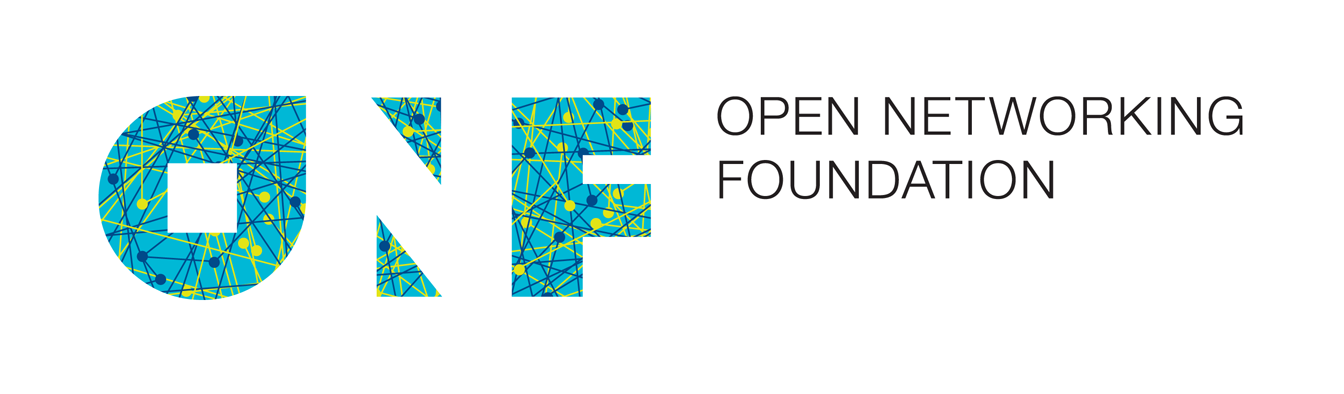
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Core Information Model (CoreModel)

TR-512.15

Compute

Version 1.6

January 2024

ONF Document Type: Technical Recommendation

ONF Document Name: Core Information Model version 1.6

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* Remove reviewer comment

Note that the table of contents and figures need to be updated several times as the table length changes the page numbering and the cross references will need to be re-updated.

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Document History

| **Version** | **Date** | **Description of Change** |
| --- | --- | --- |
| 1.0 | January 2024 | Initial Version |

# Introduction

This document is an addendum to the TR-512\_v1.5 ONF Core Information Model and forms part of the description of the ONF-CIM. For general overview material and references to the other parts refer to [TR-512.1](../TR-512.1_OnfCoreIm-Overview.pdf).

## References

For a full list of references see [TR-512.1](../TR-512.1_OnfCoreIm-Overview.pdf).

## Definitions

For a full list of definition see [TR-512.1](../TR-512.1_OnfCoreIm-Overview.pdf).

## Conventions

See [TR-512.1](../TR-512.1_OnfCoreIm-Overview.pdf) for an explanation of:

* UML conventions
* Lifecycle Stereotypes
* Diagram symbol set

## Viewing UML diagrams

Some of the UML diagrams are very dense. To view them either zoom (sometimes to 400%) or open the associated image file (and zoom appropriately) or open the corresponding UML diagram via Papyrus (for each figure with a UML diagram the UML model diagram name is provided under the figure or within the figure).

## Understanding the figures

Figures showing fragments of the model using standard UML symbols and also figures illustrating application of the model are provided throughout this document. Many of the application-oriented figures also provide UML class diagrams for the corresponding model fragments (see [TR-512.1](../TR-512.1_OnfCoreIm-Overview.pdf) for diagram symbol sets). All UML diagrams depict a subset of the relationships between the classes, such as inheritance (i.e. specialization), association relationships (such as aggregation and composition), and conditional features or capabilities. Some UML diagrams also show further details of the individual classes, such as their attributes and the data types used by the attributes.

# Introduction to Compute

This document describes a general model for compute functionality including processing and storage. The model is considered sufficient to represent the capabilities of the compute functions of network devices and of a controller of those devices.

For storage the document covers management of Block, File and Object storage, both directly attached and over a network. It includes standalone hosts with local storage, raid, SCSI as well as network-based storage, including enterprise and cloud storage.

Note that this model excludes physical devices such as CPU and memory chips. All physical device considerations are covered by the existing Equipment model (see [TR-512.6](TR-512.6_OnfCoreIm-Physical.pdf)).

A data dictionary that sets out the details of all classes, data types and attributes is also provided ([TR-512.DD](file:///C:\Users\ndavis\git\ONFInfoModel\OnfModel\CoreGendoc\ModelDescriptions\TR-512.DD_v1.3_OnfCoreIm-DataDictionary.pdf)).

## Background

The compute model covers representation of the functions of CPU, memory and storage.

This model is designed to represent compute architectures in a technology independent manner and is focused on management and control of the compute functions.

### CPU

The original CPUs consisted of many physical units {{<http://www.megaprocessor.com/index.html>}}.

They then were implemented in a single chip {{<https://spectrum.ieee.org/tech-history/silicon-revolution/chip-hall-of-fame-intel-4004-microprocessor>}}.

Now a single chip may contain many CPU cores, and a core may run more than one thread. So, a definition of a ‘logical CPU’ function is required.

Some chips have a mix of architectures and/or capabilities (asymmetric), others simply have several replications of the same architecture (symmetric).

For example, an asymmetric CPU may have 4 + 4 cores ( 4 \* 1.8 GHz Type-A + 1.4 GHz Type-B).

The CPU hardware may be a FRU or a non-FRU. This is covered in the Equipment model (see [TR-512.6](TR-512.6_OnfCoreIm-Physical.pdf)).

### Memory

Memory chip(s) / SIMM DIMM modules may be a FRU or non-FRU. This is covered in the Equipment model (see [TR-512.6](TR-512.6_OnfCoreIm-Physical.pdf)). The model in this document considered in the memory functionality (capabilities and capacity).

### Storage

#### Challenges

The challenges in producing an abstract, standard storage model include :

* The large number of variations in storage options
* the lack of standard terminology.

For example, the definition of a LUN is problematic :

* “A LUN, is a number used to identify a logical unit, which is a device addressed by the SCSI protocol or Storage Area Network protocols which encapsulate SCSI, such as Fibre Channel or iSCSI[”  
  https://en.wikipedia.org/wiki/Logical\_unit\_number](https://en.wikipedia.org/wiki/Logical_unit_number)
* “a logical unit *number* (LUN) is a slice or portion of a configured set of disks that is presentable to a host and mounted as a volume within the OS.”  
  <https://www.computerweekly.com/answer/What-is-a-LUN-and-why-do-we-need-storage-LUNs>

#### Storage Options

Storage can be provided in many forms and some of the options commonly used today are shown below.

With each of the options, there could be more than one protocol used, and the diagram shows some of these in pink.

A screen shot of a computer

Description automatically generated

Figure 1 – Storage Options

#### Data “at rest”

Both storage and memory allow data to be ‘at rest’, ready for later retrieval. Memory can perform as volatile storage “RAM drives” or “RAM disks” and storage devices can be used as “virtual memory” where volatile memory is paged in and out of disk to increase the apparent amount of main memory.

The storage model is used for both storage and memory. It covers both the case where the access is to files, blocks, objects using a storage protocol and the case where access is to locations via the memory protocols.

## Storage Extent

In the model set out in this document, StorageExtent is defined as the key unit of storage capacity that the rest of the model is built around. The extent is a block or segment of storage (bytes).

The model covers ranges of extents.

## Partitioning and Aggregation

The model supports both partitioning and aggregation of StorageExtent ranges.

The simple example below, where StorageExtent range is represented as a ‘piece of tape’, should help clarify the concepts.

A green square with black background

Description automatically generated

Figure 2 - StorageExtent as a ‘piece of tape’

The tape can be aggregated in two ways, by end-to-end concatenation and by striping.

A colorful rectangular shapes on a black background

Description automatically generated

Figure 3 – StorageExtent concatenation and striping

The tape can be cut into sub extents, i.e., can be partitioned (the opposite of concatenation).

A green and black rectangles

Description automatically generated

Figure 3 – StorageExtent partitioning

Note that the operations are ‘closed’ that is both the inputs and the results of the operations are StorageExtent ranges, allowing the operations to be performed recursively.

## Storage Pooling

Originally storage was based on local storage due to the limitations of the hardware at the time. To support shared storage (provided over a network), the model needs to support pooling of physical storage that can then be allocated logically to various consumers.

To do that, the model defines a ComputePool with ComputePoolEntries.

There are two types of entries :

* Pool inputs for SSD, PhysicalDisk, VM VirtualDisk and LogicalEntry
* A pool output as an extent allocation (volume)

Note that the extent allocation from a pool can be a LogicalEntry to another pool allowing for allocation chaining.

Note that the decision was made to have a single compute pool rather than separate Storage, CPU and memory pools[[1]](#footnote-1), because :

* CPU and memory are usually tightly coupled and the pool can then allocate these consistently
* *Sometimes* storage is tightly coupled with CPU and memory and the pool can then allocate these consistently

Note also that the pools aren’t hierarchical (deliberately no ComputePool contained in self-join)

* The association StorageExtentPoolEntryIsLogical allows an output from one pool to become the input of another pool
* This needs to form a directed acyclic graph (no loops)

Note that there is no association linking the pool inputs and outputs. The ordering of the inputs allows the input to output extent mapping to be determined.

It is assumed that there will be many simple pools rather than few large complex pools with complex mappings.

# Compute model and context

## ComputeConstruct positioning

The following figures set out the core of the compute model.

[for(p:Package|Package.allInstances())]<drop/>

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## ComputePool

This part of the model allows for basic allocation of compute resources.

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### ComputePoolSegment

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### RoleInPool

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### ErrorCorrectionStrategy

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### ExtentRange

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### Media

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### Lifetime

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### SpeedCharacteristic

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### AccessStrategy

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### ApplicationRole

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### SpeedProfile

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### SpeedCharacteristicName

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### InstructionSet

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### ProcessorArchitecture

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### Availability

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### MediaType

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## Relationship to File System and Software

The following diagram shows the relationships between this compute model and other existing models described in [TR-512.6](TR-512.12_OnfCoreIm-Software.pdf).

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## Examples

### A simple compute example

A screenshot of a computer program

Description automatically generated

Figure - Simple Compute example

This simple example shows how the concepts in the model fit together.

There is traceability from the physical equipment instances to the CPU and Memory functionality and from there to the running software that is using the functionality.

A screenshot of a computer

Description automatically generated

Figure - Compute example instance diagram

# Storage Model Example - Single Disk

A single attached disk is the simplest example (one in – one out).

In this case there is one instance of Equipment that maps to one pool input into one pool and one pool output which then has a FileSystem installed on it.

Note the overhead that our general model imposes on this case.

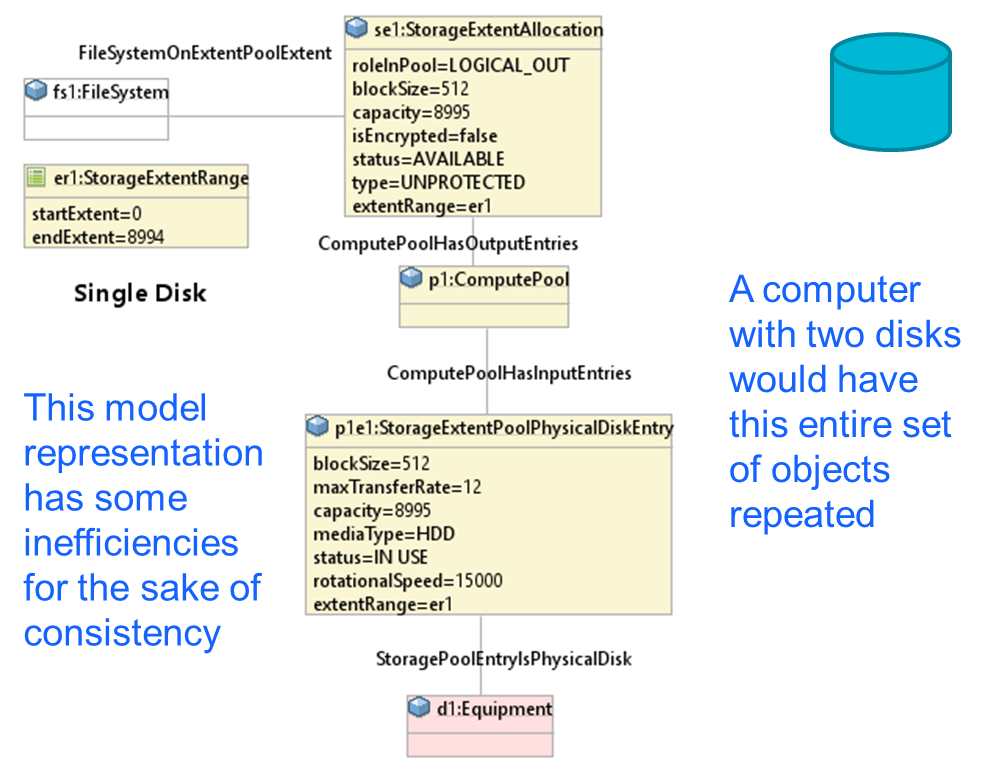


Figure 5 - Example - Single Disk

# Appendix

## Model consideration

### Pooling

Note that the decision was made to have a single compute pool rather than separate Storage, CPU and memory pools[[2]](#footnote-2), because :

* CPU and memory are usually tightly coupled (vie the CPU and memory buses) and the pool can then allocate these consistently
* *Sometimes* storage is tightly coupled with CPU and memory and the pool can then allocate these consistently (local attached un-sharable storage)

Note also that the pools aren’t hierarchical (deliberately no ComputePool contained in self-join)

* The association StorageExtentPoolEntryIsLogical allows an output from one pool to become the input of another pool
* This needs to form a directed acyclic graph (no loops)

Note that there is no association linking the pool inputs and outputs. The ordering of the inputs allows the input to output extent mapping to be determined.

Assume that there will be a large number of simple pools rather than few large complex pools with complex mappings.

### Partitioning and Aggregation

The partitioning and aggregation of CPU and memory is subtly different from that of Storage.

With Storage, in theory each extent can be considered separately. Some extents could come from a disk A, some from disk B. With a sensible pool allocation there is no need to worry about segmenting the pool.

With CPU and storage we have 2 issues :

1. The pool needs to remember and enforce segmentation (resource chunks)
2. The pool needs to pair CPU and Memory segments

For example, if there are 2 blade servers Blade-A and Blade-B.

* I can’t allocate a software process CPU from Blade-A and memory Blade-B.
* I can’t give a software thread half its CPU requirements from Blade-A and half from Blade-B.
* I can’t give a software thread half its memory requirements from Blade-A and half from Blade-B.

A multi-threaded application may be able to run across multiple CPU/memory pairs, but it would have to know the segmentation.

This model will use the following :

* ComputePoolSegment is defined to allow the definition of ‘segments’
* Inputs to the pool can be optionally assigned to a segment
* Each pool input/output may optionally be related to one segment
* If an input entry relates to a segment, then no output can be assigned that ‘crosses’ the segment (Each output can only relate to 1 segment)
* Multiple inputs can only be combined if both do not relate to a segment or if both relate to the same segment
* If an input entry is related to a segment, then it should be propagated to any outputs that relate to the same segment
* If a CPU output relates to a segment then it can only be used with memory that relates to the same segment (and visa-versa)
* Each segment should have its own internal number range in the pool

### Items for Further Investigation

What units should we use for memory sizes?

What units should we use for CPU clock speed?

* Note that Kubernetes works in units of CPU, where   
  “One CPU, in Kubernetes, is equivalent to a *Hyperthread* on a bare-metal Intel processor with Hyperthreading”
* A CPU hardware thread is also called a vCPU (virtual CPU)

Note that we should try and avoid using floating point numbers for the quantities as the rounding proves problematic

**End of Document**

</gendoc><drop/>

To take latest template: <drop/>

* delete text from “Template version…” to end of file <drop/>
* insert a line in “Normal” style<drop/>
* insert text (Insert 🡪 Object 🡪 Text from File… (alt njf)) from: <drop/>
  + TR-512.GT\_v1.3\_OnfCoreIm-CommonGendocTemplate-Fragments.docx <drop/>

Template version 0.0.10 17 September 2017 <drop/>

# Fragment: Insert class <drop/>

<fragment name=’insertClass’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’cl’ type=’uml::Class’/><drop/>  
<arg name=’className’ type=’String’/><drop/>  
<arg name=’packageName’ type=’String’/><drop/>  
[if (not cl.qualifiedName.contains(packageName))]<drop/>  
[else] <drop/>  
[if(cl.name.contains(className))]<drop/>

Qualified Name: [cl.qualifiedName/]

[for (co:Comment | cl.ownedComment)]<drop/>

<dropEmpty>[cleanAndFormat(co.\_body.clean())/]</dropEmpty>

[/for]<drop/>  
[if (cl.isAbstract)]<drop/>

This class is abstract.

[/if]<drop/>

[if (cl.oclAsType(uml::Class).general ->notEmpty())]<drop/>

Inherits properties from:

[for (gen:Class | cl.oclAsType(uml::Class).general)]<drop/>

* [gen.name/]

[/for]<drop/>

[/if]<drop/>

[for (st:Stereotype | cl.getAppliedStereotypes())]<drop/>  
[if(not st.name.contains(‘OpenModelClass’))]<drop/>

This class is [st.name/].

[else] <drop/>  
[/if]<drop/>  
[/for]<drop/>  
[else] <drop/>  
[/if]  
[/if]  
</fragment><drop/>

# Fragment: Insert standard diagram <drop/>

<fragment name=’insertStandardDiagram’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’p’ type=’uml::Package’/><drop/>  
<arg name=’diagramName’ type=’String’/><drop/>  
<arg name=’diagramTitle’ type=’String’/><drop/>

[for (d:Diagram|p.getPapyrusDiagrams())]<drop/>

[if d.name.contains(diagramName)]

<drop/>

<image object='[d.getDiagram()/]' maxW='true' keepH='false' keepW = ‘false’></image>

CoreModel diagram: [d.name/]

Figure 7-1 [diagramTitle/]

[else]<drop/>

[/if]<drop/>

[/for]<drop/>  
</fragment><drop/>

# Fragment: Insert small diagram <drop/>

<fragment name=’insertSmallDiagram’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’p’ type=’uml::Package’/><drop/>  
<arg name=’diagramName’ type=’String’/><drop/>  
<arg name=’diagramTitle’ type=’String’/><drop/>

[for (d:Diagram|p.getPapyrusDiagrams())]<drop/>

[if d.name.contains(diagramName)]

<drop/>

<image object='[d.getDiagram()/]' maxW='true' keepH='false' keepW = ‘false’></image>

CoreModel diagram: [d.name/]

Figure 8-1 [diagramTitle/]

[else]<drop/>

[/if]<drop/>

[/for]<drop/>  
</fragment><drop/>

# Fragment: Insert attribute row brief not Obsolete<drop/>

<fragment name=’insertAttributeRowBriefNotObsolete’ importedBundles=’commons;gmf;papyrus’><drop/>

Does not work unless we have Mature stereotype… <drop/>  
<arg name=’p’ type=’uml::Property’/><drop/>

[for (st:Stereotype | p.getAppliedStereotypes())]<drop/>

[if(not st.name.contains(‘OpenModelAttribute’))]

[if(not st.name.contains(‘Obsolete’))]

| [p.name/] | [for (st:Stereotype | p.getAppliedStereotypes())]<drop/>  [if(not st.name.contains(‘OpenModelAttribute’))] [st.name/]  [/if]<drop/>  [/for]<drop/>  Do NOT remove the previous line as word throws an error if the cell is empty <drop/> | [if p.ownedComment->notEmpty()]<drop/>  [for (c:Comment | p.ownedComment)] <drop/>  [cleanAndFormat(c.\_body.clean())/]  [/for]  [else] [if (p.name.contains (‘\_’))]See referenced class  [else]To be provided  [/if]<drop/>  [/if]<drop/>  Do NOT remove the previous line as word throws an error if the cell is empty <drop/> |
| --- | --- | --- |

[/if]<drop/>

[/if]<drop/>

[/for]<drop/>  
</fragment><drop/>

# Fragment: Insert attribute row brief <drop/>

<fragment name=’insertAttributeRowBrief’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’p’ type=’uml::Property’/><drop/>

| [p.name/] | [for (st:Stereotype | p.getAppliedStereotypes())]<drop/>  [if(not st.name.contains(‘OpenModelAttribute’))] [st.name/]  [/if]<drop/>  [/for]<drop/>  Do NOT remove the previous line as word throws an error if the cell is empty <drop/> | [if p.ownedComment->notEmpty()]<drop/>  [for (c:Comment | p.ownedComment)] <drop/>  [cleanAndFormat(c.\_body.clean())/]  [/for]  [else] [if (p.name.contains (‘\_’))]See referenced class  [else]To be provided  [/if]<drop/>  [/if]<drop/>  Do NOT remove the previous line as word throws an error if the cell is empty <drop/> |
| --- | --- | --- |

</fragment><drop/>

# Fragment: Start attribute table brief <drop/>

<fragment name=’insertAttributeTableHeader’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’cl’ type=’uml::Class’/><drop/>

|  |  |  |
| --- | --- | --- |
| **Attribute Name** | **Lifecycle Stereotype (empty = Mature)** | **Description** |

</fragment><drop/>

# Fragment: Insert Attribute table brief <drop/>

<fragment name=’insertAttributeTableBrief’ importedBundles=’commons;gmf;papyrus’ importedFragments='insertAttributeTableHeader;insertAttributeRowBrief’><drop/>  
<arg name=’cl’ type=’uml::Class’/><drop/>  
[if cl.ownedAttribute->notEmpty()]<drop/>

Table 1: Attributes for [cl.name/]

<table><drop/>

[cl.insertAttributeTableHeader ()/]

[for (p:Property|cl.ownedAttribute)]<drop/>

[if (not p.name.contains(‘\_’))]<drop/>

[p.insertAttributeRowBrief ()/]

[/if]<drop/>

[/for]<drop/>

[for (p:Property|cl.ownedAttribute)]<drop/>

[if (p.name.contains(‘\_’))]<drop/>

[p.insertAttributeRowBrief ()/]

[/if]<drop/>

[/for]<drop/>

</table><drop/>

[/if]<drop/>

</fragment><drop/>

# Fragment: Insert Ten Specified Attribute table brief <drop/>

<fragment name=’insertTenSpecifiedAttributeTableBrief’ importedBundles=’commons;gmf;papyrus’ importedFragments='insertAttributeTableHeader;insertAttributeRowBrief’><drop/>  
<arg name=’cl’ type=’uml::Class’/><drop/>

<arg name=’p1’ type=‘String’/><drop/>

<arg name=’p2’ type=‘String’/><drop/>  
<arg name=’p3’ type=‘String’/><drop/>  
<arg name=’p4’ type=‘String’/><drop/>  
<arg name=’p5’ type=‘String’/><drop/>  
<arg name=’p6’ type=‘String’/><drop/>  
<arg name=’p7’ type=‘String’/><drop/>  
<arg name=’p8’ type=‘String’/><drop/>  
<arg name=’p9’ type=‘String’/><drop/>  
<arg name=’p10’ type=‘String’/><drop/>  
[if cl.ownedAttribute->notEmpty()]<drop/>

Table 1: Attributes for [cl.name/]

<table><drop/>

[cl.insertAttributeTableHeader ()/]

[for (p:Property|cl.ownedAttribute)]<drop/>

[if (p.name.contains(p1) or p.name.contains(p2) or p.name.contains(p3) or p.name.contains(p4) or p.name.contains(p5) or p.name.contains(p6) or p.name.contains(p7) or p.name.contains(p8) or p.name.contains(p9) or p.name.contains(p10))]<drop/>

[if (not p.name.contains(‘\_’))]<drop/>

[p.insertAttributeRowBrief ()/]

[/if]<drop/>

[/if]<drop/>

[if (p.name.contains(p1) or p.name.contains(p2) or p.name.contains(p3) or p.name.contains(p4) or p.name.contains(p5) or p.name.contains(p6) or p.name.contains(p7) or p.name.contains(p8) or p.name.contains(p9) or p.name.contains(p10))]<drop/>

[if (p.name.contains(‘\_’))]<drop/>

[p.insertAttributeRowBrief ()/]

[/if]<drop/>

[/if]<drop/>

[/for]<drop/>

</table><drop/>

[/if]<drop/>

</fragment><drop/>

# Fragment: Insert DataType <drop/>

<fragment name=’insertDataType’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’dt’ type=’uml::DataType’/><drop/>  
<arg name=’dataTypeName’ type=’String’/><drop/>  
<arg name=’packageName’ type=’String’/><drop/>  
[if (dt.qualifiedName.contains(packageName))]<drop/>  
[if(dt.name.contains(dataTypeName))]<drop/>

Qualified Name: [dt.qualifiedName/]

[for (co:Comment | dt.ownedComment)]<drop/>

<dropEmpty>[cleanAndFormat(co.\_body.clean())/]</dropEmpty>

[/for]<drop/>  
[if (dt.oclAsType(uml::DataType).general ->notEmpty())]<drop/>

Inherits properties from:

[for (tp:DataType | dt.oclAsType(uml::DataType).general)]<drop/>

* [tp.name/]

[/for]<drop/>

[for (gen:Class | dt.oclAsType(uml::DataType).general)]<drop/>

* [gen.name/]

[/for]<drop/>

[/if]<drop/>

[for (st:Stereotype | dt.getAppliedStereotypes())]<drop/>  
This class is [st.name/].

[/for]<drop/>  
[else] <drop/>  
[/if] <drop/>  
[/if] <drop/>  
</fragment><drop/>

# Fragment: Start Data Type attribute table brief <drop/>

<fragment name=’insertDataTypeAttributeTableHeader’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’dt’ type=’uml::DataType’/><drop/>

|  |  |  |
| --- | --- | --- |
| **Attribute Name** | **Lifecycle Stereotype (empty = Mature)** | **Description** |

</fragment><drop/>

# Fragment: Insert Data Type Attribute table brief <drop/>

<fragment name=’insertDataTypeAttributeTableBrief’ importedBundles=’commons;gmf;papyrus’ importedFragments='insertDataTypeAttributeTableHeader;insertAttributeRowBrief’><drop/>  
<arg name=’dt’ type=’uml::DataType’/><drop/>  
[if dt.ownedAttribute->notEmpty()]<drop/>

Table 1: Attributes for [dt.name/]

<table><drop/>

[dt.insertDataTypeAttributeTableHeader ()/]

[for (p:Property|dt.ownedAttribute)]<drop/>

[p.insertAttributeRowBrief ()/]

[/for]<drop/>

</table><drop/>

[/if]<drop/>

</fragment><drop/>

# Fragment: Insert enums <drop/>

<fragment name=’insertEnums’ importedBundles=’commons;gmf;papyrus’><drop/>  
<arg name=’dt’ type=’uml::DataType’/><drop/>

Qualified Name: [dt.qualifiedName/]

[for (co:Comment | dt.ownedComment)]<drop/>

<dropEmpty>[cleanAndFormat(co.\_body.clean())/]</dropEmpty>

[/for]<drop/>

Applied stereotypes:

[if dt.getAppliedStereotypes()->notEmpty()] <drop/>

[for (st:Stereotype | dt.getAppliedStereotypes())]<drop/>

* [st.name/]

[/for]<drop/>

[else] No stereotypes applied

[/if]<drop/>

[if (dt.oclAsType(uml::DataType).general ->notEmpty())]<drop/>

Inherits literals from:

[for (tp:DataType | dt.oclAsType(uml::DataType).general)]<drop/>

* [tp.name/]

[/for]

[/if]<drop/>

[if (dt.oclAsType(Enumeration).ownedLiteral->notEmpty())]<drop/>

Contains Enumeration Literals:

[for (e:EnumerationLiteral|dt.oclAsType(Enumeration).ownedLiteral)]<drop/>

* [e.name/]:
  + [for (co:Comment | e.ownedComment)]<drop/>
  + <dropEmpty>[cleanAndFormat(co.\_body.clean())/]
  + </dropEmpty>[/for]<drop/>
  + [if dt.getAppliedStereotypes()->notEmpty()] <drop/>
  + Applied stereotypes:
    - [for (st:Stereotype | e.getAppliedStereotypes())]<drop/>
    - [st.name/]
    - [/for]<drop/>
  + [/if]<drop/>

[/for]<drop/>

[/if]<drop/>

</fragment><drop/>

1. Note that this document only considers storage entries. [↑](#footnote-ref-1)
2. Note that this document only considers CPU and memory entries. [↑](#footnote-ref-2)