NTIA SBOM: Formats and Tooling

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Technical Briefing for the Energy Community

Formats and Tooling: Objectives (1/3)

- Focus on enabling automated SBOM generation and use
- Build and expand on what already exists
- Try to avoid re-inventing the wheel
- Document what tools exist
- Identify any gaps in the tooling ecosystem
- Promote inclusion of SBOM capabilities into existing tools and services

Formats and Tooling: Objectives (2/3)

Identify SBOM Formats in Commercial Use

- SPDX - https://spdx.github.io/spdx-spec/
- SWID - ISO/IEC 19770-2:2015
- CycloneDX - https://cyclonedx.org/docs/1.2/

Identify Software Identifiers in Commercial Use and Emerging Identifiers

- Common Package Enumeration - CPE
- Package URLs - PURL
- Software ID tags - SWID tag
- Software Heritage persistant ID - SWHID

Formats and Tooling: Objectives (3/3)

- Define and categorize criteria for the minimum required information in an SBOM
  - Field definitions
  - Data extensions for provision of additional/external/deeper information

- Enable translation between SBOM formats
  - “Decoder Ring” tool - in progress
  - “SwiftBOM” tool - in progress, used in HealthCare PoC

- Create Playbooks for Generation and Consumption of SBOM
  - Supplier Playbook - in progress
  - Consumer Playbook - draft release: https://docs.google.com/document/d/1Ae0l1MDS8m1on58e8mdVIA9NujzPD0k5j352VlDZr9I/edit

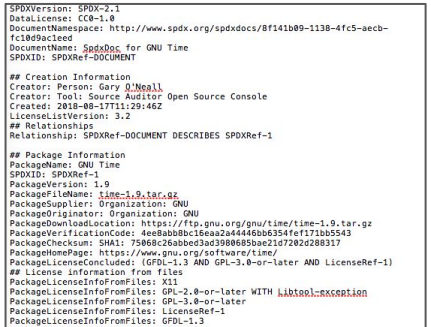
What should a minimum viable SBOM contain?

NTIA SBOM Minimum Fields	SPDX	SWID	CycloneDX
Supplier Name	(3.5) PackageSupplier:	<Entity> @role (softwareCreator/publisher), @name	publisher
Component Name	(3.1) PackageName:	<softwareIdentity> @name	name
Unique Identifier	(3.2) SPDXID:	<softwareIdentity> @tagID	bom/serialNumber and component/bom-ref
Version String	(3.3) PackageVersion:	<softwareIdentity> @version	version
Component Hash	(3.10) PackageChecksum:	<Payload>/../<File> @[hash-algorithm]:hash	hash
Relationship	(7.1) Relationship: CONTAINS	<Link> @rel, @href	(Nested assembly/subassembly and/or dependency graphs)
Author Name	(2.8) Creator:	<Entity> @role (tagCreator), @name	bom-descriptor:metadata/manufacture/contact

Source: NTIA's **Framing Software Component Transparency: Establishing a Common Software Bill of Material (SBOM)**

Current SBOM Options Available

SPDX



```
SPDXVersion: SPDX-2.1
DataLicense: CC0-1.0
DocumentNamespace: http://www.spdx.org/spdxdocs/8f141b09-1138-4fc5-aecb-
fc10d9ac1eed
DocumentName: SpdxDoc for GNU Time
SPDXID: SPDXRef-DOCUMENT

## Creation Information
Creator: Person: Gary O'Neall
Creator: Tool: Source Auditor Open Source Console
Created: 2018-08-17T11:29:46Z
LicenseListVersion: 3.2
## Relationships
Relationship: SPDXRef-DOCUMENT DESCRIBES SPDXRef-1

## Package Information
PackageName: GNU Time
SPDXID: SPDXRef-1
PackageVersion: 1.9
PackageFileName: time-1.9.tar.gz
PackageSupplier: Organization: GNU
PackageOriginator: Organization: GNU
PackageDownloadLocation: https://ftp.gnu.org/gnu/time/time-1.9.tar.gz
PackageVerificationCode: 4ee8abb8bc16eaa2a44466bb6354fef171bb5543
PackageChecksum: SHA1: 75068c26abbed3ad3980685bae21d7202d288317
PackageHomePage: https://www.gnu.org/software/time/
PackageLicenseConcluded: (GFDL-1.3 AND GPL-3.0-or-later AND LicenseRef-1)
## License information from files
PackageLicenseInfoFromFiles: X11
PackageLicenseInfoFromFiles: GPL-2.0-or-later WITH Libtool-exception
PackageLicenseInfoFromFiles: GPL-3.0-or-later
PackageLicenseInfoFromFiles: LicenseRef-1
PackageLicenseInfoFromFiles: GFDL-1.3
PackageLicenseDeclared: GPL-3.0-or-later
PackageLicenseComments: <text>Several files contained a GPL 2.0 or later
license.  Since they were linked to a GPL 3.0 package, GPL 3.0 was used.</
text>
PackageCopyrightText: <text>Copyright (C) 1990-2018 Free Software Foundation,
Inc.</text>
PackageSummary: <text>The `time' command runs another program, then displays
information about the resources used by that program.</text>
PackageDescription: <text>The `time' command runs another program, then
displays information about the resources used by that program.</text>

## File Information
FileName: ./tests/help-version.sh
SPDXID: SPDXRef-164
FileType: SOURCE
FileChecksum: SHA1: 30b3973b22ddbcd9e8982a06c5a2440fcb315013
LicenseConcluded: GPL-3.0-or-later
LicenseInfoInFile: GPL-3.0
LicenseComments: Seen licenses generated by Source Auditor Scanner.  Results
should be manually verified.
FileCopyrightText: <text>Copyright Free Software Foundation, Inc</text>
FileNotice: <text>NOASSERTION</text>
```

File formats: .xls, .spdx, .rdf, .json, .yml, .xml

SWID

```
<?xml version="1.0" encoding="utf-8"?>
<SoftwareIdentity xmlns="http://standards.iso.org/iso/19770/-2/2015/schema.xsd" xmlns:sha256="http:/
/www.w3.org/2001/04/xmlenc#sha256" xmlns:n8060="http://csrc.nist.gov/ns/swid/2015-extensions/1.0" xm
lns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://standards.iso.org/iso
/19770/-2/2015/schema.xsd http://standards.iso.org/iso/19770/-2/2015-current/schema.xsd      http://c
src.nist.gov/ns/swid/2015-extensions/1.0 https://csrc.nist.gov/schema/swid/2015-extensions/swid-2015
-extensions-1.0.xsd" xml:lang="en-US" name="zip" tagId="unavailable.invalid.zip-3.0-26.fc32.x86_64"
version="3.0-26.fc32.x86_64" versionScheme="rpm">
  <Entity name="" regid="invalid.unavailable" role="tagCreator"/>
  <Link rel="required" use="required" type="swid+xml" ownership="shared" href="swid:unavailable.inva
lid.bzip2-libs-1.0.8-2.fc32.x86_64-rpm-72c50b49853aa0ce60806262a85734085f7836d7553e18e68037f3e913724
25d.swidtag"/>
  <Link rel="required" use="required" type="swid+xml" ownership="shared" href="swid:unavailable.inva
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idtag"/>
  <Link rel="required" use="required" type="swid+xml" ownership="shared" href="swid:unavailable.inva
lid.unzip-6.0-47.fc32.x86_64-rpm-8a274fd9aafd2a6d435dd0f923b73be1870097e3bd8e989ad5809f59de14ba78.sw
idtag"/>
  <Meta product="zip" colloquialVersion="3.0" revision="26.fc32" arch="x86_64" summary="A file compr
ession and packaging utility companiestible with PKZIP"/>
  <Evidence date="2020-06-12T19:08:27Z" deviceId="localhost.localdomain" n8060:pathSeparator="/" n80
60:envVarPrefix="$" n8060:envVarSuffix="">
    <File size="213648" name="zip" location="/usr/bin" sha256:hash="8abb7885954cd7cd8a2f9dbecf96a965
c4a837329b9a9bf1eb4e586b8f7e22f5" key="true"/>
    <File size="106416" name="zipcloak" location="/usr/bin" sha256:hash="fa902ca689f188358642284ba56
306660d5747555ddb63fc72f79b333e8ec7f08" key="true"/>
    <File size="97816" name="zipnote" location="/usr/bin" sha256:hash="141860f5d7675b39e681eec8cc6f
30e0bb418ffd92a73a28575514c38abbac2" key="true"/>
    <File size="97864" name="zipsplit" location="/usr/bin" sha256:hash="0d13183bb15a20ad76012b83b26b
a5b8def1e37195caf48c34a54e09557ef2f8" key="true"/>
    <Directory name="..build-id" location="/usr/lib">
      <Directory name="4c">
        <File size="28" name="224381b5ef923772f5e1742f80af581b848da" key="true"/>
      </Directory>
      <Directory name="54">
        <File size="27" name="65529f3700a53099150775c5c55cf4db21ad84a" key="true"/>
      </Directory>
```

File formats: .xml

CycloneDX

```
<?xml version="1.0"?><bom serialNumber="9e253f92-4e1c-497e-8f87-50730d24f18a" xmlns="http://cyclonedx.org/schema/bom/1.1">
<components><component type="library"><description>Nerves System BR - Buildroot based build platform for Nerves
Systems</description><hashes><hash alg="SHA-256">e3fda6bc49f8e3662d37355aad88c0839296597c0b6ff6653d21967db1890b038</hash></hashes>
<licenses><license><id>Apache-2.0</id></license><license><name>GPLv2</name></license></licenses><name>nerves_system_br</name>
<purl>pkg:hex/nerves_system_br@1.9.5</purl><version>1.9.5</version></component><component type="library"><description>Nerves -
Create firmware for embedded devices like Raspberry Pi, BeagleBone Black, and more</description><hashes><hash alg="SHA-
256">07079342db3a03d19694118a93f2203598fbd94b6e174b98d1ea2703db9e81da9</hash></hashes><licenses><license><id>Apache-2.0</id>
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type="library"><description>Socket handling library for Elixir</description><hashes><hash alg="SHA-
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</licenses><name>socket</name><purl>pkg:hex/socket@0.3.13</purl><version>0.3.13</version></component><component type="library">
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</license></licenses><name>uboot_env</name><purl>pkg:hex/uboot_env@0.1.1</purl><version>0.1.1</version></component><component
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256">452f8589c1a58ac787477caab20a8cfc6671e345837ccc19beefe49ae35ba983</hash></hashes><licenses><license><id>Apache-2.0</id>
</license></licenses><name>nerves_toolchain_ctng</name><purl>pkg:hex/nerves_toolchain_ctng@1.6.0</purl><version>1.6.0</version>
</component><component type="library"><description>A ring buffer backend for Elixir Logger with IO streaming.</description><hashes>
<hash alg="SHA-256">b1baddc269099b2afe2ea3a87b8e2b71e57331c00000388ea55090068aac679db</hash></hashes><licenses><license><id>Apache-
2.0</id></license></licenses><name>ring_logger</name><purl>pkg:hex/ring_logger@0.8.0</purl><version>0.8.0</version></component>
<component type="library"><description>Nerves System Linter - Lint Nerves System Defconfigs.</description><hashes><hash alg="SHA-
256">84e0f63c8ac196b16b77608bbe7df66dcf352845c4e4fb394bffd2b572025413</hash></hashes><licenses><license><id>Apache-2.0</id>
</license></licenses><name>nerves_system_linter</name><purl>pkg:hex/nerves_system_linter@0.3.0</purl><version>0.3.0</version>
</component><component type="library"><description>DNS library for Elixir using `inet_dns` module.

Note: The `inet_dns` module is considered internal to Erlang and subject to
change. If this happened this library will be updated.</description><hashes><hash alg="SHA-
256">81c46d39f7934f0e733683551246a4266762cf227ba61d5889635d83b2d64a493</hash></hashes><licenses><license><name>BSD-3-Clause</name>
</license></licenses><name>dns</name><purl>pkg:hex/dns@2.1.2</purl><version>2.1.2</version></component><component type="library">
<description>A simple mDNS (zeroconf, bonjour) server and client for device discovery on your local network.</description><hashes>
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2.0</id></license></licenses><name>mdns</name><purl>pkg:hex/mdns@1.0.3</purl><version>1.0.3</version></component><component
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</license></licenses><name>nerves_toolchain_armv6_rpi_linux_gnueabi</name>
<purl>pkg:hex/nerves_toolchain_armv6_rpi_linux_gnueabi@1.2.0</purl><version>1.2.0</version></component><component type="library">
<description>Nerves System - Raspberry Pi A+ / B+ / B</description><hashes><hash alg="SHA-
256">a9b68559cbb4585d7b050394f2e2395cc7517f9a0816d9ea9115f1164db731e9</hash></hashes><licenses><license><id>Apache-2.0</id>
</license></licenses><name>nerves_system_rpi</name><purl>pkg:hex/nerves_system_rpi@1.9.2</purl><version>1.9.2</version></component>
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</license></licenses><name>shoehorn</name><purl>pkg:hex/shoehorn@0.6.0</purl><version>0.6.0</version></component><component
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alg="SHA-256">e7ac32898cc4fb259a308116df27455ff12ea360cdb91c74906baef49b223ada</hash></hashes><licenses><license><id>Apache-
2.0</id></license></licenses><name>nerves_system_bbb</name><purl>pkg:hex/nerves_system_bbb@2.4.2</purl><version>2.4.2</version>
</component><component type="library"><description>A Make compiler for Mix</description><hashes><hash alg="SHA-
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</license></licenses><name>elixir_make</name><purl>pkg:hex/elixir_make@0.6.0</purl><version>0.6.0</version></component><component
```

File formats: .json, .xml

Translating between SBOM formats & file formats

SwiftBOM: (SPDX(.spdx), SWID(.xml), CycloneDX(.xml,.json))

- Demo at: https://democert.org/sbom/
- Source code at: https://github.com/CERTCC/SBOM/tree/master/sbom-demo

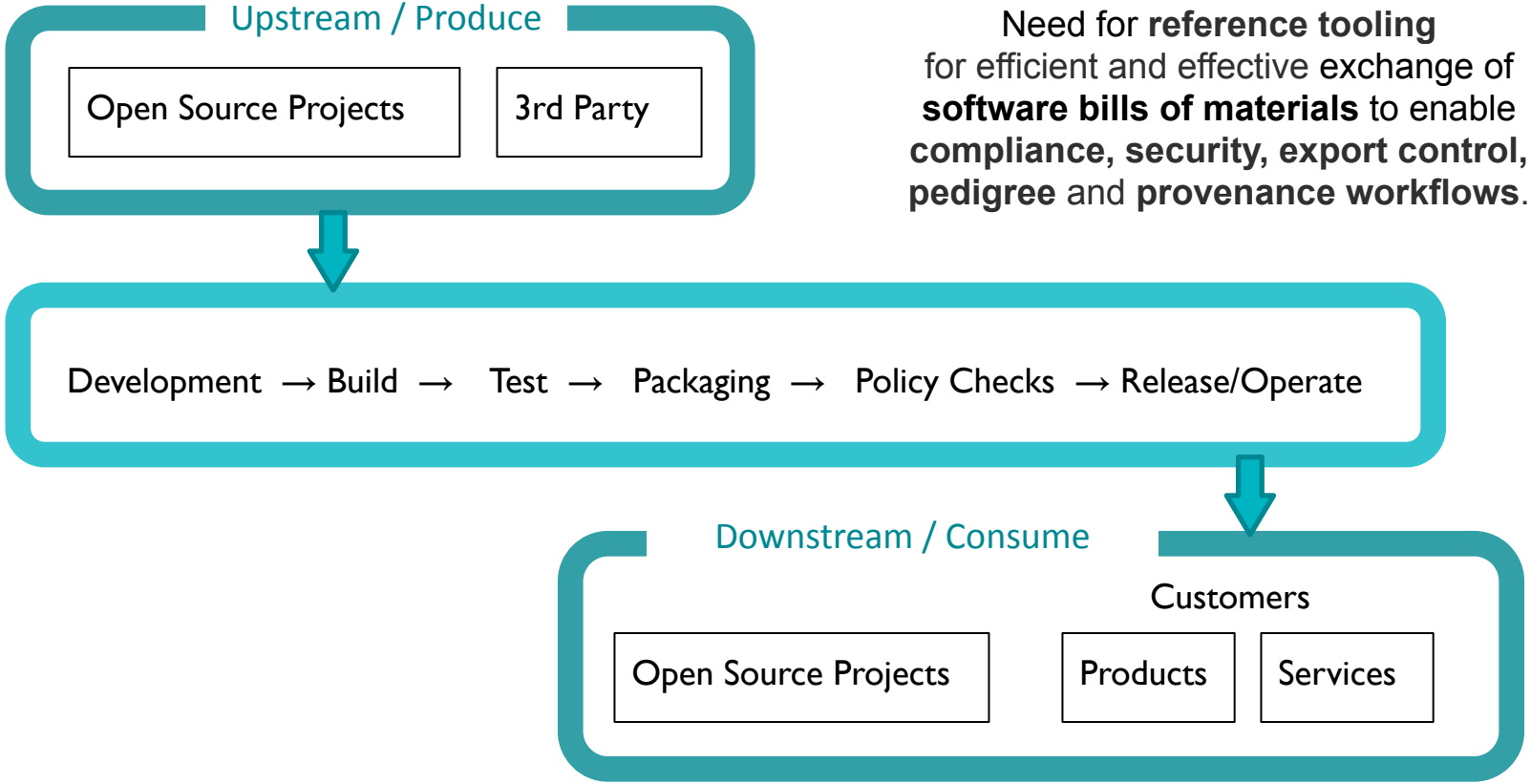
DecoderRing: (SPDX (.spdx), SWID(.xml))

- Source code at: https://github.com/DanBeard/DecoderRIng

SPDX tools: (SPDX (.spdx, json, yaml, rdf, xml, xls))

- Demo at: https://tools.spdx.org/app/
- Source code at: https://github.com/spdx/spdx-online-tools

Where use an SBOM? All stages



Need for **reference tooling** for efficient and effective exchange of **software bills of materials** to enable **compliance, security, export control, pedigree** and **provenance workflows**.

Taxonomy used for Classifying SBOM Tools (UPDATED Feb26)

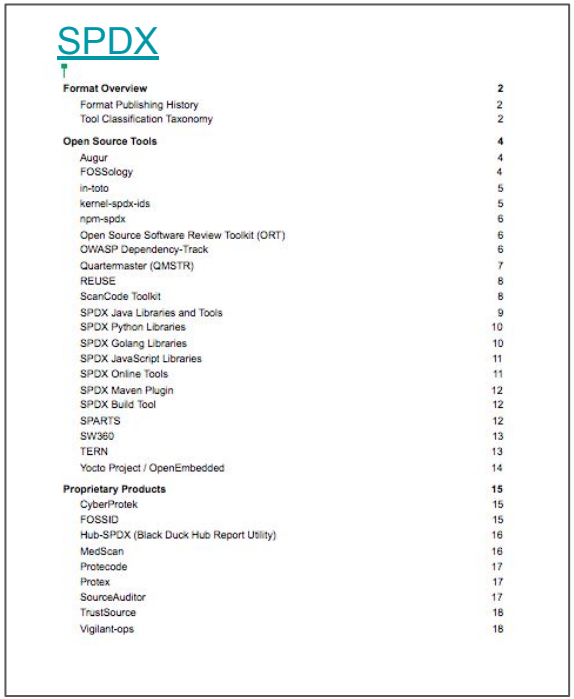
Category	Type of Tool	Description
Produce	Build	SBOM is automatically created as part of building a software artifact and contains information about the build.
	Manual	A person will manually fill in the SBOM information
	Analysis	Analysis of source or binary files will generate the SBOM by inspection of the artifacts and any associated sources.
Consume	View	Be able to understand the contents in human readable form (picture, figures, tables, text.). Use to support decision making & business processes.
	Diff	Be able to compare two documents of a given formation and clearly see the differences. For instance, comparing between two versions of a piece of software.
	Import	Be able to import an SBOM into your system for further processing
Transform	Translate	Change from one file type to another file type while preserving the same information.
	Merge	Multiple sources of documents can be merged together for analysis and audit purposes
	Tool support	Support use in other tools by APIs, object models, libraries, or other reference sources.

Taxonomy used for Classifying SBOM Tools

Category	Type	Description
Produce	Build	Document is automatically created as part of building an artifact and contains information about the build.
	Manual	A person will manually fill in the information
	Audit Tool	A source code analysis or audit tool will generate the document by inspection of the artifact and any associated sources.
Consume	View	Be able to understand the contents in human readable form (picture, figures, tables, text.). Use to support decision making & business processes.
	Diff	Be able to compare two documents of a given formation and clearly see the differences. For instance, comparing between two versions of a piece of software.
	Analyze	Be able to import a document into your system
Transform	Translate	Change from one file type to another file type while preserving the same information.
	Merge	Multiple sources of documents can be merged together for analysis and audit puproses
	Tool integration	Support use in other tools by APIs, libraries.

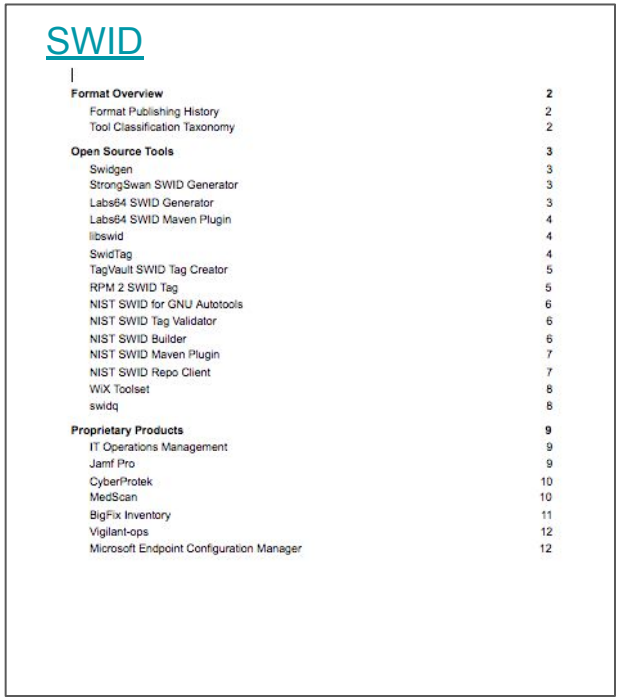
Tool Support for Different SBOM Formats

SPDX



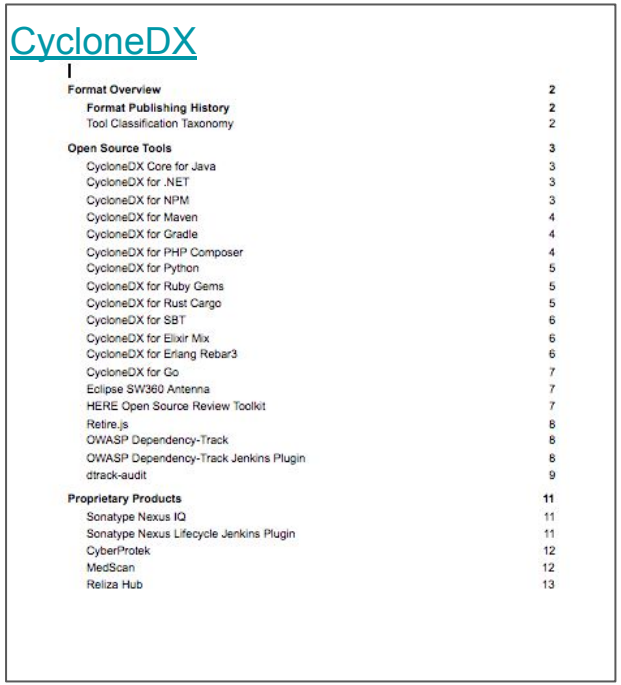
http://tiny.cc/SPDX

SWID



http://tiny.cc/SWID

CycloneDX



http://tiny.cc/CycloneDX

SBOMs Examples (Work in Progress)

SPDX

- https://github.com/lfscanning - LF projects source packages.
- https://github.com/swinslow/spdx-examples - source & binary examples

CycloneDX

- https://github.com/CycloneDX/sbom-examples - binary examples

SWID

- Time 1.9 from Red Hat distro - binary example

SBOM Playbooks: Supplier Playbook

- Supplier defined to include: commercial vendor, contract developer, open source software supplier developing and maintaining OSS code.
- SBOM production workflow: development pipeline vs. legacy processes
- SBOM scope: What's in the Box
- Build Artifacts
  - Functional workflow (tool-agnostic) for commit → build with SBOM production as an output
  - Example outputs: SPDX, CycloneDX
- Provision of SBOMs to recipients
  - Reference to NTIA Framing Group report: https://www.ntia.doc.gov/files/ntia/publications/ntia_sbom_framing_sharing_july9.pdf

SBOM Playbook: Consumer Playbook

- Acquisition of SBOM from supplier
- SBOM Ingestion and Parsing
- Software Entity Resolution
- Data Flows into Third Party Processes and Platforms
  - Configuration Management Database
  - Security Operations Center
  - Software Asset Management System
- Ongoing Monitoring

Areas to Learn: Generalized vs. Energy-Specific Requirements

- Generalized requirements for code: software, firmware, embedded
- Where do SBOM requirements of firmware/embedded diverge from IT?
- Where do SBOM requirements for licensed/proprietary third party components diverge from third party open source components?
- Lessons Learned and Best Practices for SBOM access control
  - Open Formats
  - Content may be delivered under NDA
  - Rely on confidentiality terms and access control, rather than IP/copyright
- Why this matters: SBOM is an intermediary phase of the data
  - Operational requirement for data to be ingested by enterprise processes and platforms
  - Ex: CMDB, SAM, SOC
  - Configuration management can’t become a “derivative work” and function as intended.