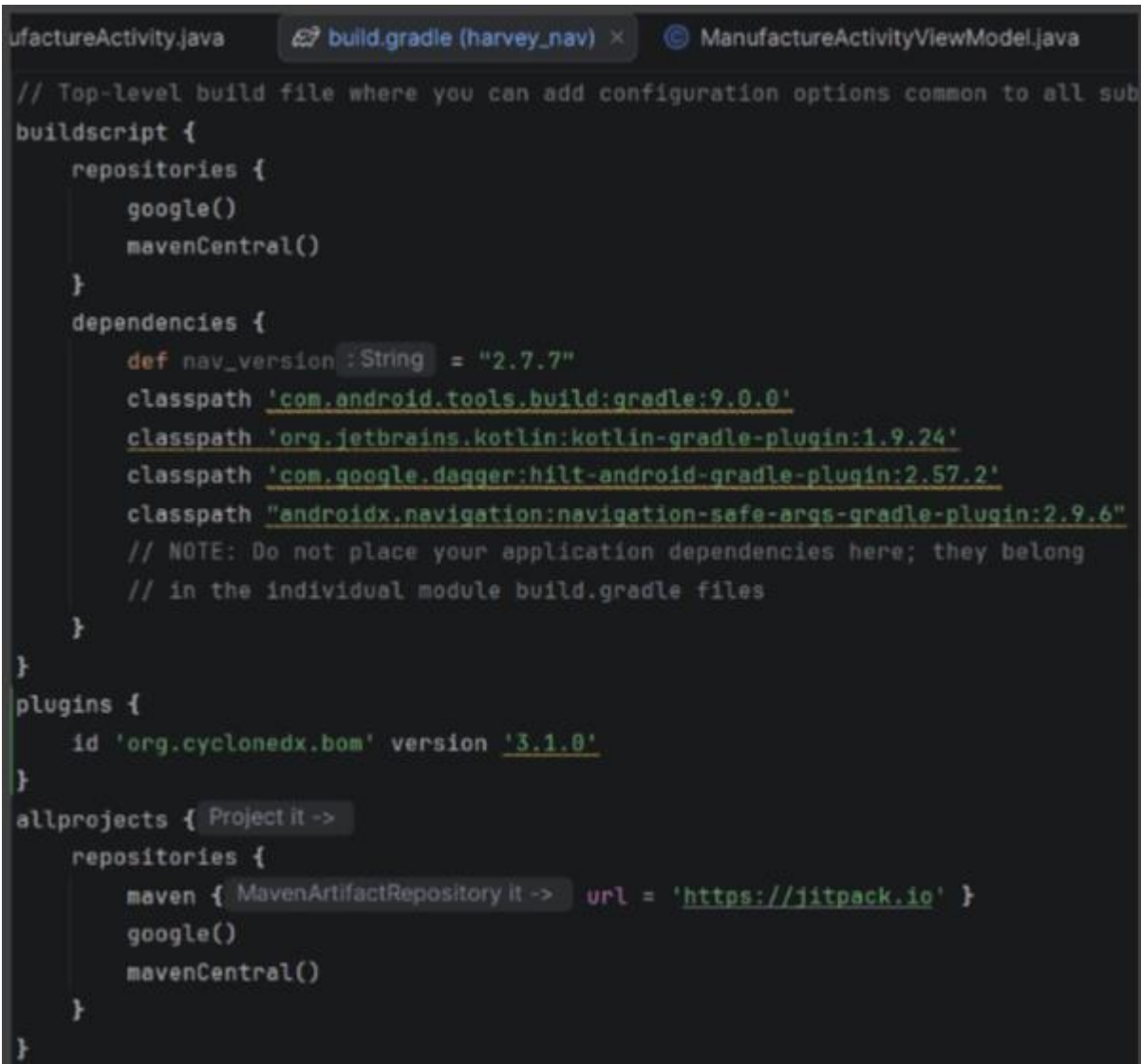
Software components that have reached their end of life, are no longer supported, or are no longer maintained, and shall not be utilized in new released products. If this occurs to components that are in existing released products, evaluation of the impact and cybersecurity risk of the component shall be performed on this product. Depending upon the results of this evaluation, replacement component(s) might be sought to replace the older component in a new release of the software.

Using the OWASP Dependency Track tool, OrthAlign generated a Software Bill of Materials for the project's software and firmware and identified known vulnerabilities that could affect the system, according to the NIST NVD, CISA KEV, and other threat sources. All vulnerabilities were first reviewed for impact analysis to determine whether they affect the software. All were determined to not be exploitable or to not affect the system software. Vulnerability Exploitability exchange (VEX) information detailing these assessments are included in the SBOMs as machine-readable vulnerability disclosure reports in the CycloneDX JSON format. Please see the Appendices for the reports.

For a human-readable SBOM table and information regarding the support status of third-party software components included in the project, see the SBOM Support Report (03590-4104-SBSU).

For the Navigation application SBOM, we use a downloadable **Gradle library** to generate the SBOM. We are not using a separate SBOM-generation application. The output of running the Gradle command is the SBOM itself.

Example of how the SBOM is generated – Screenshot 1

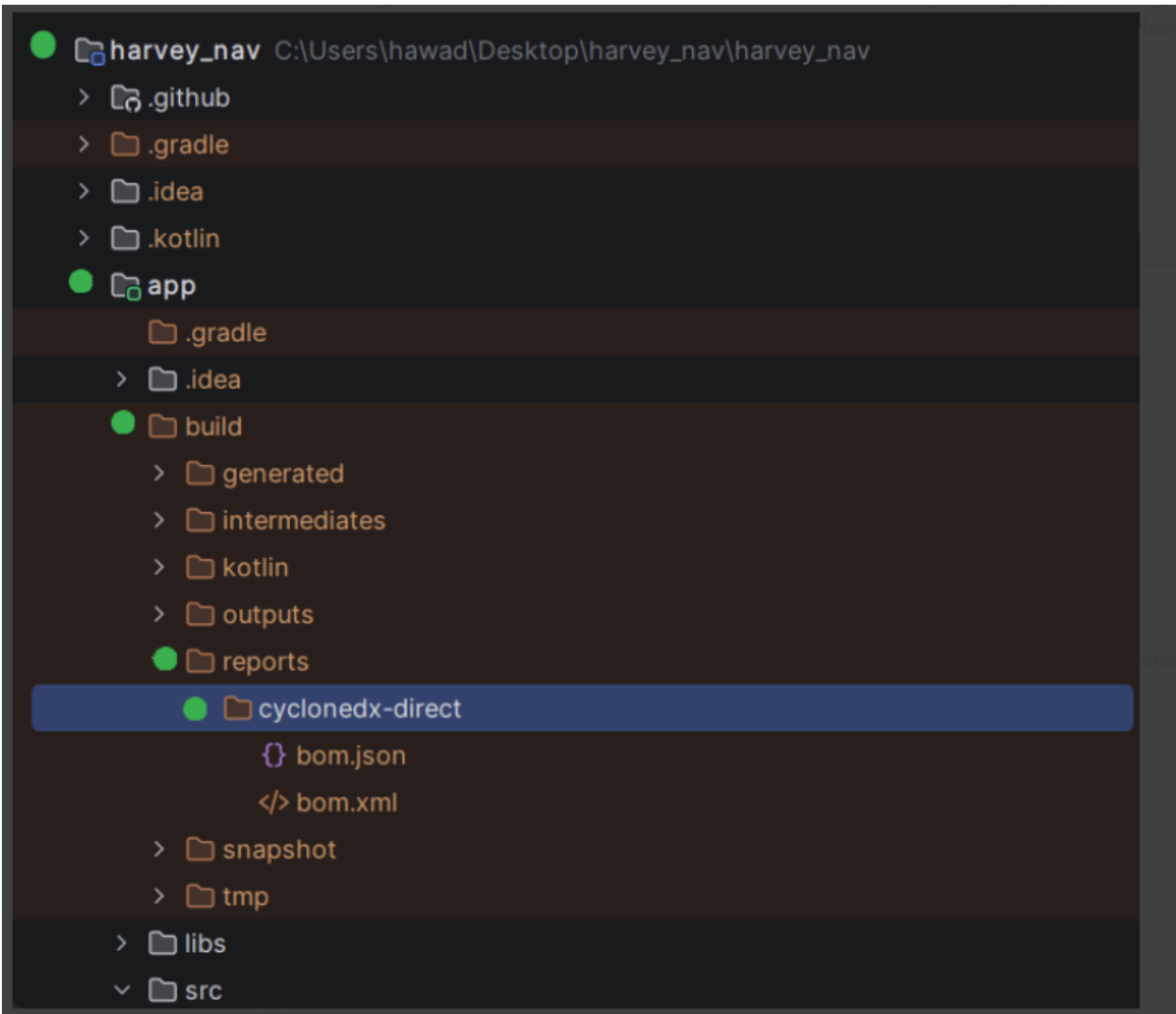


```
// Top-level build file where you can add configuration options common to all sub
buildscript {
    repositories {
        google()
        mavenCentral()
    }
    dependencies {
        def nav_version :String = "2.7.7"
        classpath 'com.android.tools.build:gradle:9.0.0'
        classpath 'org.jetbrains.kotlin:kotlin-gradle-plugin:1.9.24'
        classpath 'com.google.dagger:hilt-android-gradle-plugin:2.57.2'
        classpath "androidx.navigation:navigation-safe-args-gradle-plugin:2.9.6"
        // NOTE: Do not place your application dependencies here; they belong
        // in the individual module build.gradle files
    }
}

plugins {
    id 'org.cyclonedx.bom' version '3.1.0'
}

allprojects { Project it ->
    repositories {
        maven { MavenArtifactRepository it -> url = 'https://jitpack.io' }
        google()
        mavenCentral()
    }
}
```

Example of how the SBOM is generated – Screenshot 2



Example of how the SBOM is generated – Screenshot 3

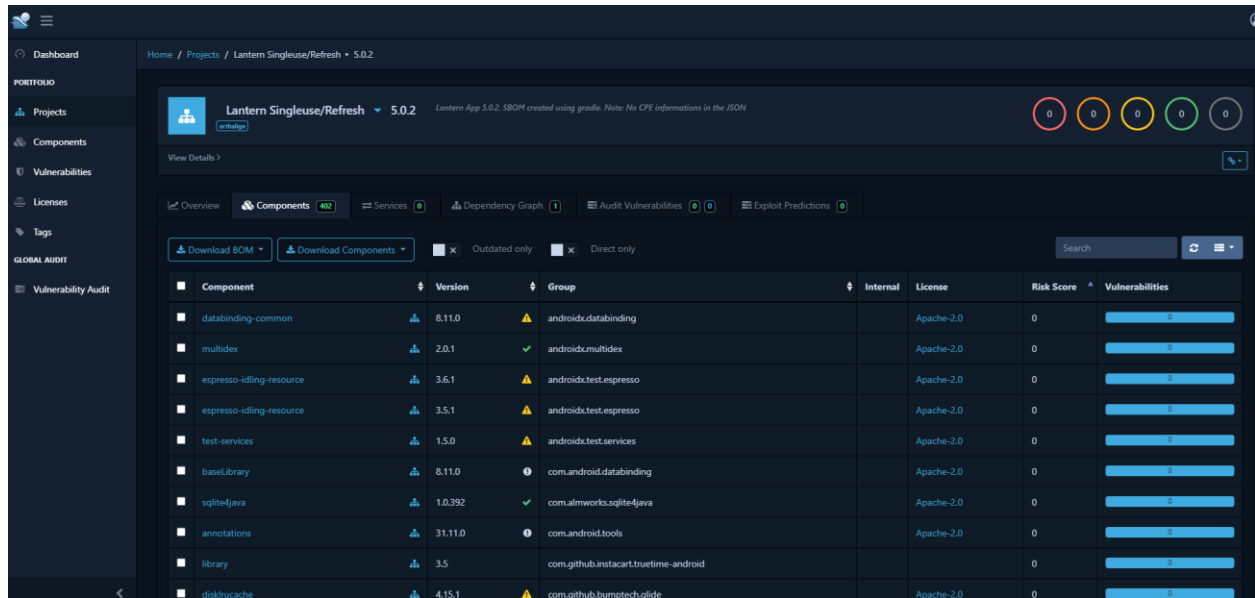
```
1 C:\Users\havad\Desktop\harvey_nav\harvey_nav> ./gradlew cyclonedxBom
2
3 Starting a Gradle Daemon, 1 incompatible Daemon could not be reused, use --status for details
4 Calculating task graph as no cached configuration is available for tasks: cyclonedxBom
5
6 > Configure project :app
7 WARNING: The option setting 'android.useSdKInManifest.disabled=false' is deprecated.
8 The current default is 'true'.
9 It will be removed in version 10.0 of the Android Gradle plugin.
10 WARNING: The option setting 'android.sdk.defaultTargetSdkToCompileSdkIfUnset=false' is deprecated.
11 The current default is 'true'.
12 It will be removed in version 10.0 of the Android Gradle plugin.
13 WARNING: The option setting 'android.enableAppCompileTimeRClass=false' is deprecated.
14 The current default is 'true'.
15 It will be removed in version 10.0 of the Android Gradle plugin.
16 WARNING: The option setting 'android.builtInKotlin=false' is deprecated.
17 The current default is 'true'.
18 It will be removed in version 10.0 of the Android Gradle plugin.
19 WARNING: The option setting 'android.newDsl=false' is deprecated.
20 The current default is 'true'.
21 It will be removed in version 10.0 of the Android Gradle plugin.
22 WARNING: The option setting 'android.r8.optimizedResourceShrinking=false' is deprecated.
23 The current default is 'true'.
24 It will be removed in version 10.0 of the Android Gradle plugin.
25 WARNING: The option setting 'android.defaults.buildfeatures.resvalues=true' is deprecated.
26 The current default is 'false'.
27 It will be removed in version 10.0 of the Android Gradle plugin.
28 WARNING: The option setting 'android.nonFinalResIds=false' is deprecated.
29 The current default is 'true'.
30 It will be removed in version 10.0 of the Android Gradle plugin.
31 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
32 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
33 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
34 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
35 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
36 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
37 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
38 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
39 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
40 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
41 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
42 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
43 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
44 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
45 WARNING: The property android.dependency.excludeLibraryComponentsFromConstraints improves project import performance for very large projects. It should be enabled to improve performance.
46 To suppress this warning, add android.generateSyncIssueWhenLibraryConstraintsAreEnabled=false to gradle.properties
47 [CycloneDX] Project group or version are not set for project [harvey_nav], will use "unspecified"
48
49 > Task :gplolb-2.1.1-debug:cyclonedxDirectBom
50 Unknown keyword meta:enum - you should define your own Meta Schema. If the keyword is irrelevant for validation, just use a NonValidationKeyword or if it should generate annotations AnnotationKeyword
51 Unknown keyword deprecated - you should define your own Meta Schema. If the keyword is irrelevant for validation, just use a NonValidationKeyword or if it should generate annotations AnnotationKeyword
52
53 BUILD SUCCESSFUL in 2m 47s
54 5 actionable tasks: 5 executed
55 Configuration cache entry stored.
```

SOFTWARE BILL OF MATERIALS

Monitored these SBOMs regularly for potential security vulnerabilities through **Kynetics** SBOM monitoring **Dashboard**. See the snapshot below of the monitored softwares.

These software components are regularly scanned for potential security vulnerabilities through the Kynetics SBOM monitoring Dashboard.

Screenshot #1 of the monitored softwares.

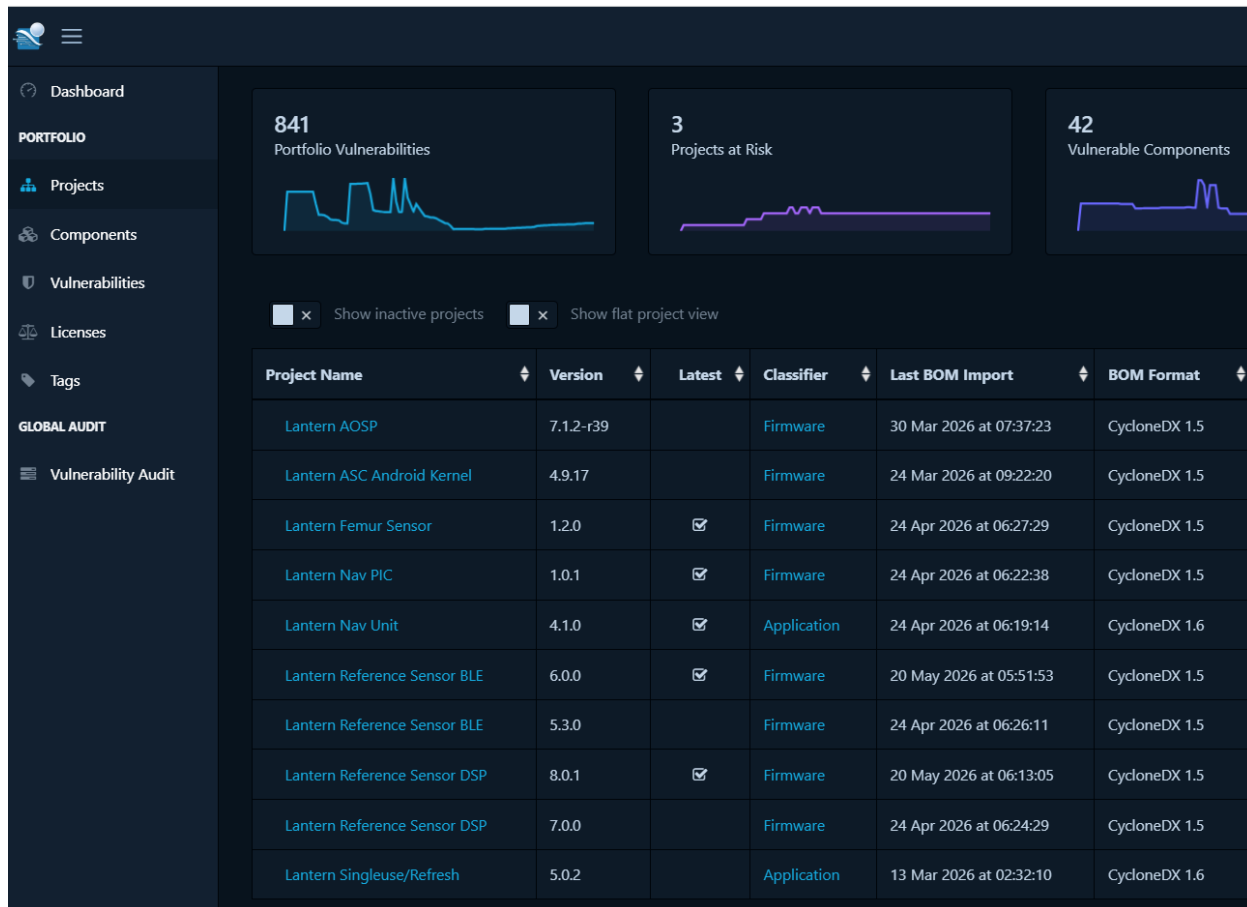


The screenshot displays the Kynetics SBOM monitoring Dashboard. The interface includes a sidebar with navigation options like Dashboard, Portfolio, Projects, Components, Vulnerabilities, Licenses, Tags, and Global Audit. The main content area shows details for a specific project, 'Lantern Singleuse/Refresh', version 5.0.2. It features a table of software components with columns for Component, Version, Group, Internal, License, Risk Score, and Vulnerabilities. The table lists various components such as databinding-common, multidex, espresso-idling-resource, test-services, baselibrary, sqldite4java, annotations, library, and disklucache, each with its respective version, group, license, risk score, and vulnerability status.

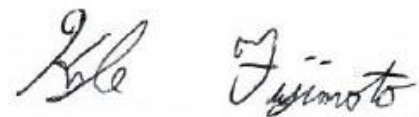
Component	Version	Group	Internal	License	Risk Score	Vulnerabilities
databinding-common	8.11.0	androidx.databinding		Apache-2.0	0	0
multidex	2.0.1	androidx.multidex		Apache-2.0	0	0
espresso-idling-resource	3.6.1	androidx.test.espresso		Apache-2.0	0	0
espresso-idling-resource	3.5.1	androidx.test.espresso		Apache-2.0	0	0
test-services	1.5.0	androidx.test.services		Apache-2.0	0	0
baselibrary	8.11.0	com.android.databinding		Apache-2.0	0	0
sqldite4java	1.0.392	com.almworks.sqldite4java		Apache-2.0	0	0
annotations	31.11.0	com.android.tools		Apache-2.0	0	0
library	3.5	com.github.instacart.truetime-android			0	0
disklucache	4.15.1	com.github.bumotech.glide		Apache-2.0	0	0

SOFTWARE BILL OF MATERIALS

Screenshot #2 of the monitored softwares.



Prepared By:



Kyle Fujimoto
EMC Test Engineer
Signed for and on behalf of Element

Reviewed By:



Trevor Buls
Principal EMC Test Engineer
Signed for and on behalf of Element

APPENDIX A

Machine-Readable Software Bill of Materials – Navigation Unit PIC Firmware (SW0100)

Machine-Readable Software Bill of Materials – Navigation Unit PIC Firmware (SW0100)

```
{
  "$schema": "http://cyclonedx.org/schema/bom-1.5.schema.json",
  "bomFormat": "CycloneDX",
  "specVersion": "1.5",
  "serialNumber": "urn:uuid:f5a7fc03-5820-44cd-879c-15ac0acbe51d",
  "version": 1,
  "metadata": {
    "timestamp": "2026-04-08T13:11:41-07:00",
    "tools": {
      "components": [
        {
          "type": "application",
          "author": "anchore",
          "name": "syft",
          "version": "1.14.2"
        },
        {
          "type": "application",
          "author": "Microchip Technology Inc.",
          "name": "MPLAB X IDE",
          "version": "5.25"
        }
      ]
    }
  }
}
```

```
},
"component": {
  "bom-ref": "SW0100_OA_NAV_PIC",
  "type": "firmware",
  "name": "OANavPic",
  "version": "1.0.1",
  "description": "Firmware Source Code for the OA Nav PIC",
  "hashes": [
    {
      "alg": "SHA-256",
      "content": "2DDECB3E2A528EB697DE4CE665E6552A121AFFDC0E6412F9ED46F1D1C9765CDD"
    }
  ],
  "licenses": [
    {
      "license": {
        "name": "OrthAlign Custom Proprietary License",
        "url": "https://www.orthalign.com/terms-of-use/",
        "licensing": {
          "licensor": {
            "organization": {
              "name": "OrthAlign, Inc."
            }
          }
        }
      },
      "licenseTypes": [
        "appliance"
      ]
    }
  ]
}
```

```
        ]
      }
    }
  }
]
},
"authors": [
  {
    "name": "OrthAlign, Inc.",
    "email": "info@orthalign.com"
  }
],
"supplier": {
  "name": "OrthAlign, Inc.",
  "url": [
    "https://www.orthalign.com/"
  ],
  "contact": [
    {
      "name": "OrthAlign, Inc.",
      "email": "info@orthalign.com"
    }
  ]
}
},
```

"components": [

```

{
  "type": "library",
  "name": "PIC16F1503 Driver-1.65.2",
  "author": "Microchip Technology Inc.",
  "version": "2.0.0",
  "bom-ref": "pkg:PIC16F1503 Driver-1.65.2@2.0.0",
  "description": "Firmware driver for PIC16F1503 - Product Rev: 1.65.2",
  "copyright": "2018 Microchip Technology Inc. and its subsidiaries"
},
{
  "type": "library",
  "name": "MPLAB XC8 Compiler",
  "author": "Microchip Technology Inc.",
  "version": "1.45",
  "bom-ref": "pkg:MPLAB XC8 Compiler@1.4.5",
  "description": "The MPLAB XC8 C Compiler is a free-standing, optimizing ISO C99 compiler. It supports all
8-bit PIC",
  "copyright": "2018 Microchip Technology Inc. and its subsidiaries"
}
],
"dependencies": [
  {
    "ref": "SW0100_OA_NAV_PIC",
    "dependsOn": [
      "pkg:MPLAB XC8 Compiler@1.4.5"
    ]
  }
]

```

```
},  
  {  
    "ref": "pkg:MPLAB XC8 Compiler@1.4.5",  
    "dependsOn": [  
      "pkg:PIC16F1503 Driver-1.65.2@2.0.0"  
    ]  
  },  
  {  
    "ref": "pkg:PIC16F1503 Driver-1.65.2@2.0.0"  
  }  
]  
}}
```

APPENDIX B

Machine-Readable Software Bill of Materials – Reference Sensor DSP Firmware (SW0104)

Machine-Readable Software Bill of Materials – Reference Sensor DSP Firmware (SW0104)

```
{  
  "$schema": "http://cyclonedx.org/schema/bom-1.5.schema.json",  
  "bomFormat": "CycloneDX",  
  "specVersion": "1.5",  
  "serialNumber": "urn:uuid:7fd2547b-ba6b-4e21-bf17-b916e437a563",  
  "version": 1,  
  "metadata": {  
    "timestamp": "2024-11-11T14:11:43-08:00",  
    "tools": {  
      "components": [  
        {  
          "type": "application",  
          "author": "anchore",  
          "name": "syft",  
          "version": "1.14.2"  
        },  
        {  
          "type": "application",  
          "author": "Analog Devices, Inc.",  
          "name": "Cross Core Embedded Studios",  
          "version": "2.8.3.0"  
        }  
      ]  
    }  
  }  
}
```

```
    },
    "component": {
      "bom-ref": "SW0104_LanternRS_DSP",
      "type": "firmware",
      "name": "HarveyRS",
      "version": "7.0.0",
      "description": "Firmware Source Code for the Lantern RS DSP",
      "hashes": [
        {
          "alg": "SHA-256",
          "content":
"BE75D78420F6D8436429F8FA044C7BF487C6A01A02F2C5F3D080B37A585DE72E"
        }
      ],
      "licenses": [
        {
          "license": {
            "name": "OrthAlign Custom Proprietary License",
            "url": "https://www.orthalign.com/terms-of-use/",
            "licensing": {
              "licensor": {
                "organization": {
                  "name": "OrthAlign, Inc."
                }
              }
            }
          }
        }
      ],
      "licenseTypes": [
```

```
        "appliance"
      ]
    }
  }
}

},
"authors": [
  {
    "name": "OrthAlign, Inc.",
    "email": "info@orthalign.com"
  }
],
"supplier": {
  "name": "OrthAlign, Inc.",
  "url": [
    "https://www.orthalign.com/"
  ],
  "contact": [
    {
      "name": "OrthAlign, Inc.",
      "email": "info@orthalign.com"
    }
  ]
}
},
```

```

"components": [
  {
    "type": "operating-system",
    "name": "uCOS-III for SHARC",
    "author": "Analog Devices, Inc",
    "version": "2.7.0",
    "bom-ref": "pkg:ucos-iii@2.7.0",
    "description": "Real Time Operating System and SDK",
    "licenses": [
      {
        "license": {
          "name": "Proprietary License: Perpetual"
        }
      }
    ],
    "copyright": "2013 Analog Devices, Inc."
  },
  {
    "type": "library",
    "name": "RTOS OSAL",
    "author": "Analog Devices, Inc",
    "version": "1.2.3",
    "bom-ref": "pkg:rtos-osal@1.2.3",
    "description": "Real Time Operating System and SDK",
    "licenses": [
      {

```

```

        "license": {
            "name": "Proprietary License: Perpetual"
        }
    },
    "copyright": "2013 Analog Devices, Inc."
},
{
    "type": "library",
    "name": "uC-CPU for SHARC",
    "author": "Analog Devices, Inc",
    "version": "1.30.01",
    "bom-ref": "pkg:uccpu@1.30.01",
    "description": "SHARC CPU Library",
    "licenses": [
        {
            "license": {
                "name": "Proprietary License: Perpetual"
            }
        }
    ],
    "copyright": "2013 Analog Devices, Inc."
},
{
    "type": "library",
    "name": "uC-LIB for SHARC",

```

```
"author": "Analog Devices, Inc",
"version": "1.38.01",
"bom-ref": "pkg:uclib@1.38.01",
"description": "Libraries for SHARC chipset",
"licenses": [
  {
    "license": {
      "name": "Proprietary License: Perpetual"
    }
  }
],
"copyright": "2013 Analog Devices, Inc."
},
{
  "type": "library",
  "name": "uCOS-III",
  "author": "Analog Devices, Inc",
  "version": "3.04.05",
  "bom-ref": "pkg:ucos3@3.04.05",
  "description": "Libraries for SHARC chipset",
  "licenses": [
    {
      "license": {
        "name": "Proprietary License: Perpetual"
      }
    }
  ]
}
```

```
    ],  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "SPI Driver for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "1.0.0",  
    "bom-ref": "pkg:spi_driver@1.0.0",  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "TWI Driver for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "1.0.0",  
    "bom-ref": "pkg:twi_driver@1.0.0",  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "UART Driver for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "1.0.0",  
    "bom-ref": "pkg:uart_driver@1.0.0",  
    "copyright": "2013 Analog Devices, Inc."
```

```

},
{
  "type": "library",
  "name": "DMA Service for SHARC",
  "author": "Analog Devices, Inc",
  "version": "1.0.0",
  "bom-ref": "pkg:dma_service@1.0.0",
  "copyright": "2013 Analog Devices, Inc."
},
{
  "type": "library",
  "name": "GPIO Driver for SHARC",
  "author": "Analog Devices, Inc",
  "version": "1.0.0",
  "bom-ref": "pkg:gpio_driver@1.0.0",
  "copyright": "2013 Analog Devices, Inc."
},
{
  "type": "library",
  "name": "PWR Service for SHARC",
  "author": "Analog Devices, Inc",
  "version": "1.0.0",
  "bom-ref": "pkg:pwr_service@1.0.0",
  "copyright": "2013 Analog Devices, Inc."
},
{

```

```
"type": "library",  
  
"name": "HADC Driver for SHARC",  
  
"author": "Analog Devices, Inc",  
  
"version": "1.0.0",  
  
"bom-ref": "pkg:hadc_driver@1.0.0",  
  
"copyright": "2013 Analog Devices, Inc."  
  
},  
  
{  
  
  "type": "library",  
  
  "name": "WDT Service for SHARC",  
  
  "author": "Analog Devices, Inc",  
  
  "version": "1.0.0",  
  
  "bom-ref": "pkg:wdt_service@1.0.0",  
  
  "copyright": "2013 Analog Devices, Inc."  
  
},  
  
{  
  
  "type": "library",  
  
  "name": "Startup Code/LDF",  
  
  "author": "Analog Devices, Inc",  
  
  "version": "1.0.0",  
  
  "bom-ref": "pkg:startup_code@1.0.0",  
  
  "copyright": "2013 Analog Devices, Inc."  
  
},  
  
{  
  
  "type": "library",  
  
  "name": "Heap and Stack Configuration",
```

```
"author": "Analog Devices, Inc",  
  
"version": "1.0.0",  
  
"bom-ref": "pkg:heap_and_stack_config@1.0.0",  
  
"copyright": "2013 Analog Devices, Inc."  
  
}  
  
],  
  
"dependencies": [  
  
  {  
  
    "ref": "SW0104_LanternRS_DSP",  
  
    "dependsOn": [  
  
      "pkg:ucos-iii@2.7.0",  
  
      "pkg:uccpu@1.30.01",  
  
      "pkg:uclib@1.38.01",  
  
      "pkg:startup_code@1.0.0",  
  
      "pkg:heap_and_stack_config@1.0.0"  
  
    ]  
  
  },  
  
  {  
  
    "ref": "pkg:ucos-iii@2.7.0",  
  
    "dependsOn": [  
  
      "pkg:spi_driver@1.0.0",  
  
      "pkg:twi_driver@1.0.0",  
  
      "pkg:uart_driver@1.0.0",  
  
      "pkg:dma_service@1.0.0",  
  
      "pkg:gpio_driver@1.0.0",  
  
      "pkg:pwr_service@1.0.0",
```

```
        "pkg:hadc_driver@1.0.0",  
        "pkg:wdt_service@1.0.0"  
    ]  
  
    },  
  
    {  
  
        "ref": "pkg:rtos-osal@1.2.3"  
  
    },  
  
    {  
  
        "ref": "pkg:uccpu@1.30.01"  
  
    },  
  
    {  
  
        "ref": "pkg:uclib@1.38.01"  
  
    },  
  
    {  
  
        "ref": "pkg:ucos3@3.04.05"  
  
    },  
  
    {  
  
        "ref": "pkg:spi_driver@1.0.0"  
  
    },  
  
    {  
  
        "ref": "pkg:twi_driver@1.0.0"  
  
    },  
  
    {  
  
        "ref": "pkg:uart_driver@1.0.0"  
  
    },  
  
    {
```

```
        "ref": "pkg:dma_service@1.0.0"
    },
    {
        "ref": "pkg:gpio_driver@1.0.0"
    },
    {
        "ref": "pkg:pwr_service@1.0.0"
    },
    {
        "ref": "pkg:hadc_driver@1.0.0"
    },
    {
        "ref": "pkg:wdt_service@1.0.0"
    },
    {
        "ref": "pkg:startup_code@1.0.0"
    },
    {
        "ref": "pkg:heap_and_stack_config@1.0.0"
    }
]
}
```

APPENDIX C

Machine-Readable Software Bill of Materials – Reference Sensor BLE SoC Firmware

Machine-Readable Software Bill of Materials – Reference Sensor BLE SoC Firmware

```
{  
  "$schema": "http://cyclonedx.org/schema/bom-1.5.schema.json",  
  "bomFormat": "CycloneDX",  
  "specVersion": "1.5",  
  "serialNumber": "urn:uuid:7fd2547b-ba6b-4e21-bf17-b916e437a563",  
  "version": 1,  
  "metadata": {  
    "timestamp": "2024-11-11T14:11:43-08:00",  
    "tools": {  
      "components": [  
        {  
          "type": "application",  
          "author": "anchore",  
          "name": "syft",  
          "version": "1.14.2"  
        },  
        {  
          "type": "application",  
          "author": "Analog Devices, Inc.",  
          "name": "Cross Core Embedded Studios",  
          "version": "2.8.3.0"  
        }  
      ]  
    }  
  }  
}
```

```
    },
    "component": {
      "bom-ref": "SW0104_LanternRS_DSP",
      "type": "firmware",
      "name": "HarveyRS",
      "version": "7.0.0",
      "description": "Firmware Source Code for the Lantern RS DSP",
      "hashes": [
        {
          "alg": "SHA-256",
          "content":
"BE75D78420F6D8436429F8FA044C7BF487C6A01A02F2C5F3D080B37A585DE72E"
        }
      ],
      "licenses": [
        {
          "license": {
            "name": "OrthAlign Custom Proprietary License",
            "url": "https://www.orthalign.com/terms-of-use/",
            "licensing": {
              "licensor": {
                "organization": {
                  "name": "OrthAlign, Inc."
                }
              }
            }
          }
        }
      ],
      "licenseTypes": [
```

```
        "appliance"
      ]
    }
  }
}

},
"authors": [
  {
    "name": "OrthAlign, Inc.",
    "email": "info@orthalign.com"
  }
],
"supplier": {
  "name": "OrthAlign, Inc.",
  "url": [
    "https://www.orthalign.com/"
  ],
  "contact": [
    {
      "name": "OrthAlign, Inc.",
      "email": "info@orthalign.com"
    }
  ]
}
},
```

```
"components": [  
  {  
    "type": "operating-system",  
    "name": "uCOS-III for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "2.7.0",  
    "bom-ref": "pkg:ucos-iii@2.7.0",  
    "description": "Real Time Operating System and SDK",  
    "licenses": [  
      {  
        "license": {  
          "name": "Proprietary License: Perpetual"  
        }  
      }  
    ],  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "RTOS OSAL",  
    "author": "Analog Devices, Inc",  
    "version": "1.2.3",  
    "bom-ref": "pkg:rtos-osal@1.2.3",  
    "description": "Real Time Operating System and SDK",  
    "licenses": [  
      {
```

```

        "license": {
            "name": "Proprietary License: Perpetual"
        }
    },
    "copyright": "2013 Analog Devices, Inc."
},
{
    "type": "library",
    "name": "uC-CPU for SHARC",
    "author": "Analog Devices, Inc",
    "version": "1.30.01",
    "bom-ref": "pkg:uccpu@1.30.01",
    "description": "SHARC CPU Library",
    "licenses": [
        {
            "license": {
                "name": "Proprietary License: Perpetual"
            }
        }
    ],
    "copyright": "2013 Analog Devices, Inc."
},
{
    "type": "library",
    "name": "uC-LIB for SHARC",

```

```
"author": "Analog Devices, Inc",
"version": "1.38.01",
"bom-ref": "pkg:uclib@1.38.01",
"description": "Libraries for SHARC chipset",
"licenses": [
  {
    "license": {
      "name": "Proprietary License: Perpetual"
    }
  }
],
"copyright": "2013 Analog Devices, Inc."
},
{
  "type": "library",
  "name": "uCOS-III",
  "author": "Analog Devices, Inc",
  "version": "3.04.05",
  "bom-ref": "pkg:ucos3@3.04.05",
  "description": "Libraries for SHARC chipset",
  "licenses": [
    {
      "license": {
        "name": "Proprietary License: Perpetual"
      }
    }
  ]
}
```

```
    ],  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "SPI Driver for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "1.0.0",  
    "bom-ref": "pkg:spi_driver@1.0.0",  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "TWI Driver for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "1.0.0",  
    "bom-ref": "pkg:twi_driver@1.0.0",  
    "copyright": "2013 Analog Devices, Inc."  
  },  
  {  
    "type": "library",  
    "name": "UART Driver for SHARC",  
    "author": "Analog Devices, Inc",  
    "version": "1.0.0",  
    "bom-ref": "pkg:uart_driver@1.0.0",  
    "copyright": "2013 Analog Devices, Inc."
```

```

},
{
  "type": "library",
  "name": "DMA Service for SHARC",
  "author": "Analog Devices, Inc",
  "version": "1.0.0",
  "bom-ref": "pkg:dma_service@1.0.0",
  "copyright": "2013 Analog Devices, Inc."
},
{
  "type": "library",
  "name": "GPIO Driver for SHARC",
  "author": "Analog Devices, Inc",
  "version": "1.0.0",
  "bom-ref": "pkg:gpio_driver@1.0.0",
  "copyright": "2013 Analog Devices, Inc."
},
{
  "type": "library",
  "name": "PWR Service for SHARC",
  "author": "Analog Devices, Inc",
  "version": "1.0.0",
  "bom-ref": "pkg:pwr_service@1.0.0",
  "copyright": "2013 Analog Devices, Inc."
},
{

```

```
"type": "library",  
  
"name": "HADC Driver for SHARC",  
  
"author": "Analog Devices, Inc",  
  
"version": "1.0.0",  
  
"bom-ref": "pkg:hadc_driver@1.0.0",  
  
"copyright": "2013 Analog Devices, Inc."  
  
},  
  
{  
  
  "type": "library",  
  
  "name": "WDT Service for SHARC",  
  
  "author": "Analog Devices, Inc",  
  
  "version": "1.0.0",  
  
  "bom-ref": "pkg:wdt_service@1.0.0",  
  
  "copyright": "2013 Analog Devices, Inc."  
  
},  
  
{  
  
  "type": "library",  
  
  "name": "Startup Code/LDF",  
  
  "author": "Analog Devices, Inc",  
  
  "version": "1.0.0",  
  
  "bom-ref": "pkg:startup_code@1.0.0",  
  
  "copyright": "2013 Analog Devices, Inc."  
  
},  
  
{  
  
  "type": "library",  
  
  "name": "Heap and Stack Configuration",
```

```
"author": "Analog Devices, Inc",  
  
"version": "1.0.0",  
  
"bom-ref": "pkg:heap_and_stack_config@1.0.0",  
  
"copyright": "2013 Analog Devices, Inc."  
  
}  
  
],  
  
"dependencies": [  
  
  {  
  
    "ref": "SW0104_LanternRS_DSP",  
  
    "dependsOn": [  
  
      "pkg:ucos-iii@2.7.0",  
  
      "pkg:uccpu@1.30.01",  
  
      "pkg:uclib@1.38.01",  
  
      "pkg:startup_code@1.0.0",  
  
      "pkg:heap_and_stack_config@1.0.0"  
  
    ]  
  
  },  
  
  {  
  
    "ref": "pkg:ucos-iii@2.7.0",  
  
    "dependsOn": [  
  
      "pkg:spi_driver@1.0.0",  
  
      "pkg:twi_driver@1.0.0",  
  
      "pkg:uart_driver@1.0.0",  
  
      "pkg:dma_service@1.0.0",  
  
      "pkg:gpio_driver@1.0.0",  
  
      "pkg:pwr_service@1.0.0",
```

```
        "pkg:hadc_driver@1.0.0",
        "pkg:wdt_service@1.0.0"
    ]
},
{
    "ref": "pkg:rtos-osal@1.2.3"
},
{
    "ref": "pkg:uccpu@1.30.01"
},
{
    "ref": "pkg:uclib@1.38.01"
},
{
    "ref": "pkg:ucos3@3.04.05"
},
{
    "ref": "pkg:spi_driver@1.0.0"
},
{
    "ref": "pkg:twi_driver@1.0.0"
},
{
    "ref": "pkg:uart_driver@1.0.0"
},
{
```

```
        "ref": "pkg:dma_service@1.0.0"
    },
    {
        "ref": "pkg:gpio_driver@1.0.0"
    },
    {
        "ref": "pkg:pwr_service@1.0.0"
    },
    {
        "ref": "pkg:hadc_driver@1.0.0"
    },
    {
        "ref": "pkg:wdt_service@1.0.0"
    },
    {
        "ref": "pkg:startup_code@1.0.0"
    },
    {
        "ref": "pkg:heap_and_stack_config@1.0.0"
    }
]
}
```

APPENDIX D

Machine-Readable Software Bill of Materials – Navigation Unit OS (SW0101) LinuxKernel_4.9.17

Machine-Readable Software Bill of Materials – Navigation Unit OS (SW0101) LinuxKernel_4.9.17{

```
"bomFormat" : "CycloneDX",  
"specVersion" : "1.5",  
"serialNumber" : "urn:uuid:99001fb4-b153-4fb2-a189-6e812b6896f7",  
"version" : 1,  
"metadata" : {  
  "timestamp" : "2026-04-17T23:24:38Z",  
  "tools" : [  
    {  
      "vendor" : "OWASP",  
      "name" : "Dependency-Track",  
      "version" : "4.13.4"  
    }  
  ],  
  "component" : {  
    "type" : "firmware",  
    "bom-ref" : "1e75aecf-2444-4d68-ae64-fd5a6357389a",  
    "name" : "Lantern ASC Android Kernel",  
    "version" : "4.9.17"  
  }  
},  
"components" : [  
  {
```

```
"type" : "library",
"bom-ref" : "93107cb8-db08-441e-8cf2-24453812df24",
"name" : "Linux Kernel",
"version" : "v4.9.17",
"licenses" : [
{
"license" : {
"name" : "d1ff3cc0-134d-4339-9a4d-8a0edc9d2788"
}
}
],
"cpe" : "cpe:2.3:o:linux:linux_kernel:4.9.17:*:*:*:*:*:*:*",
"properties" : [
{
"name" : "syft:cpe23",
"value" : "cpe:2.3:o:linux:kernel:4.9.17:*:*:*:*:*:*:*"
},
{
"name" : "syft:cpe23",
"value" : "cpe:2.3:o:linux:linux_kernel:4.9.17:*:*:*:*:*:*:*"
}
]
}

dependencies" : [
[
```

```
"ref" : "1e75aecf-2444-4d68-ae64-fd5a6357389a",  
"dependsOn" : [ ]  
},  
{  
  "ref" : "93107cb8-db08-441e-8cf2-24453812df24",  
  "dependsOn" : [ ]  
}  
]  
}
```

APPENDIX E

Machine-Readable Software Bill of Materials – Navigation Unit OS (SW0101) uboot-sbom

Machine-Readable Software Bill of Materials – Navigation Unit OS (SW0101) uboot-sbom

firmware 25.11.19.0

Wed May 6 15:54:15 PDT 2026

npic-app version : 0.0.15

25-10-18

pthread_create Pass. Blink_Led_Func!!!

Running npic-config.sh...

Decoding base64 key...

Decoding base64 cert...

Decoding base64 cert...

Setting timezone to America/Los_Angeles...

Configuring hostname...

npic-36c17ff

Hostname set to npic-36c17ff

connection-type wifi...

Connection 'wifi-auto-connect' (30013e90-b2a6-48b6-848e-004ecb8868fb) successfully deleted.

Configuring WiFi connection...

Connection 'wifi-auto-connect' (393d9d57-b965-4992-8913-bb4135fa6e65) successfully added.

Passwords or encryption keys are required to access the wireless network 'sandbox-radius'.

Warning: password for '802-1x.identity' not given in 'passwd-file' and nmcli cannot ask without '--ask' option.

Error: Connection activation failed: Secrets were required, but not provided

npic-config.sh done...

Wed May 6 15:54:58 PDT 2026

Blink_Led_Func Thread Starting...

SD card available!!!

npic-config.conf file present in sd card.

/run/media/mmcblk1p1/npic-config.conf update success.

/run/media/mmcblk1p1/npic-config.conf npic-config.conf backup success.

Running in server mode.

WIFI HW detected!!!

Ethernet HW detected!!!

SCardListReaders return Command successful. (0x0)

Found Omnikey reader: HID Global OMNIKEY 5022 Smart Card Reader [OMNIKEY 5022 Smart Card Reader] (IM-16014571-2348-001019) 00 00

Check_Connectivity Starting...

curl_easy_perform() failed: Timeout was reached 28

Connection to Server http://npi-connect:6500 failed.

firmware 25.11.19.0

Wed May 6 15:56:07 PDT 2026

npic-app version : 0.0.15

25-10-18

pthread_create Pass. Blink_Led_Func!!!

Running npic-config.sh...

Decoding base64 key...

Decoding base64 cert...

Decoding base64 cert...

Setting timezone to America/Los_Angeles...

Configuring hostname...

npic-36c17ff

Hostname set to npic-36c17ff

connection-type wifi...

Connection 'wifi-auto-connect' (393d9d57-b965-4992-8913-bb4135fa6e65) successfully deleted.

Configuring WiFi connection...

Connection 'wifi-auto-connect' (63a44fb9-173a-44f7-abc1-bb68078297e7) successfully added.

Passwords or encryption keys are required to access the wireless network 'sandbox-radius'.

Warning: password for '802-1x.identity' not given in 'passwd-file' and nmcli cannot ask without '--ask' option.

Error: Connection activation failed: Secrets were required, but not provided

npic-config.sh done...

Wed May 6 15:56:48 PDT 2026

Blink_Led_Func Thread Starting...

SD card available!!!

npic-config.conf file present in sd card.

/run/media/mmcblk1p1/npic-config.conf update success.

/run/media/mmcblk1p1/npic-config.conf npic-config.conf backup success.

Running in server mode.

WIFI HW detected!!!

Ethernet HW detected!!!

SCardListReaders return Command successful. (0x0)

Found Omnikey reader: HID Global OMNIKEY 5022 Smart Card Reader [OMNIKEY 5022 Smart Card Reader] (IM-16014571-2348-001019) 00 00

Check_Connectivity Starting...

curl_easy_perform() failed: Timeout was reached 28

Connection to Server http://npi-connect:6500 failed.

Wed May 6 15:57:53 PDT 2026

DRM Timestamp file doesn't exist!!!

DRM Timestamp file created with time: 2026-05-06T22:57:53Z

curl_easy_perform() failed: Timeout was reached 28

Connection to Server http://npi-connect:6500 failed.