Understanding the Phase Product Dependencies Graph

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Abstract

This document describes the symbology and intent behind the AVCDL Phase Product Dependencies graph.

Overview

The AVCDL Phase Product Dependencies graph is intended to convey the means by which traceability is achieved by implementing the AVCDL processes. It visualizes this through use of a reverse dependency graph [2] showing the relationship between various AVCDL phase products. It also conveys a sense of the primary responsibility load during each phase through the use of color coding. This visualization is implemented using ISO 5807 (flowchart) symbology [1, 4]. This visualization also allows us to see the inherent parallelism present within each phase.

Document Status

Pending certification body review

License

Phase Encapsulation

The products of each phase are entirely enclosed in rounded rectangles labeled with their phase name in the upper right corner of the rectangle.

Flowchart Symbology

The phase product dependency graph visualization uses ISO standard flowchart symbols to represent various elements. This section will elaborate on those.

Document

The primary symbol used within the visualization is the **document**. This directly corresponds with the nature of the majority of AVCDL phase products. The following extract shows that there is a phase product which is a document entitled “Decommissioning Plan.”

Figure 1 - Use of document ISO flowchart symbol

Data File / Database

The **data file** / **database** symbol is used to denote AVCDL phase products which are live data stores. These products are not intended to be reports, but rather data sources for other activities. The following extract shows that there is a phase product (“Cybersecurity Requirements Catalog”) which is embodied as a database. (In this case, it is specifically embodied via Polarion.)

Figure 2 - Use of data file / database ISO flowchart symbol

Decision

The **decision** symbol is used to denote a gating activity. In traditional flowchart usage the decision would have one or more inputs and two or more outputs. For the purposes of this diagram, it will have only a single output representing a successful outcome of the gating activity. A presumption is made that failure to complete all dependent products will result in the rejection of this activity and require that the dependencies be properly satisfied. The following extract shows a design phase gate. Note that the title reflects the phase being gated.

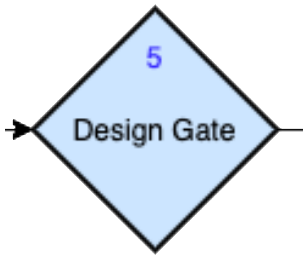

Figure 3 - Use of decision ISO flowchart symbol

Flowline

The **flowline** symbol is used to denote dependency (reversed) between AVCDL phase products. The choice of direction was made based on the natural inclination toward forward movement (this leads to that). Each product will have one or more inbound and one or more outbound flowlines. The following extract shows that the “Ranked/Risked Threat Report” phase product has three (3) dependencies and that two (2) other phase products are dependent upon its completion.

Figure 4 - Use of flowline ISO flowchart symbol

Off-page Connector

The **off-page connector** symbol is used to denote inter-phase dependencies. These are used as the phase product dependencies graph is realized over multiple physical pages in order to allow for it to be read in document form. There are two use cases of this symbol. The first is as a predecessor-successor connector. The second is as a product-specific connector.

Predecessor-successor Connector

The predecessor-successor use of the off-page connector denotes that the completion of the previous phase in its entirety represents the dependency. This is illustrated by the fact that the off-page connector sources from a phase gate product / activity. The label for this connector is a two-character sequence where the first letter denotes first letter of the name of the phase of the dependency source and the second that of the target. The following extract shows that there is a dependency carried out of the verification phase into the release phase (note the connector label VR [verification-release]. A phase should only have an input from the predecessor-successor connector for which it is the destination, all other inputs should be product-specific (see next entry).

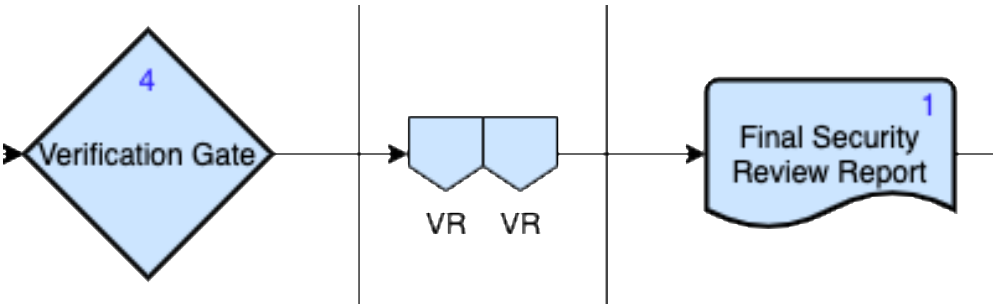

Figure 5 - Use of ISO off-page connector flowchart symbol (predecessor-successor)

Note: In actual use, these would be split across pages. They are show together here as they were sourced from the master working diagram.

Product-specific Connector

The product-specific use of the off-page connector denotes that a dependency exists between specific AVCDL phase products in different phases. In this use case we have explicit dependencies called out. In the following extract we can see that there is a dependency between the “List of Approved Tools” foundation phase and the “List of Tools Used” implementation phase products. Connectors are uniquely and integrally numbered.

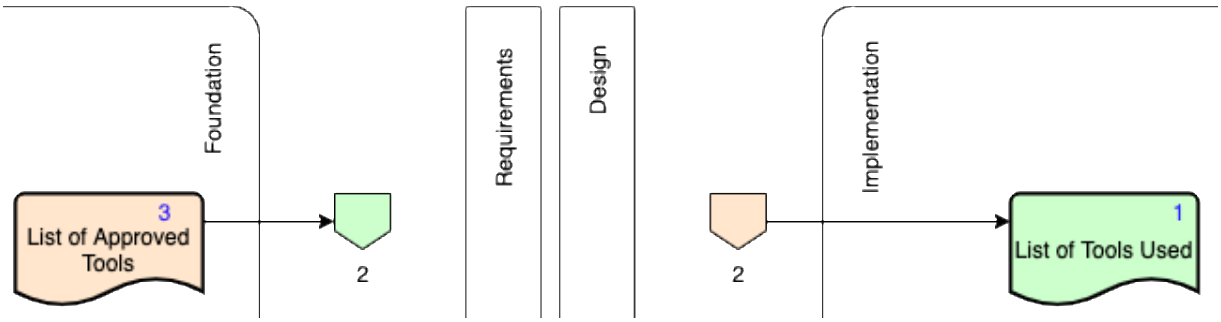

Figure 6 - Use of ISO off-page connector flowchart symbol (product-specific)

Use of Color

Within the visualization there are several distinct uses of color.

Product Ownership

A primary use of color within the body of the flowchart symbols is to denote primary owner of the phase product. In responsibility assignment parlance [3] this would be the accountable party. In the following extract we see the use of green to denote that development is the group accountable to the activities in leading to the generation of the “Currently Used Deprecated Functions” product, devops for the “Static Analysis Report” product, and security for the “Implementation Gate” product, respectively.

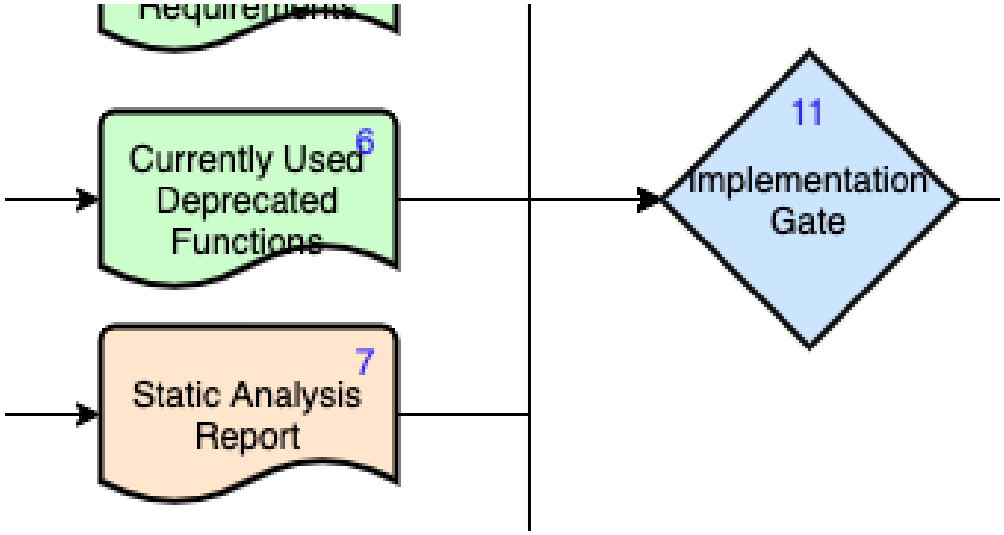

Figure 7 - Use of color to denote primary ownership

Phase Requirement

A second use of color is to denote the AVCDL phase requirement. This is shown as blue numbers in the upper right or top (depending upon available space within the flowchart symbol) of the phase products. The following extract from the **Release** phase shows AVCDL phase requirements 1 (Final Security Review Report), 2 (Archive Manifest), and 3 (Release Gate). These would be formed into the canonical AVCDL notation as AVCDL-Release-1, AVCDL-Release-2, and AVCDL-Release-3.

Figure 8 - Use of color to denote AVCDL phase requirement number

Off-page Connector Targets

The final use of color is for the off-page connectors. The body of the connectors represent the color (owner) of the target of the connector. The connector labels are uniformly black. In the following extract shows that the “List of Approved Tools” foundation phase product owned by devops is a dependency of the implementation phase “List of Tools Used” product owned by development. Note that the connector attached to the former takes the color of the target (green) and likewise the latter is colored for its target (beige).

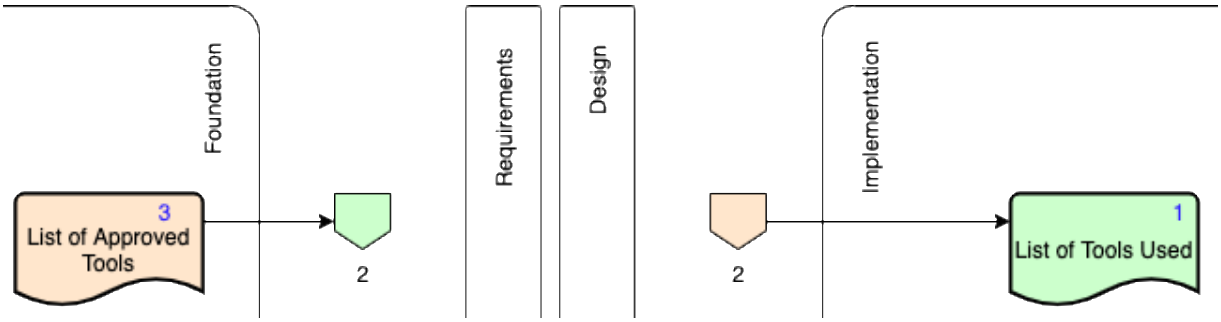

Figure 9 - Color use to denote off-page connector target activity owner

References

1. **Flowchart**
   https://en.wikipedia.org/wiki/Flowchart
2. **Dependency graph**
   https://en.wikipedia.org/wiki/Dependency_graph
3. **Responsibility assignment matrix**
   https://en.wikipedia.org/wiki/Responsibility_assignment_matrix
4. **ISO 5807:1985 Information processing – Documentation symbols and conventions for data, program and system flowcharts, program network charts and system resource charts**
   https://www.iso.org/standard/11955.html