

Block Diagram

Introduction

- ❖ SysML Block Diagram is based on the UML Class Diagram.
- ❖ Using blocks we can describe the static structure of the system. Each block describes a specific part of the system.
- ❖ Each block can represent either a logical (e.g. specific software component) or a physical unit (e.g. specific computer hardware).

Definition

“A block describes parts of the structure of a related system.

It is a stereotype <<block>> of the UML element class.”

(System Engineering with SysML/UML, Tim Weilkiens)

Notation

- ❖ The notation used for representing a block is based on UML Class Diagram with the “<<block>>” stereotype added on it.
- ❖ The “<<block>>” stereotype can be omitted
- ❖ Each compartment has its own heading (e.g. “values”, “operations”, “parts” and “references”).

Sample

<code><<block>></code> Keyboard
<i>values</i>
color: Color numOfKeys: int <code><<interval>> {min=10,max=20} keyWidth:Millimeter</code>
<i>operations</i>
pressKey(keyID:int, CTRL:boolean, ALT:boolean, SHIFT:boolean)
<i>constraints</i>
{numOfKeys <201 AND numOfKeys>19}
<i>parts</i>
numLockLed: Led capsLockLed: Led
<i>references</i>
cable: Cable

The 'properties' Compartment

- ❖ Instead of creating separated compartments it is also acceptable to create one compartment with the “properties” heading in which all properties will be listed.

'parts' and 'references'

- ❖ The 'parts' compartment includes those properties which relate to our described component via the 'aggregation' or the 'composition' relationship.
- ❖ The 'references' compartment includes those properties which relate to our described component via the 'association' relationship.

Unique Compartments

- ❖ Adding compartments with headings unique for your project should be possible as well.

The 'public' Visibility

- ❖ All properties in a SysML block diagram have (by default) the 'public' visibility. Nevertheless, specifying the visibility separately for each property should be possible as well.

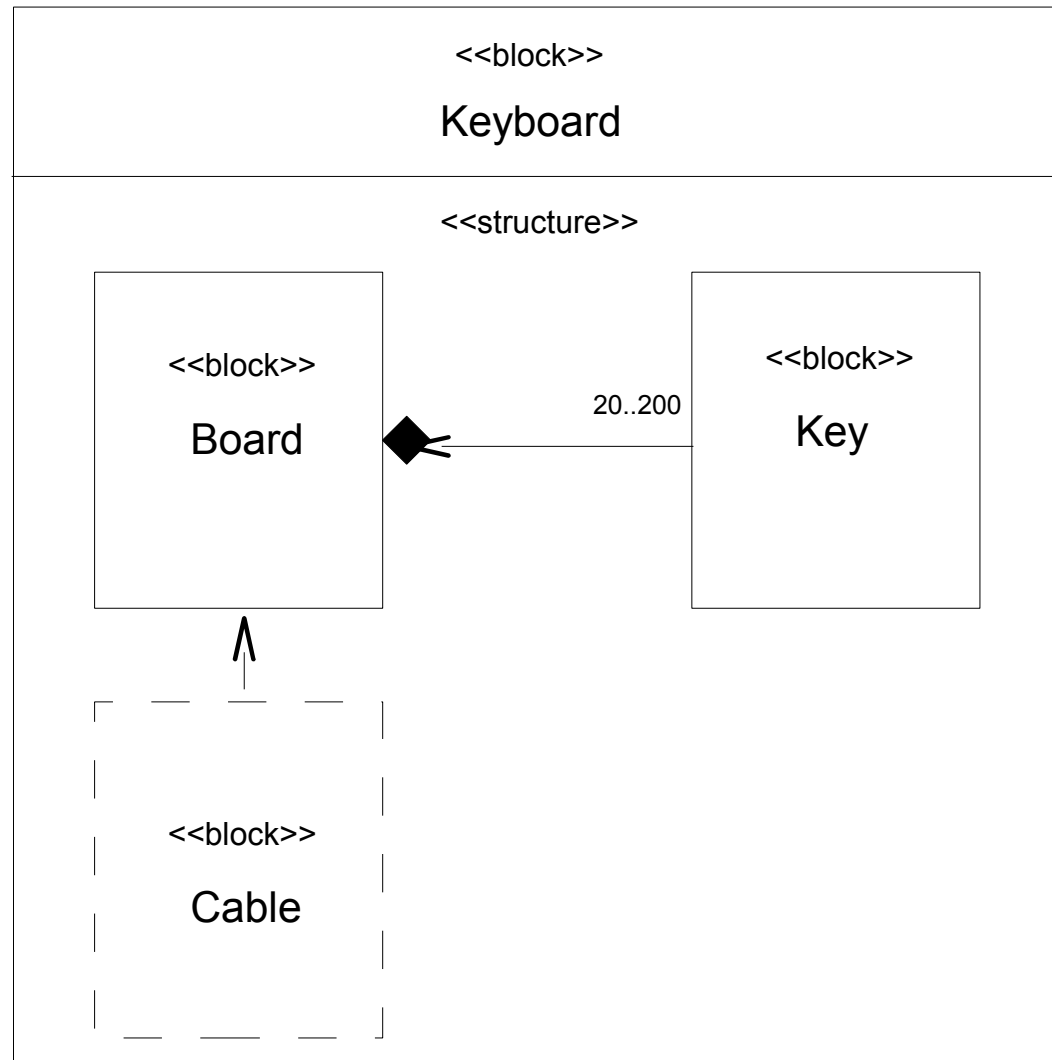
Compartments Representation

- ❖ We can represent the compartments in a graphic way as well.
- ❖ Parts of the component will be described using rectangles.
- ❖ References of the component will be described using rectangles depicted using dashed lines.

Compartments Representation

- ❖ Representing the 'values' compartment is not allowed.
- ❖ Adding the <<structure>> stereotype clarifies the diagram.
- ❖ The internal block diagram can be a diagram of another type (e.g. a UML Composite Structure diagram).
- ❖ Unlike UML, SysML allows us to nest within the internal block diagram without any limit.

Compartments Representation



The 'default values' Compartment

- ❖ The 'default values' compartment can be used to specify the initial values.
- ❖ It is also possible to initialize the values as common in UML diagrams.

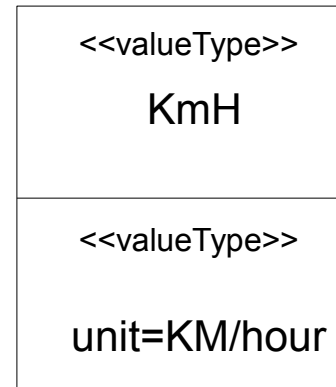
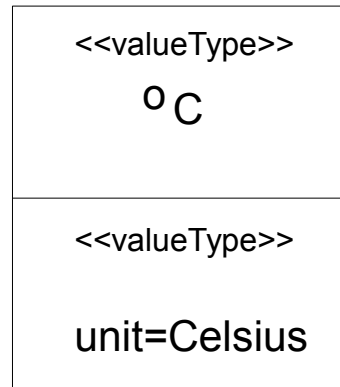
The 'default values' Compartment

<code><<block>></code> Sim Card Reader
<i>values</i> rate: Mhz
<i>default values</i> rate = 210

Value Types

- ❖ “A value type defines values that have no identity and cannot be referenced by a block but can have a unit or dimension.”
(System Engineering with SysML/UML, Tim Weilkiens)

Value Types



Value Types

- ❖ UML defines data types for values that don't have an identity (e.g. integer numbers).
- ❖ Unlike values without identity (e.g. integer numbers) blocks can have the same attribute values and still be differentiated as two different separated entities.
- ❖ We define a new value type (data type) using the additional property 'unit' that its value has a dimension.

Units

- ❖ “A unit describes the structure of a physical unit.”
(System Engineering with SysML/UML, Tim Weilkiens)
- ❖ We define a new unit using the additional property dimension.
- ❖ SysML includes a library of basic units defined for us ready to be used. We can add more units to this library.

Units

<code><<unit>></code> Kilogram
<code><<unit>></code> dimension=mass

<code><<unit>></code> Meter
<code><<unit>></code> dimension=length

Dimension

❖ “A dimension describes the quantity of a unit.”

(System Engineering with SysML/UML, Tim Weilkiens)

Dimension

<<dimension>>

Mass

<<dimension>>

Length

<<dimension>>

Time

<<dimension>>

Temperature

Dimension

- ❖ Units describe a specific physical unit. Each unit's definition uses the 'dimension' property to describe its context.

Flow Ports

- ❖ “A flow port describes an interaction point of a block used by the block to interact with its environment. Objects can flow into and out of the block over a port.”

(System Engineering with SysML/UML, Tim Weilkiens)

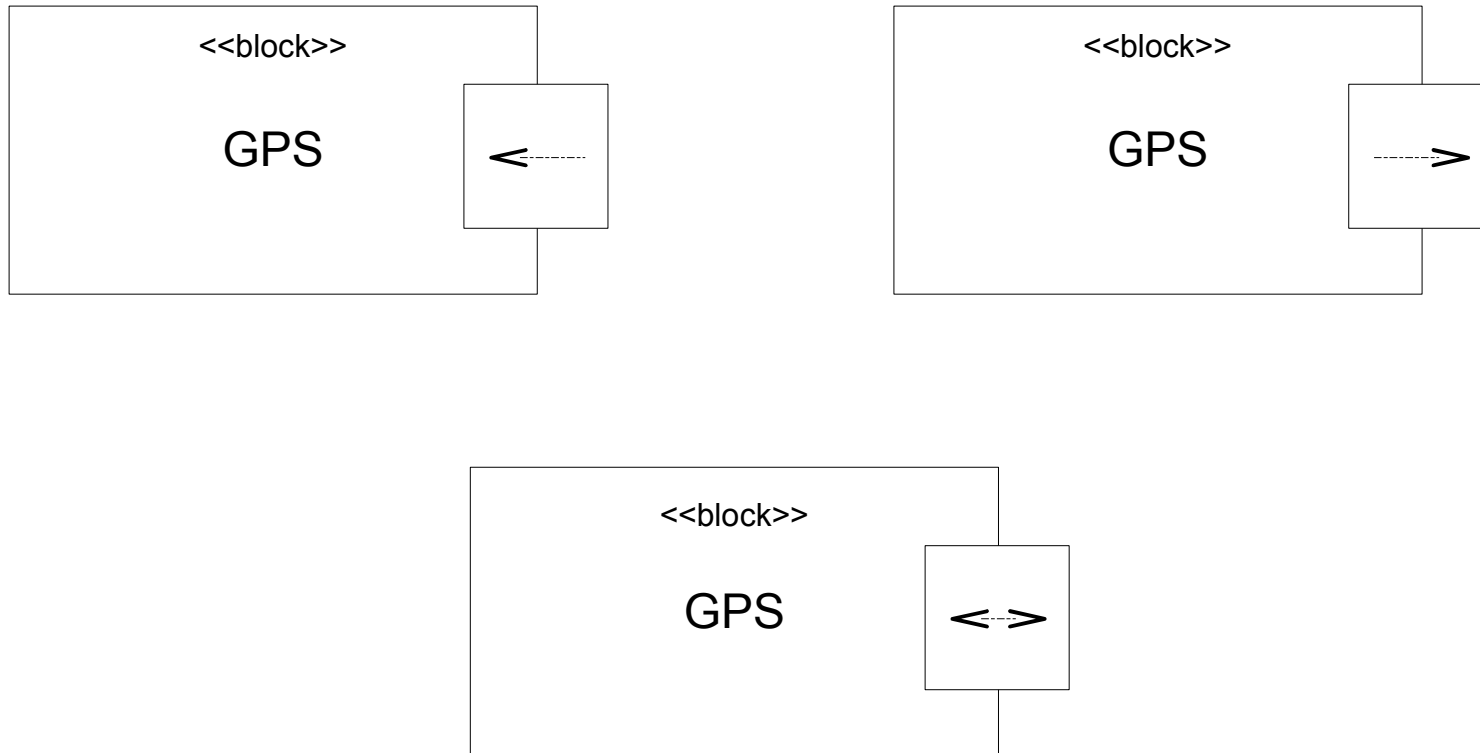
Flow Ports

- ❖ “A flow specification is a special interface, which specifies data incoming and outgoing to and from a flow port.”
(System Engineering with SysML/UML, Tim Weilkiens)

Flow Ports

- ❖ We depict a flow port using a small rectangle and a small arrow within it. The small arrow indicates about the data flow direction.

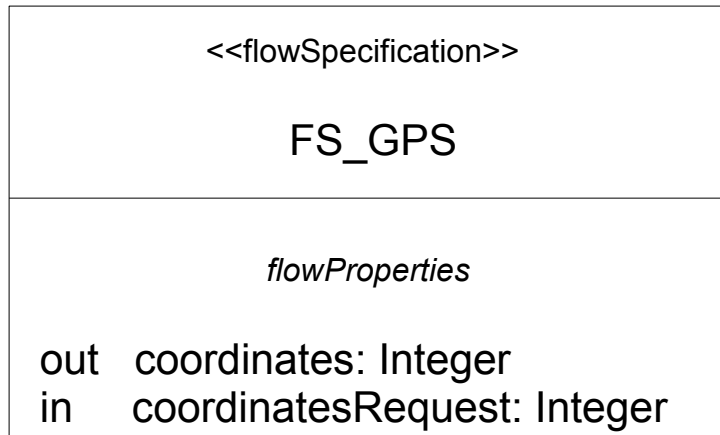
Flow Ports



Flow Ports

- ❖ We depict the flow specification using the '<<flowSpecification>>' stereotype on top and use the 'flowProperties' heading in order to list the flow characteristics.
- ❖ Incoming data should be prefixed with 'in'. Outgoing data should be prefixed with 'out' and data transferred in both directions should be described using the 'inout' keyword.

Flow Ports



Flow Ports

- ❖ When depicting a port in one block there would usually be a port in another block, so that the two be connected with each other.
- ❖ The opposite flow port will be defined using the same specifications except for the data direction that should be swapped.
- ❖ Depicting the port inversely describes a port that its data flows inversely (AKA “Conjugated Flow Port”).

Flow Ports



Flow Ports

- ❖ When the data can flow in one direction only the flow port is also known to be an atomic one.

Flow Ports



Item Flow

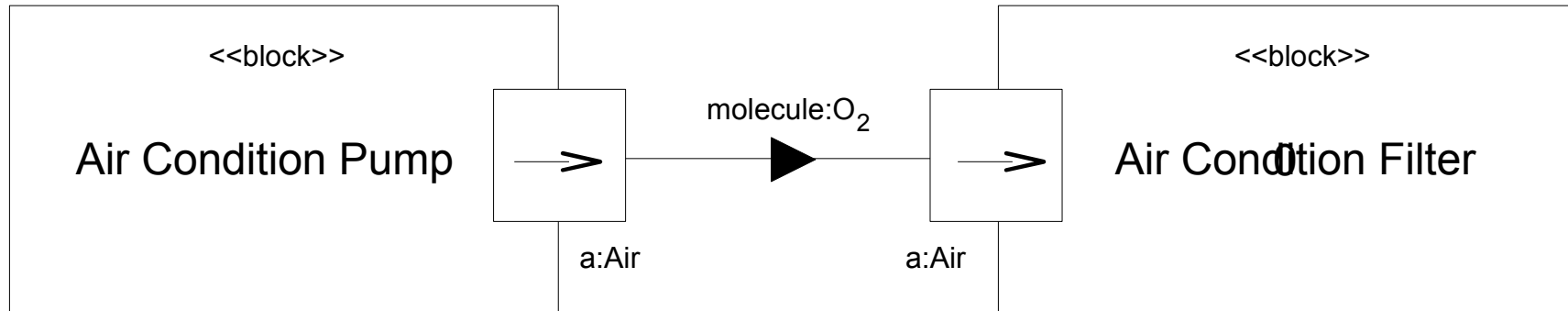
- ❖ “An item flow is a special information flow that describes at a connector in the internal block diagram that specific objects are transported.”

(System Engineering with SysML/UML, Tim Weilkiens)

Item Flow

- ❖ Using the item flow information we can describe the exact specific objects that flow.
- ❖ The item flow adds additional information to what we already know in general from the flow port specification.

Item Flow

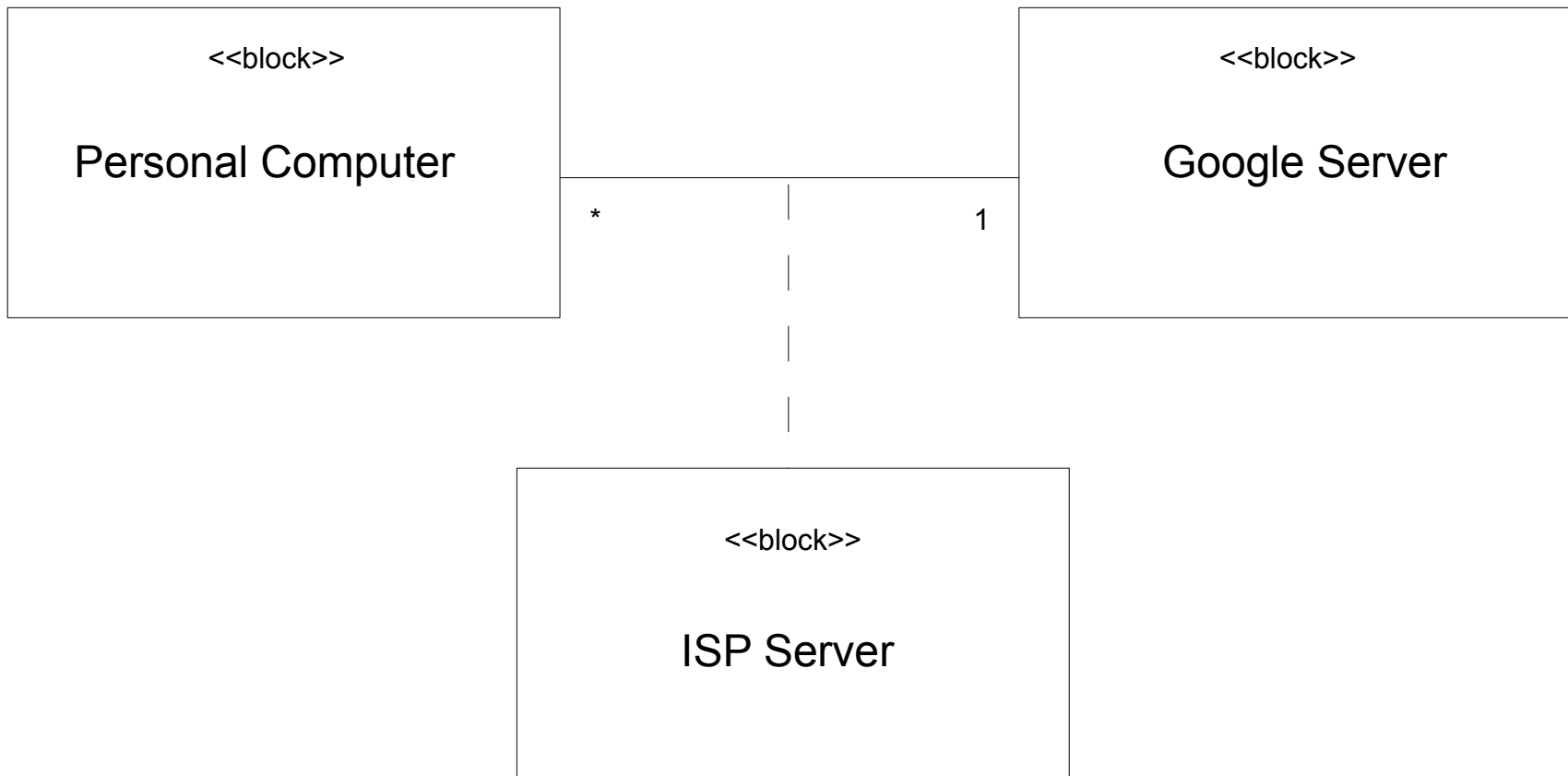


Association Block

- ❖ “An association block describes the structural properties of an association. It is the SysML name for the association class UML element.”

(System Engineering with SysML/UML, Tim Weilkiens)

Association Block



Data Types

- ❖ UML defines the following primitive data types:

 - Boolean

 - Integer

 - String

 - Unlimited Natural

- ❖ SysML adds the following primitive data types:

 - Real

 - Complex