
CACAO Layout Extension Version 1.0

Working Draft 01

22 December 2023

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Abstract:

Collaborative Automated Course of Action Operations (CACAO) is a schema and taxonomy for cyber security playbooks. The CACAO specification describes how these playbooks can be created, documented, and shared in a structured and standardized way across organizational boundaries and technological solutions [[CACAO-Security-Playbooks-v2.0](#)].

This specification defines the CACAO Layout Extension for the purpose of visually representing CACAO playbooks accurately and consistently across implementations.

Status:

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The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**NOT RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

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1 Introduction

Collaborative Automated Course of Action Operations (CACAO) is a schema and taxonomy for cyber security playbooks. The CACAO specification describes how these playbooks can be created, documented, and shared in a structured and standardized way across organizational boundaries and technological solutions [[CACAO-Security-Playbooks-v2.0](#)].

This specification defines the CACAO Layout Extension for the purpose of visually representing CACAO playbooks consistently across implementations. Further, this specification makes this mechanism available through the Extension Definition of CACAO (see section 5).

1.1 Document Conventions

The following color, font and font style conventions are used in this document:

- The Consolas font is used for all type names, property names and literals.
 - type names are in red with a light red background – `string`
 - property names are in bold style – **type**
 - literals (values) are in blue with a blue background – `coordinates`
- In a property table, if a common property is being redefined in some way, then the background is dark grey.
- All examples in this document are expressed in JSON. They are in Consolas 9-point font, with straight quotes, black text and a light grey background, and using 2-space indentation. JSON examples in this document are representations of JSON objects [RFC8259]. They should not be interpreted as string literals. The ordering of keys is insignificant. Whitespace before or after JSON structural characters in the examples are insignificant [RFC8259].
- Parts of the example may be omitted for conciseness and clarity. These omitted parts are denoted with the ellipses (...).
- The term "hyphen" is used throughout this document to refer to the ASCII hyphen or minus character (45_{dec} or 2D_{hex}), which in Unicode is "hyphen-minus", U+002D.
- Some URLs have been defanged. This specification gives no guidance on how to defang or re-fang content. It is done to help ensure that the example URLs cannot be used directly.

1.2 Glossary

CACAO - Collaborative Automated Course of Action Operations

JSON - JavaScript Object Notation as defined in [[RFC7493](#)] and [[RFC8259](#)]

ℕ - Whole numbers as defined as the set {0,1,2,3...} or {x: x >= 0}

2 Key Concepts and Features

This section explains some key concepts and features used in this specification.

2.1 Vocabularies

Some properties in this specification use defined vocabularies. These vocabularies can be either open or closed. An open vocabulary (see section 10.13 of the CACAO specification [\[CACAO-Security-Playbooks-v2.0\]](#)) allows implementers to use additional values beyond what is currently defined in the specification. However, if a similar value is already in the vocabulary, that value **MUST** be used. Open vocabulary types have an **-ov** suffix. A closed vocabulary is effectively an enumeration and **MUST** be used as defined. Enumeration types have an **-enum** suffix.

Vocabularies defined in this specification enhance interoperability by increasing the likelihood that different entities use the exact same string to represent the same concept.

2.2 Data Types

This specification uses the following data types as defined in the CACAO specification

[\[CACAO-Security-Playbooks-v2.0\]](#): **string**, **integer**, **list**, **enum**, and **identifier**.

In addition, this specification defines three new data types: **canvas**, **coordinates**, and **connection**.

2.3 CACAO Layout

This specification defines Layout as an Extension to CACAO Security Playbooks to be used for visually/graphically representing CACAO playbooks in a consistent, repeatable, and accurate manner.

This specification defines one Extension Definition (as defined in section 5) for CACAO Playbooks and has the following identifier:

`extension-definition--418ee24c-9cb1-46d9-afa5-309e01aabc7f`

3 Layout

The Layout object (**layout**) defines the canvas size (meant to be used in the playbook metadata level - section 3.1 in the CACAO specification [[CACAO-Security-Playbooks-v2.0](#)]) and coordinates for Workflow Steps and Agent and Targets.

3.1 Layout Properties

Property Name	Data Type	Description
type (required)	string	The value of this property MUST be layout .
canvas (optional)	canvas	This property defines the canvas size. This property MUST be used only with the “playbook_extension” property at the metadata level of a CACAO playbook as defined in section 3.1 of the CACAO specification.
coordinates (optional)	coordinates	The coordinates of the visualized object in relation to the upper-left corner of the canvas. This property MUST be used with the “step_extensions” and/or “agent_target_extensions” CACAO properties.

Example 3.1

Layout object when used to define the size of the Canvas at the playbook metadata level (“playbook_extensions” property).

```
{
  "type": "layout",
  "canvas": { ... }
}
```

Example 4.2

Layout object when used to define the Coordinates of the workflow steps and agent and targets and their connections (“step_extensions” or “agent_targets_extensions” properties).

```
{
  "type": "layout",
  "coordinates": { ... }
}
```

4 Data Types

4.1 Canvas

The Canvas data type (**canvas**) indicates the overall size (in pixels) of the canvas that subsequent playbook elements will be displayed. This data type **MUST** only be populated when the Layout object is used in the **playbook_extensions** property in the Playbook object of CACAO (as described in Section 3.1 of the CACAO specification [[CACAO-Security-Playbooks-v2.0](#)]).

Property Name	Data Type	Description
width (required)	integer	A number (ℕ - whole number) representing the width of the canvas. This number refers to pixels.
height (required)	integer	A number (ℕ - whole number) representing the height of the canvas. This number refers to pixels.

Example 4.1

```
{
  "width": 1000,
  "height": 500
}
```

4.2 Coordinates

The Coordinates data type (**coordinates**) indicates the position (in pixels) of the midpoint of a visualized CACAO object relative to the upper left (origin - O) corner of a canvas, along with its connections (paths) to other objects. This data type **MUST** only be populated when the Layout object is used in the **step_extension** (in the Workflow Step object) and/or the **agent_target_extension** (in the Agent-Target object) properties.

Property Name	Data Type	Description
x (required)	integer	A number (ℕ - whole number) representing the X coordinate of the midpoint of the object visualized relative to the upper-left (origin - O) corner of the canvas. This number refers to pixels.
y (required)	integer	A number (ℕ - whole number) representing the Y coordinate of the midpoint of the object visualized relative to the upper-left (origin - O) corner of the canvas. This number refers to pixels.
outgoing_connections (optional)	list of connection	The outgoing connections (paths) of the object visualized.

Example 4.2

```
{
  "x": 40,
  "y": 30,
  "outgoing_connections": [ ... ]
}
```

4.3 Connection

A Connection data type (**connection**) defines the position of an outgoing relation/path of a visualized CACAO object. It comprises a list of points (in pixels) that altogether represent a line. A CACAO object may have multiple outgoing connections, each one of them represented by a connection data type. A connection should have, at a minimum, two x and y values to represent a straight line (point to point).

Property Name	Data Type	Description
connection_type (required)	enum	<p>The type of connection being used.</p> <p>The value of this property MUST come from the connection-type-enum enumeration.</p>
x (required)	list of integer	<p>A list of numbers (\mathbb{W} - whole number) numbers (\mathbb{W} - whole number) representing the X coordinates of the connection. The list MUST contain at least two values to represent one straight line. x1 and the last x coordinate of a path SHOULD represent the midpoint x coordinates of the two connected visualized objects.</p> <p>This property is strongly connected with the y property. Both x and y lists MUST have the same number of values defined, as they together create a point of the connection on the canvas (e.g., x1 with y1, x2 with y2, etc.).</p>
y (required)	list of integer	<p>A list of numbers (\mathbb{W} - whole number) numbers (\mathbb{W} - whole number) representing the Y coordinates of the connection. The list MUST contain at least two values to represent one straight line. y1 and the last y coordinate of a path SHOULD represent the midpoint y coordinates of the two connected visualized objects.</p> <p>This property is strongly connected with the x property. Both x and y lists MUST have the same number of values defined, as they together create a point of the connection on the canvas (e.g., x1 with y1, x2 with y2, etc.).</p>
case (optional)	string	<p>A string that represents the case value. This property MUST match a dictionary key as defined in the dictionary of a CACAO Switch Condition Step.</p> <p>This property MUST be used only with the CACAO Switch Condition Step.</p>
next_step (optional)	identifier	<p>An identifier that identifies the next step.</p> <p>This property MUST be used only with the CACAO Parallel Step.</p>

4.3.1 Connection Type Enumeration

Enumeration Name: `connection-type-enum`

This section defines the following connection types. For more information about the meaning of each connection type, refer to the CACAO specification [[CACAO-Security-Playbooks-v2.0](#)].

Connection Type	Description
<code>on-completion</code>	This connection type is valid for all Workflow steps and is mutually exclusive with <code>on-success</code> and <code>on-failure</code> .
<code>on-success</code>	This connection type is valid for all Workflow steps and is mutually exclusive with <code>on-completion</code> .
<code>on-failure</code>	This connection type is valid for all Workflow steps. It is mutually exclusive with <code>on-completion</code> .
<code>on-true</code>	This connection type MUST only be used by If Condition Steps and While Condition Steps.
<code>on-false</code>	This connection type MUST only be used by If Condition Steps.
<code>cases</code>	This connection type MUST only be used by Switch Condition Steps.
<code>next-steps</code>	This connection type MUST only be used by Parallel Steps.

Example 4.3

The “on-completion” connection from a CACAO Workflow Step

```
{
  "connection_type": "on-completion"
  "x": [40, 90],
  "y": [30, 30]
}
```

Example 4.4

Connection from a CACAO Switch Conditional Step

```
{
  "connection_type": "cases"
  "x": [40, 90],
  "y": [30, 30],
  "case": "1"
}
```

Example 4.5

Connection from a CACAO Parallel Step

```
{
  "connection_type": "next-steps"
  "x": [40, 90],
  "y": [30, 30],
  "next_step": "action--c6728da5-f96a-4ba8-a4eb-fda6f24c9d7f"
}
```

5 Layout Extension Definition

This section defines the Layout extension for CACAO Playbooks and has the following identifier:

`extension-definition--418ee24c-9cb1-46d9-afa5-309e01aabc7f`

The definition for this extension is as follows:

```
{
  "type": "extension-definition",
  "name": "CACAO Layout",
  "description": "Extension definition for diagramming CACAO playbooks.",
  "created_by": "identity--5abe695c-7bd5-4c31-8824-2528696cdbf1",
  "schema":
    "https://raw.githubusercontent.com/oasis-tcs/cacao/master/Extensions/layout/schemas/layout.
    json",
  "version": "1.0.0",
  "external_references": [
    {
      "name": "CACAO Layout Specification.",
      "description": "Specification for diagramming CACAO Playbooks.",
      "source": "[CACAO-Layout-Extension-v1.0] CACAO Layout Extension Version 1.0. Edited
        by Vasileios Mavroeidis and Mateusz Zych. 22 December 2023. OASIS Committee Specification
        Draft 01. https://docs.oasis-open.org/cacao/layout/v1.0/csd01/layout-v1.0-csd01.html.
        Latest version: https://docs.oasis-open.org/cacao/layout/v1.0/layout-v1.0.html.",
      "url": "https://docs.oasis-open.org/cacao/layout/v1.0/layout-v1.0.html"
    }
  ]
}
```

Appendix A. Examples

The following example highlights how a CACAO Switch Condition Step is visualized using the Layout Extension. A complete example is available on the official CACAO TC GitHub [[CACAO-TC-GitHub](#)].

```
{
  "type": "playbook",
  "spec_version": "cacao-2.0",
  "id": "playbook--aa1898b6-5251-49b4-aeb7-fd5e912583ff",
  "name": "Example Playbook",
  "description": "A CACAO playbook showcasing how to use the Layout extension.",
  "created_by": "identity--5abe695c-7bd5-4c31-8824-2528696cdbf1",
  "created": "2023-11-20T13:26:54.640Z",
  "modified": "2023-11-20T13:26:54.640Z",
  "revoked": false,
  "workflow_start": "start--5820e9bf-35c0-4b36-a266-7c173a9edeb5",
  "workflow": {
    ...
    "switch-condition--72c55a11-5091-4714-8050-baa854d72eda": {
      "type": "switch-condition",
      "name": "switch case example",
      "cases": {
        "1": "action--4005472a-0b74-48c6-b04b-45bb8cf2b1ae",
        "2": "action--63483dce-6122-4975-8c7c-795d2453243d",
        "default": "action--9a4ef680-ba51-4c1b-9b2d-715caf06ef3a"
      },
      "on_completion": "action--9ae9e500-155e-4f63-a76e-a43856063f55",
      "step_extensions": {
        "extension-definition--418ee24c-9cb1-46d9-afa5-309e01aabc7f": {
          "type": "layout",
          "coordinates": {
            "x": 690,
            "y": 440,
            "outgoing_connections": [
              {
                "connection_type": "on-completion",
                "x": [810, 900],
                "y": [470, 470]
              },
              {
                "connection_type": "cases",
                "x": [750, 750, 900],
                "y": [500, 540, 540],
                "case": "1"
              },
              {
                "connection_type": "cases",
                "x": [750, 750, 900],
                "y": [500, 610, 610],
                "case": "2"
              },
              {
                "connection_type": "cases",
                "x": [750, 750, 900],
                "y": [500, 690, 690],
                "case": "default"
              }
            ]
          }
        }
      }
    }
  }
}
```

```

    ...
  },
  "playbook_extension": {
    "extension-definition--418ee24c-9cb1-46d9-afa5-309e01aabc7f": {
      "type": "layout",
      "canvas": {
        "width": 1300,
        "height": 800
      }
    }
  },
  "extension_definitions": {
    "extension-definition--418ee24c-9cb1-46d9-afa5-309e01aabc7f": {
      "type": "extension-definition",
      "name": "CACAO Layout",
      "description": "Extension definition for diagramming CACAO playbooks.",
      "created_by": "identity--5abe695c-7bd5-4c31-8824-2528696cdbf1",
      "schema":
"https://raw.githubusercontent.com/oasis-tcs/cacao/master/Extensions/layout/schemas/layout.json",
      "version": "1.0.0",
      "external_references": [
        {
          "name": "CACAO Layout Specification.",
          "description": "Specification for diagramming CACAO Playbooks graphically.",
          "source": "[CACAO-Layout-Extension-v1.0] CACAO Layout Extension Version 1.0.
Edited by Vasileios Mavroeidis and Mateusz Zych. 22 December 2023. OASIS Committee
Specification Draft 01.
https://docs.oasis-open.org/cacao/layout/v1.0/csd01/layout-v1.0-csd01.html. Latest version:
https://docs.oasis-open.org/cacao/layout/v1.0/layout-v1.0.html.",
          "url": "https://docs.oasis-open.org/cacao/layout/v1.0/layout-v1.0.html"
        }
      ]
    }
  }
}

```

Appendix B. Security & Privacy Considerations

See Appendix B from CACAO Security Playbooks Version 2.0 [[CACAO-Security-Playbooks-v2.0](#)].

Appendix C. References

[CACAO-Security-Playbooks-v2.0]

CACAO Security Playbooks Version 2.0. Edited by Bret Jordan and Allan Thomson. 27 November 2023. OASIS Committee Specification 01.

<https://docs.oasis-open.org/cacao/securityplaybooks/v2.0/cs01/security-playbooks-v2.0-cs01.html>.

Latest version:

<https://docs.oasisopen.org/cacao/security-playbooks/v2.0/security-playbooks-v2.0.html>.

[RFC7493]

The I-JSON Message Format, RFC 7493, March 2014. [Online]. Available:

<https://www.rfc-editor.org/info/rfc7493>

[RFC8259]

The JavaScript Object Notation (JSON) Data Interchange Format, RFC 8259, December 2017.

[Online]. Available: <https://www.rfc-editor.org/info/rfc8259.txt>

[CACAO-TC-GitHub]

The official GitHub of the CACAO Technical Committee. [Online]. Available:

<https://github.com/oasis-tcs/cacao>

Appendix D. Acknowledgements

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Appendix E. Revision History

Revision	Date	Editor(s)	Changes Made
1	2023-12-22	Vasileios Mavroeidis, Mateusz Zych	Write up of Version 1.0.