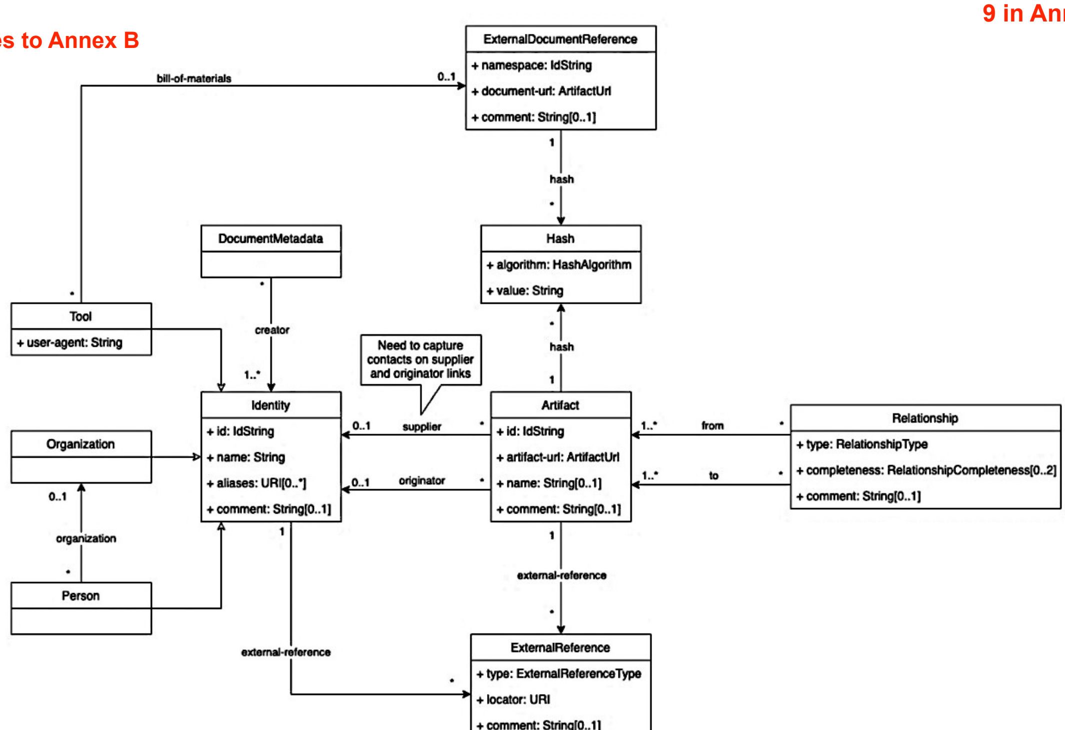
7 History, Motivation and Rationale

The OMG and CISQ involvement in developing this specification has its start due to a need that came from the several years of work in the Department of Commerce's National Telecommunications and Information Administration (NTIA) in creating an Initiative to Improve Software Component Transparency in July of 2018 [1]. That effort actually was the culmination of several earlier attempts to get software transparency, updatability and bill of material as requirements in safety critical sectors like automotive and healthcare as early as 2013/2014 [2, 3] with many talks and papers written for and against them and discussions. With the launch of the NTIA Software Component Transparency Initiative there was a major increase in the energy and coordination of those proposing Software Bill of Material (SBOM) as a key element of communication across the different participants in software supply chains. These meetings, which started with a public meeting in Washington DC consisted primarily of vendors of software and customers of those vendors. It was this mix of participants that struck us that these efforts were missing an important community member if they were to make SBOMs successful and useful – they seemed to be missing the organizations who create the tools for developing software.

To address this gap, over the winter and spring of 2019, we crafted a market analysis of the software development tooling ecosystem and documented usage scenarios to drive the functionality needed for an SBOM standard usable by tools to talk to other tools and bring speed and agility into the discussion of software transparency and assurance about the information itself. This information was used to present to the Systems Assurance Platform Task Force (PTF) and the Architecture Driven Modernization PTF in March and June of 2019. The paper "Standardizing SBOM within the SW Development Tooling Ecosystem", which captured this work, was later published by MITRE [4] and included 8 core usage scenarios for SBOMs as well as a discussion of the various roles were in the software creation tooling ecosystem. This paper and its various pre-publication drafts were used as a discussion starter to garner interest and participation in the Tool-to-Tool (3T) Software Bill of Materials Exchange effort [5]. The 3T-SBOM Exchange effort was co-sponsored by CISQ and OMG and launched in the fall of 2019 with three to four weekly meetings working the various facets of SBOMs. Over the next two years the 3T-SBOM community, which included over 30 organizations that develop and integrate software creation tooling and infrastructure, developed a 3T-SBOM core model (shown in Figure 1) in September of 2020 that had seven basic concepts connected together to address the usage scenarios outlined for the project.

9 in Annex B

Move figures to Annex B



9

Figure 5 – 3T-SBOM draft core model (circa Sep 2020)

While the 3T-SBOM community was working to develop their model, the work within the NTIA Software Component Transparency effort also met in numerous weekly virtual meetings to discuss the various aspects of SBOMs, their use, the roles of different players in the lifecycle of an SBOM and the need to educate the world about SBOMs. This was captured in the NTIA Software Bill Of Materials web page. [6]

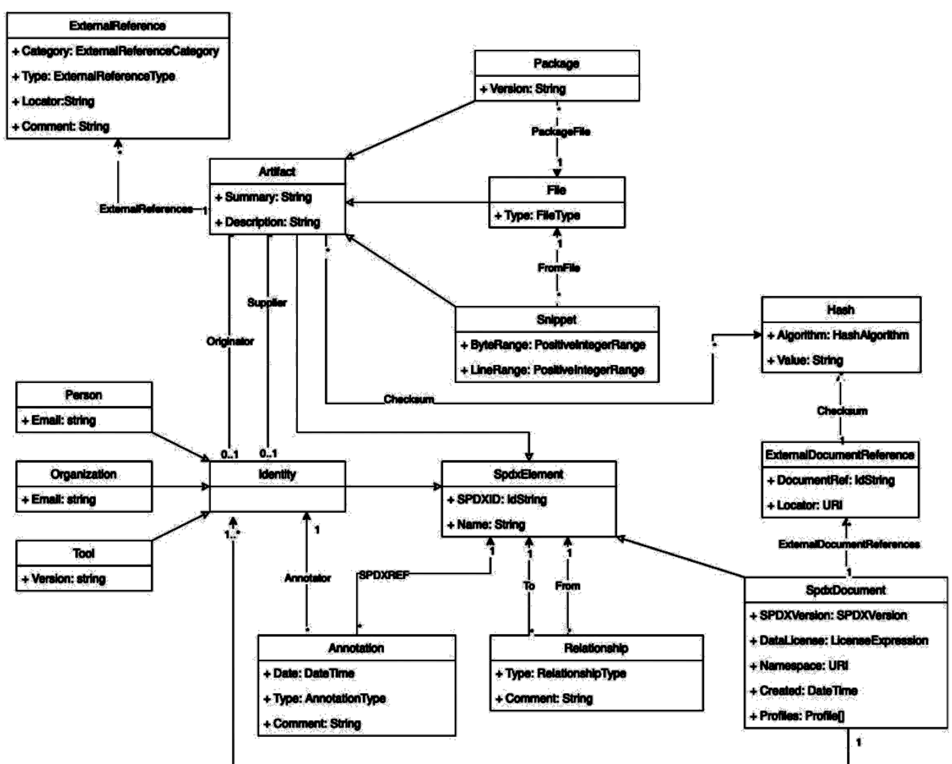
In late 2020 and much of 2021 the world of software security turned its attention to the software supply chain attack on the Solar Winds Corporation [7] and the need to prevent similar types of attacks in the future. The United States Government responded to this and other similar attacks by issuing Executive Order 14028 in May 2021 [8] calling for stronger software security practices for products used by the government and that the software have SBOMs with them. The Executive Order required that "Within 60 days of the date of this order, the Secretary of Commerce, in coordination with the Assistant Secretary for Communications and Information and the Administrator of the National Telecommunications and Information Administration, shall publish minimum elements for an SBOM." This was done leveraging the community work that NTIA had been doing with industry for the past 34 months and set the new requirements for SBOM capabilities. [9]

Over the 2019-2020 timespan, some of the organization in the 3T-SBOM community were also working within the Linux Foundation's Software Package Data Exchange (SPDX®) open-source effort to evolve their previous work. Started in 2010 to help organizations developing software that planned to incorporate open source software make sure that the licenses for that open source software were appropriate for how the organizations planned to use them in their own offerings, the SPDX community developed a series of software products, specifications, and capabilities to address this area. The first published work was a version 1.0 specification in August of 2011; followed by 1.1 version a year later; a 1.2 version in October 2013; a 2.0 version in 2015; and 2.1 version in 2016. The 2.1 version of SPDX was published through the Linux Foundation's new Joint Development Foundation and sent to ISO under the Publicly Available Standard (PAS) process with it eventually being republished as "ISO/IEC 5962:2021 - Information technology — SPDX®" in 2021.

Through the common members in 3T-SBOM and the Linux Foundation's SPDX effort many of the concepts around SBOMs flowed back and forth between the two resulting in a draft core model for SPDX 3.0 in September of 2020 that had the same seven basic concepts connected together that were in the 3T-SBOM core model. Figure 2 shows the state of the SPDX 3.0 core model at that time.

10 in Annex B

Move figures to Annex B



10

Figure 6 – SPDX 3.0 draft core model (circa Sep 2020)

11 in Annex B

The similarities and alignment of the two group's work (shown in Figure ~~6~~ below) was brought to the attention of both teams and after long discussions about each other's efforts, goals, and approach to creating a standard for today, both agreed in principle to join together under the SPDX 3.0 label but to make several changes in the way the SPDX community activities were run as well as how the resulting specification would be vetted.

Move figures to Annex B

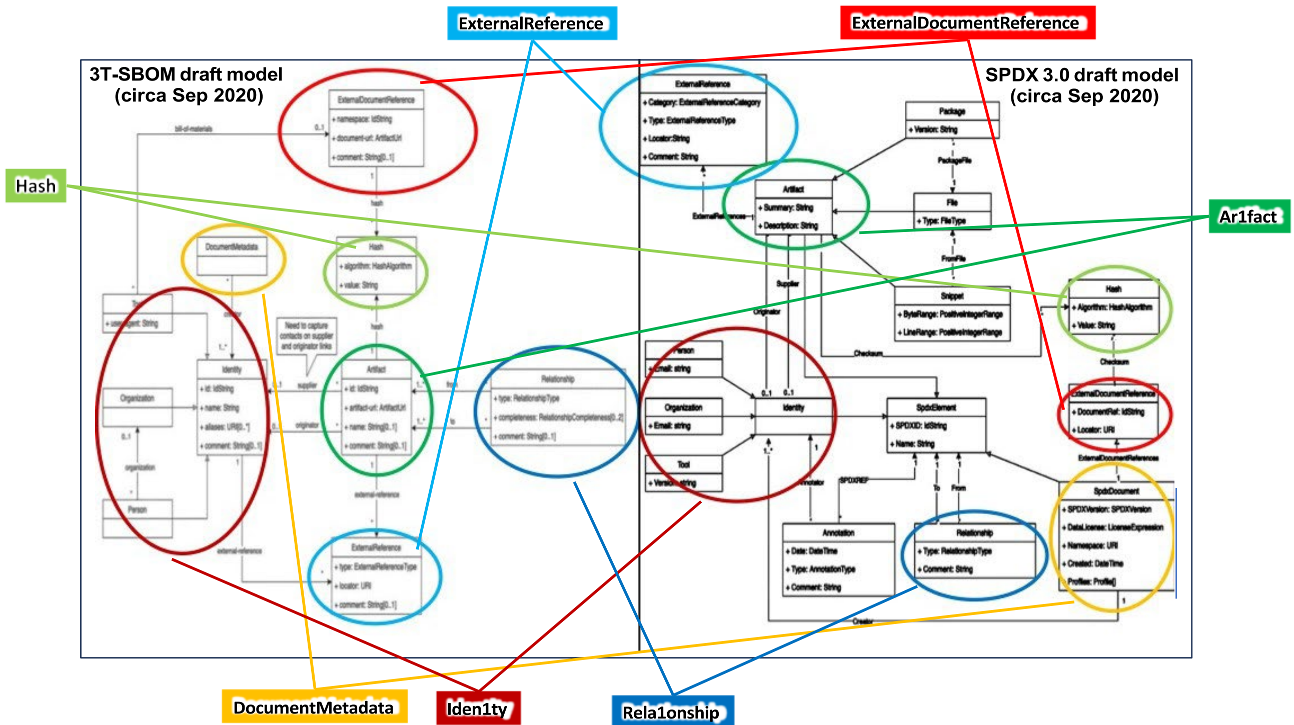


Figure ~~7~~ 11 – Correspondence between 3T-SBOM and SPDX 3.0 draft models (circa Sep 2020)

Specifically, the SPDX community revised their charter to align with the processes of a Standards Development Organization, electing new chairs and adding the OMG Architecture Board review as a gating factor in the publication of SPDX 3.0 and subsequent versions.

The merged activities of the two group slid together the beginning weeks of 2021 with activities generally moving forward but occasionally stalling while the larger group worked through issues that one or the other hadn't discussed or had a different opinion about. Eventually, after releasing SPDX 2.3 in August of 2022 with updates that brought some of the concepts and capabilities slated for SPDX 3.0 to the community in preparation of the shift that SPDX 3.0 represents, the first release candidate of SPDX 3.0 was released in May of 2023. Within the SPDX community, which is both a standards creation organization as well as a community of open source developers, a release candidate offers an opportunity for implementors of SPDX, both new and old, to review the work and determine whether there were parts that were unclear or that would be extremely burdensome to implement.

Based on the comments and change requests from the initial candidate release several areas of the model were revised and reworked, resulting in a release candidate 2 of SPDX in February of 2024. This release candidate will give tool creators and those who maintain the support libraries for working with SPDX time to start revising their projects in advance of the final version of the specification.For those not following the inner workings, debates, and discussion of the combined 3T-SBOM and SPDX 3.0 working group for the last 3 years there will be a dramatic change in the SPDX model as it goes from SPDX 2.3 to SPDX 3.0, as shown by looking at Figure ~~7~~'s left-side (SPDX 2.3 model) compared to its right-side (SPDX 3.0). shifting the SPDX name from Software Package Data eXchange to System Package Data eXchange and the scope of items it can convey in a Bill of Materials. 12 in Annex B

Move figures to Annex B

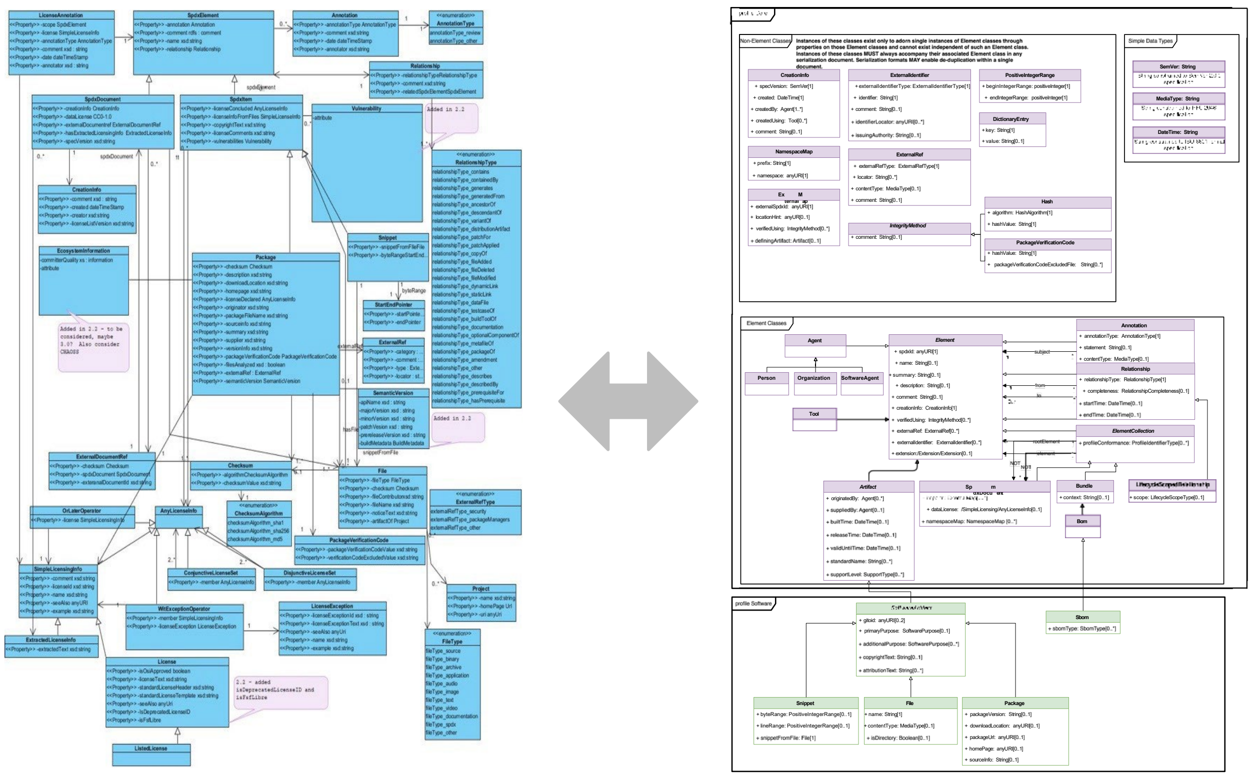


Figure ~~8~~ 12 – SPDX 2.3 Model compared to the SPDX 3.0 Model

The SPDX 3.0 model is available at: https://github.com/spdx/spdx-3-model

The SPDX 3.0 ontology is available at: https://github.com/spdx/spdx-spec/tree/development/v3.0/ontology

The SPDX 3.0 specification is available as web pages at: https://spdx.github.io/spdx-spec/v3.0/

8 Core Profile

Summary

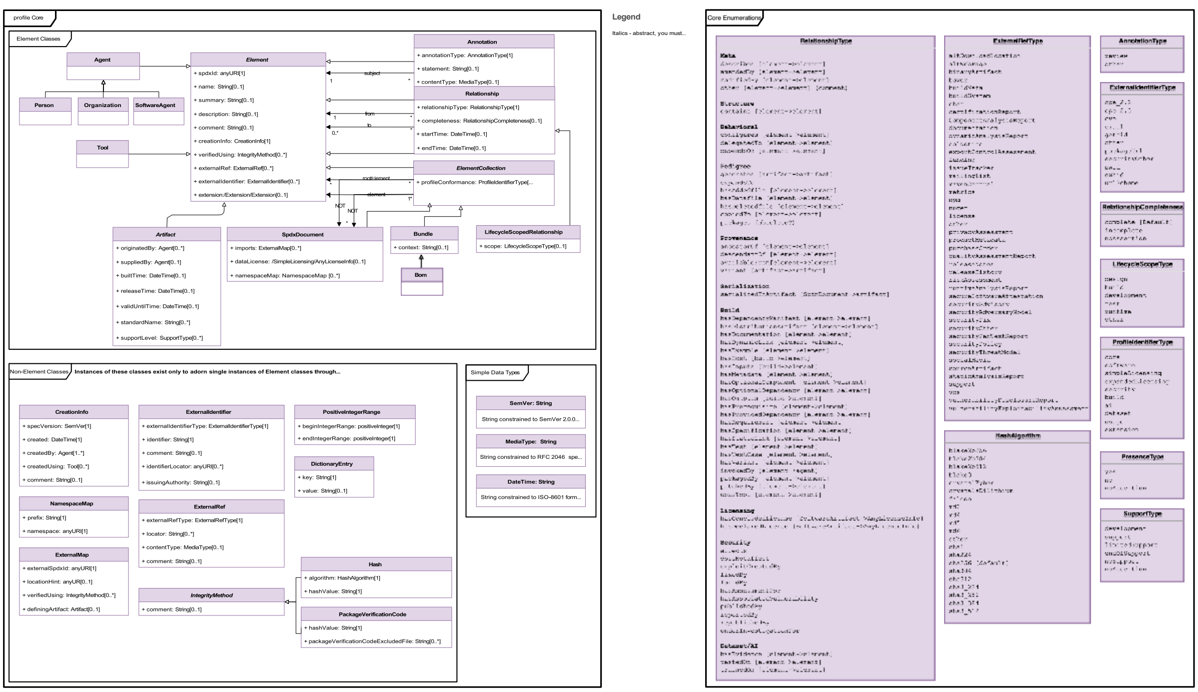
The basis for all SPDX profiles.

Description

Figure 1 in Annex B

The Core namespace defines foundational concepts serving as the basis for all SPDX-3.0 profiles. ~~Figure 5 below~~ shows the logical model for Core profile, for the Software profile, and the non-element classes, enumerations, and data types for both.

Move figures to Annex B



~~Figure 5~~ Figure 1 – Core model profile, non-element classes, enumerations, and single data types

9 Software Profile

Summary

Everything having to do with software.

Description

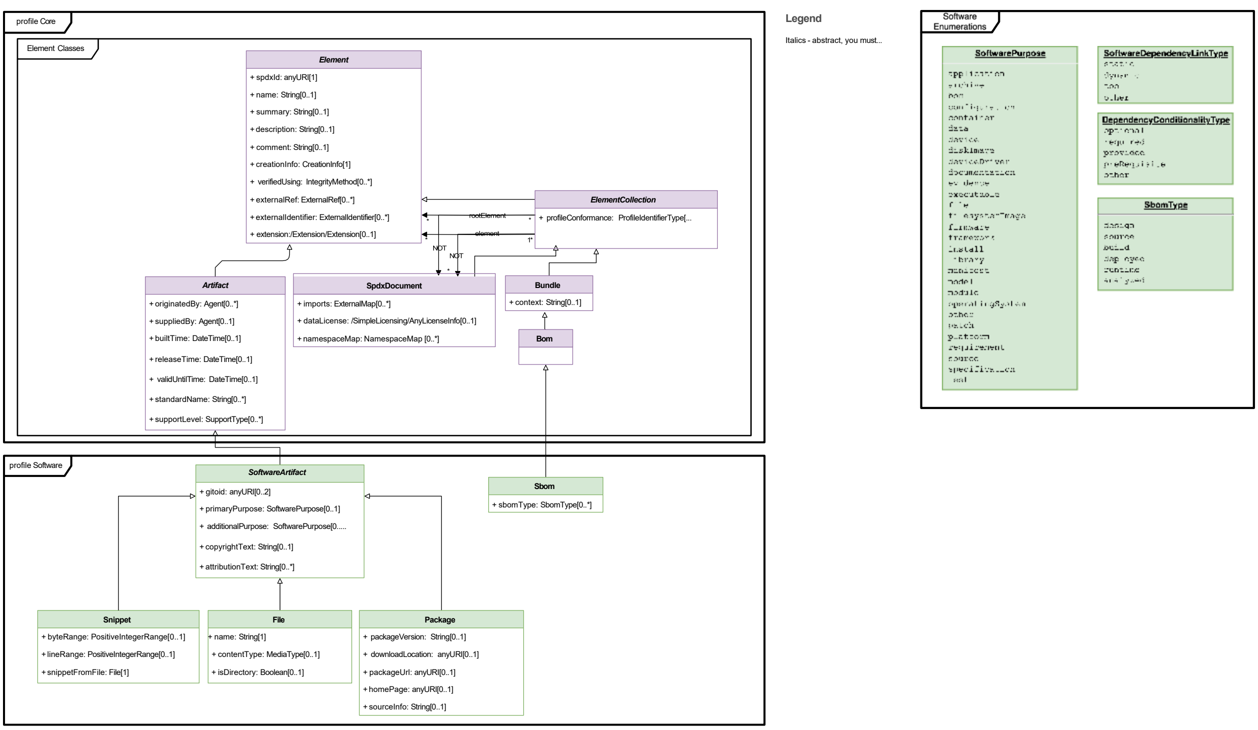
Figure 2 in Annex B

The Software namespace defines concepts related to software artifacts. ~~Figure 6 below~~ shows the logical model for Core profile, for the Software profile, and the non-element classes, enumerations, and data types for both.

Metadata

Name	Software

Move figures to Annex B



~~Figure 10~~ – Software Model profile, non-element classes, enumerations, & single data types

Figure 2

10 Security Profile

Summary

The Security Profile captures security related information.

Description

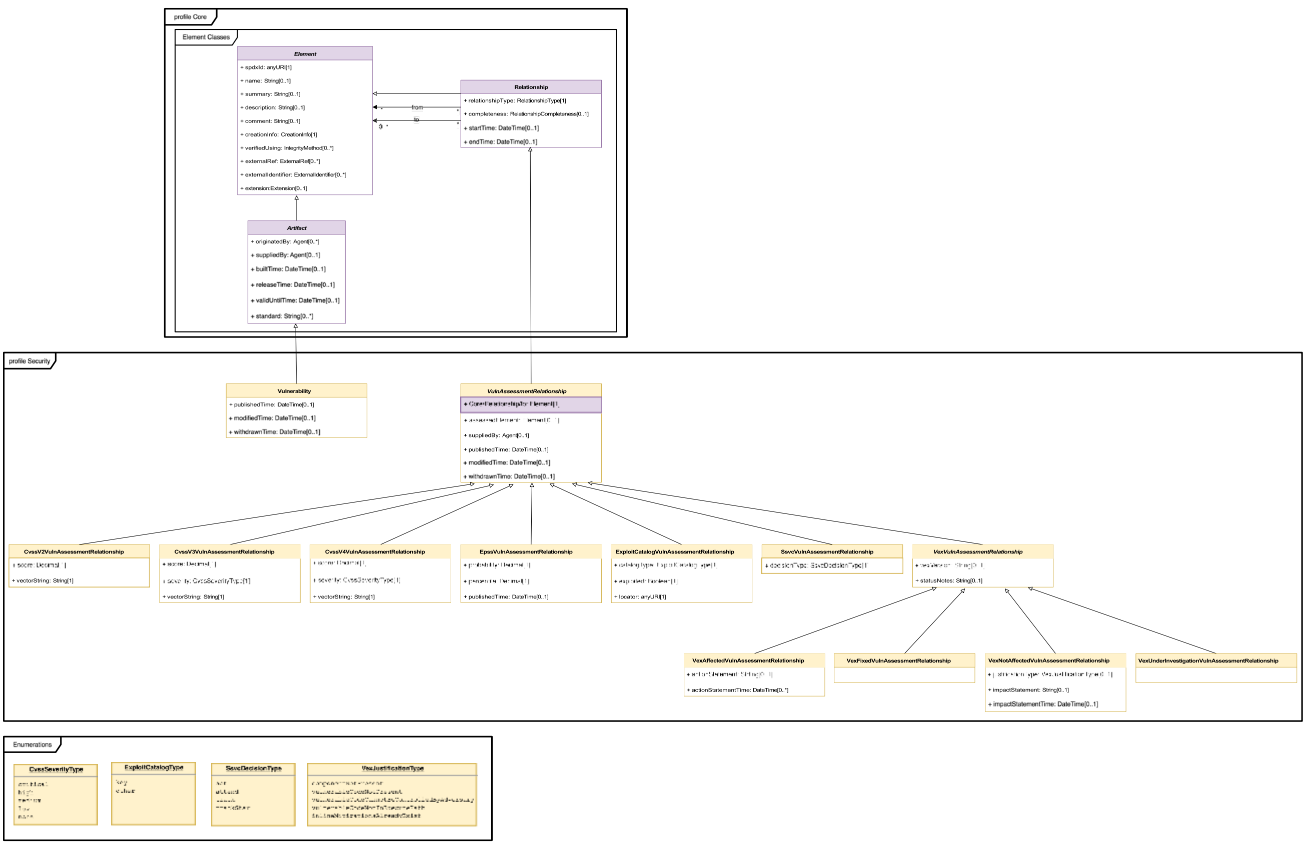
Figure 3 in Annex B

The Security Profile captures security related information. ~~Figure 7 below~~ shows the logical model for the Security profile and its enumerations.

Metadata

Name	Security

Move figures to Annex B



~~Figure 11~~ – Security Model profile and enumerations

Figure 3

A concludedLicense relationship to NoAssertionLicense indicates that one of the following applies: * the SPDX data creator has attempted to but cannot reach a reasonable objective determination; * the SPDX data creator has made no attempt to determine this field; or * the SPDX data creator has intentionally provided no information (no meaning should be implied by doing so).

If a concludedLicense is not present, no assumptions can be made about whether or not a concludedLicense exists. Note that a missing concludedLicense is not the same as a relationship to a NoAssertionLicense since the latter is a "known unknown" whereas no assumptions can be made from a missing concludedLicense relationship.

A written explanation of a relationship to a NoAssertionLicense MAY be provided in the comment field for the relationship.

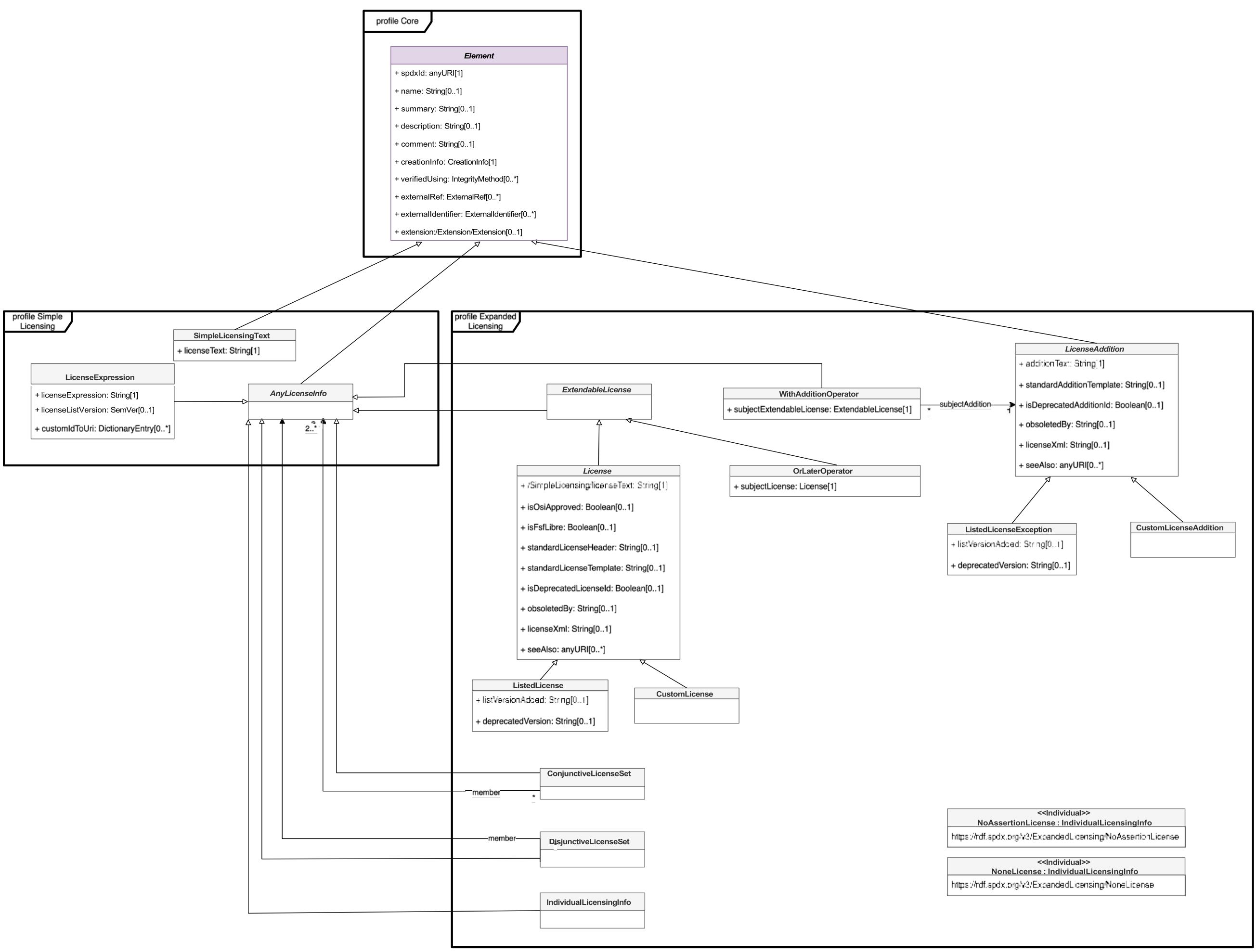
If the concludedLicense for a Software Artifact is not the same as its declaredLicense, a written explanation SHOULD be provided in the concludedLicense relationship comment field.

Figure 4 in Annex B
~~Figure 8 below~~ shows the logical model for the Simple and Expanded Licensing profiles.

Metadata

Name	Licensing

Move figures to Annex B



~~Figure 12~~ – Licensing Simple and Expanded Model profiles
Figure 4

12 Dataset Profile

Summary

Everything having to do with datasets.

Description

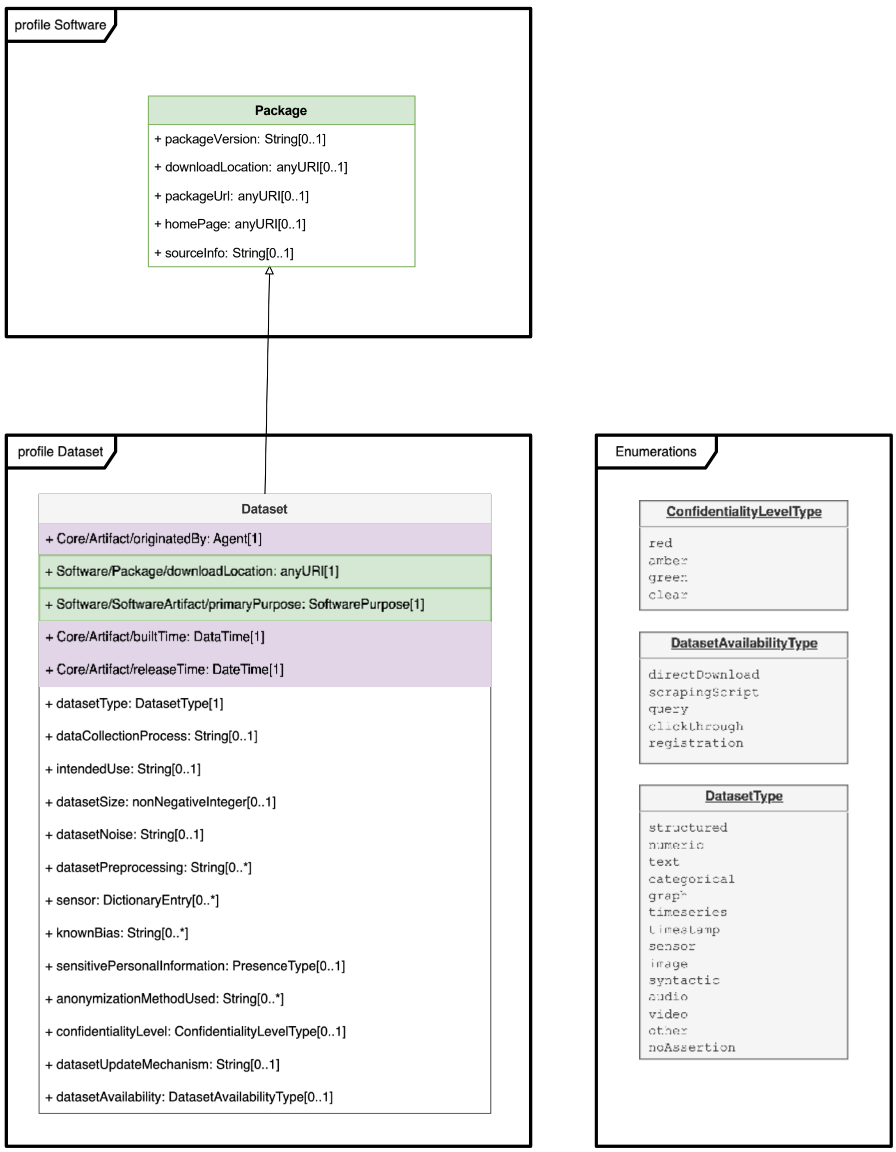
Figure 5 in Annex B

The Dataset profile provides meta-data about data files. ~~Figure 9 below~~ shows the logical model for the Dataset profile with its classes and enumerations.

Metadata

Name	Dataset

Move figures to Annex B



~~Figure 13~~ – Dataset Model profile and enumerations

Figure 5

13 AI Profile

Summary

Additional metadata based on software profile, that is useful for ai applications and models.

Description

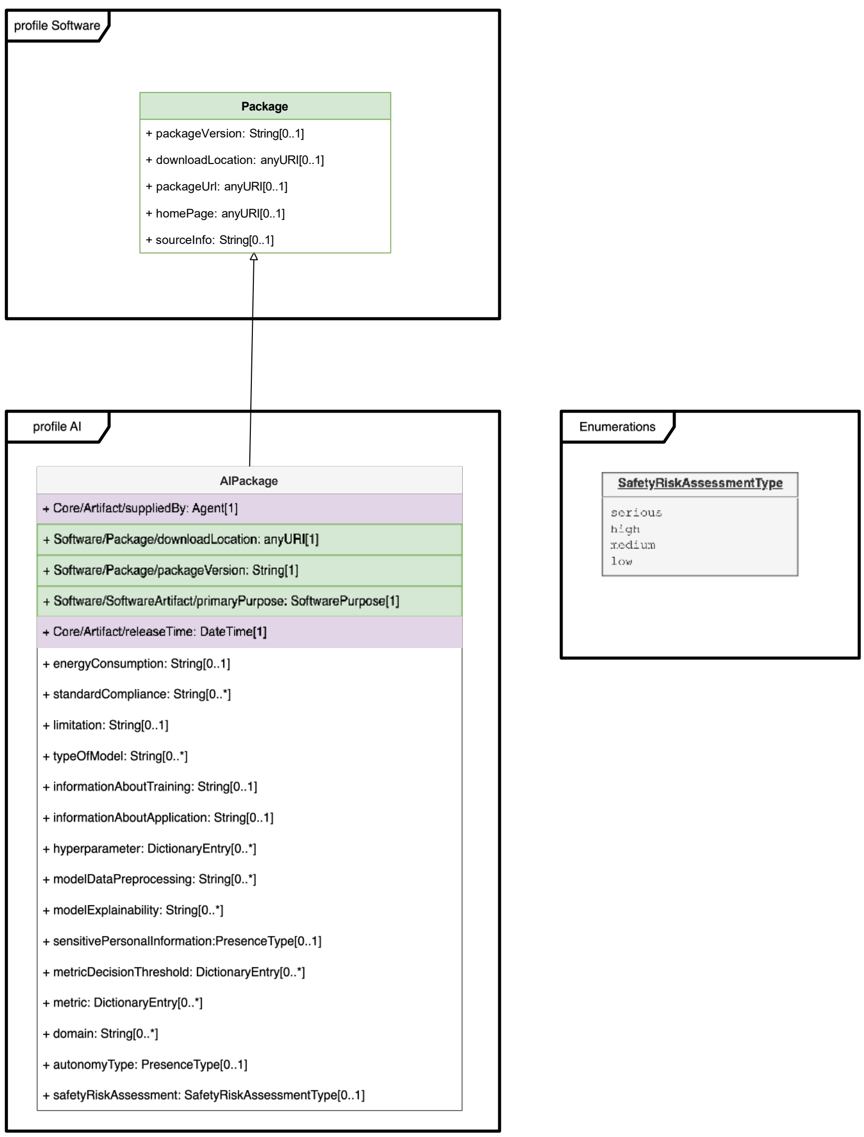
Figure 6 in Annex B

The AI profile namespace defines concepts related to AI application and model artifacts. ~~Figure 10 below~~ shows the logical model for the AI profile with its classes and enumerations.

Metadata

Name	AI

Move figures to Annex B



~~Figure 14~~ – AI Model profile and enumerations

Figure 6

14 Build Profile

Summary

The Build Profile defines the set of information required to describe an instance of a Software Build.

Description

A Software Build is defined here as the act of converting software inputs into software artifacts using software build tools. Inputs can include source code, config files, artifacts that are build environments, and build tools. Outputs can include intermediate artifacts to other build inputs or the final artifacts. **Figure 6 in Annex B shows the logical model for the Build profile with its classes and enumerations.**

The Build profile provides a subclass of Element called Build. It also provides a minimum set of required Relationship Types from the Core profile:

- hasInputs: Describes the relationship from the Build element to its inputs.
- hasOutputs: Describes the relationship from the Build element to its outputs.
- invokedBy: Describes the relationship from the Build element to the Agent that invoked it.

In addition, the following Relationship Types may be used to describe a Build.

- hasHost: Describes the relationship from the Build element to the build stage or host.
- configures: Describes the relationship from a configuration to the Build element.
- ancestorOf: Describes a relationship from a Build element to Build eelements that describe its child builds.
- decendentOf: Describes a relationship from a child Build element to its parent.
- usesTool: Describes a relationship from a Build element to a build tool.

All relationships in the Build Profile are scoped to the "build" LifecycleScopeType period.

The hasInputs relationship can be applied to a config file or a build tool if the nature of these inputs are not known at the creation of an SPDX document.

Move figures to Annex B

Metadata

Name	Build

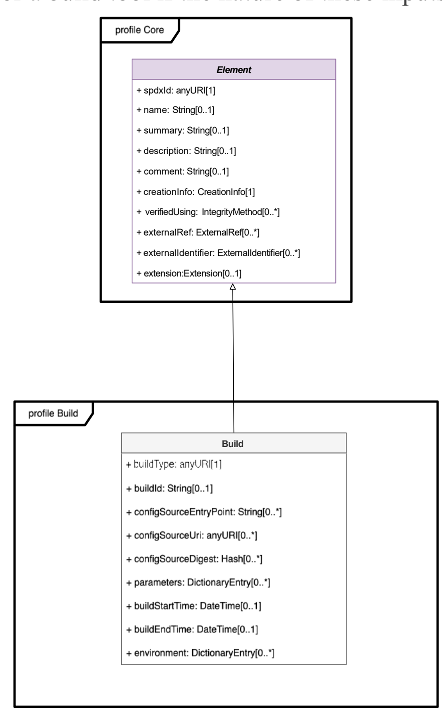


Figure 7 – Build Model profile and enumerations

16 Extension Profile

Summary

Everything having to do with SPDX extensions.

Description

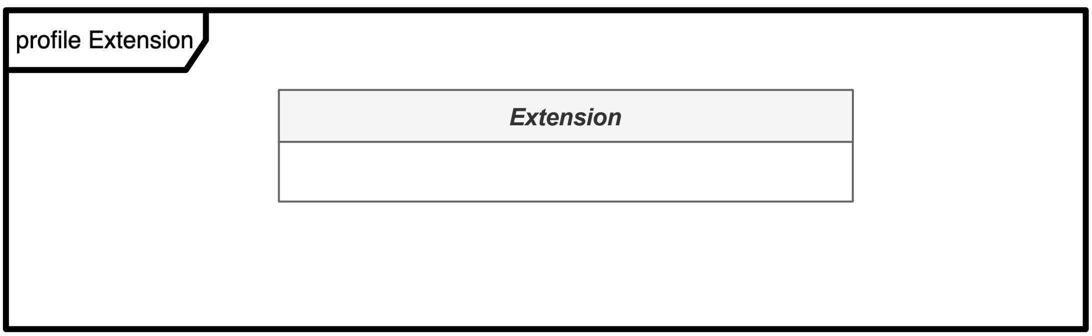
The Extension namespace defines the abstract Extension class serving as the base for all defined extension subclasses. ~~Figure 12 below~~ shows the logical model for the Extension profile.

Figure 8 in Annex B

Metadata

Name	Extension

Move figures to Annex B



~~Figure 16~~ – Extension Model profile

Figure 8