Tutorial

CIP Statemachine - Lamp

Tutorial	Actifsource Tutorial – CIP Statemachine - Lamp
Required Time	• 60 Minutes
Prerequisites	• Actifsource Tutorial – Installing Actifsource • Actifsource Tutorial – Simple Service
Goal	• Creating a state machine using the CIP method • Generating real time C code for any embedded system
Topics covered	• Setting up a new CIP Project • Communicating with the Outer World • Specify the State Machine • Generating State Machine Code
Notation	To do ⓘ Information • **Bold**: Terms from actifsource or other technologies and tools • **Bold underlined**: actifsource Resources • Underlined: User Resources • *UnderlinedItalics*: Resource Functions • `Monospaced`: User input • *Italics*: Important terms in current situation
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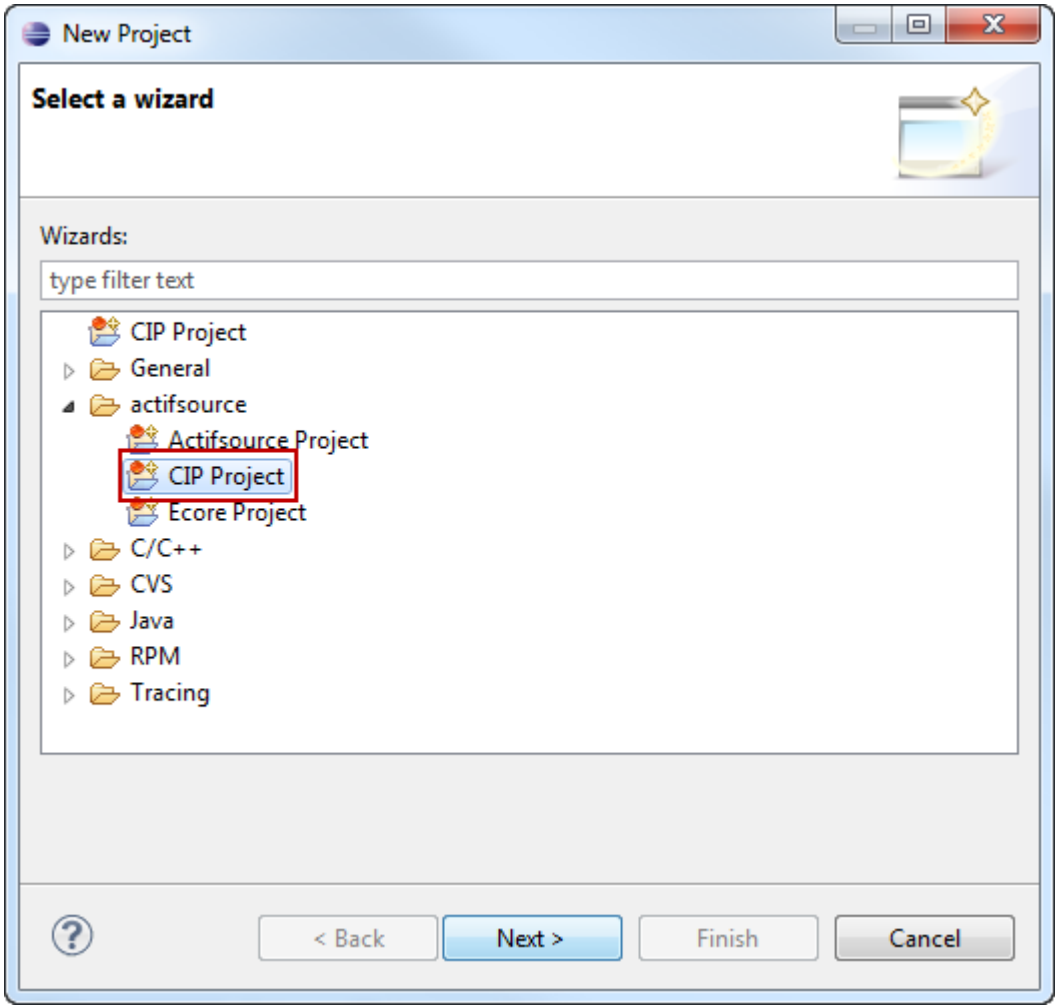
Compatibility	Created with **actifsource** Version 5.8.7

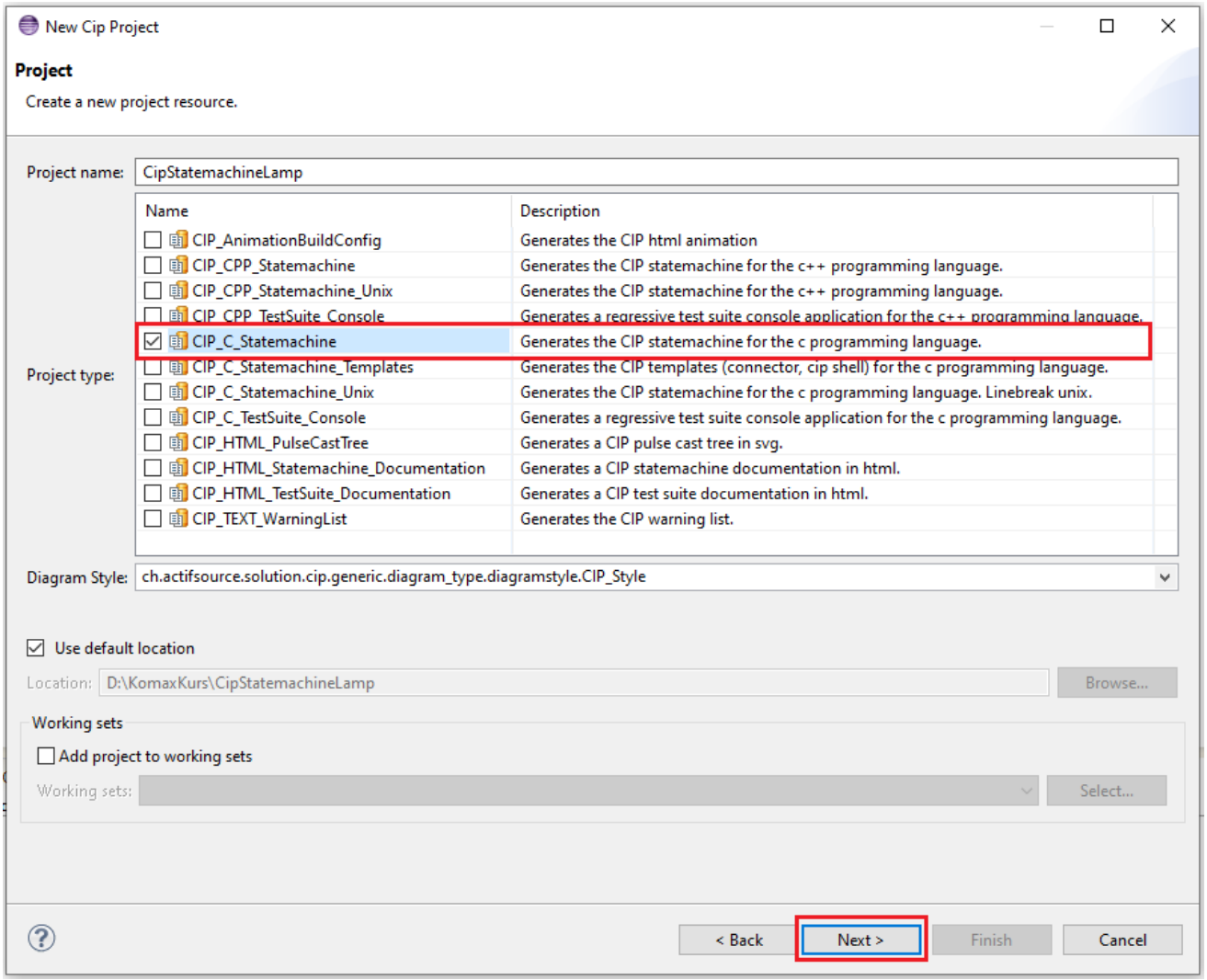
- Learn how to specify a simple state machine
- Example
  - Button to turn on and off a lamp
  - Turning off the lamp shall be delayed
- CIP Method
  - The CIP System is the root element
  - The CIP System consists of Clusters
    - Clusters are used to model distributed state machines
  - The CIP Cluster consists of Processes
    - The process declares the state of the state machine
  - The CIP Process consists of Modes
    - Modes are used for different situations like normal, error, run-in, run-out
    - The mode declares the transitions between the states

Part I: 4
Setting up a new CIP Project

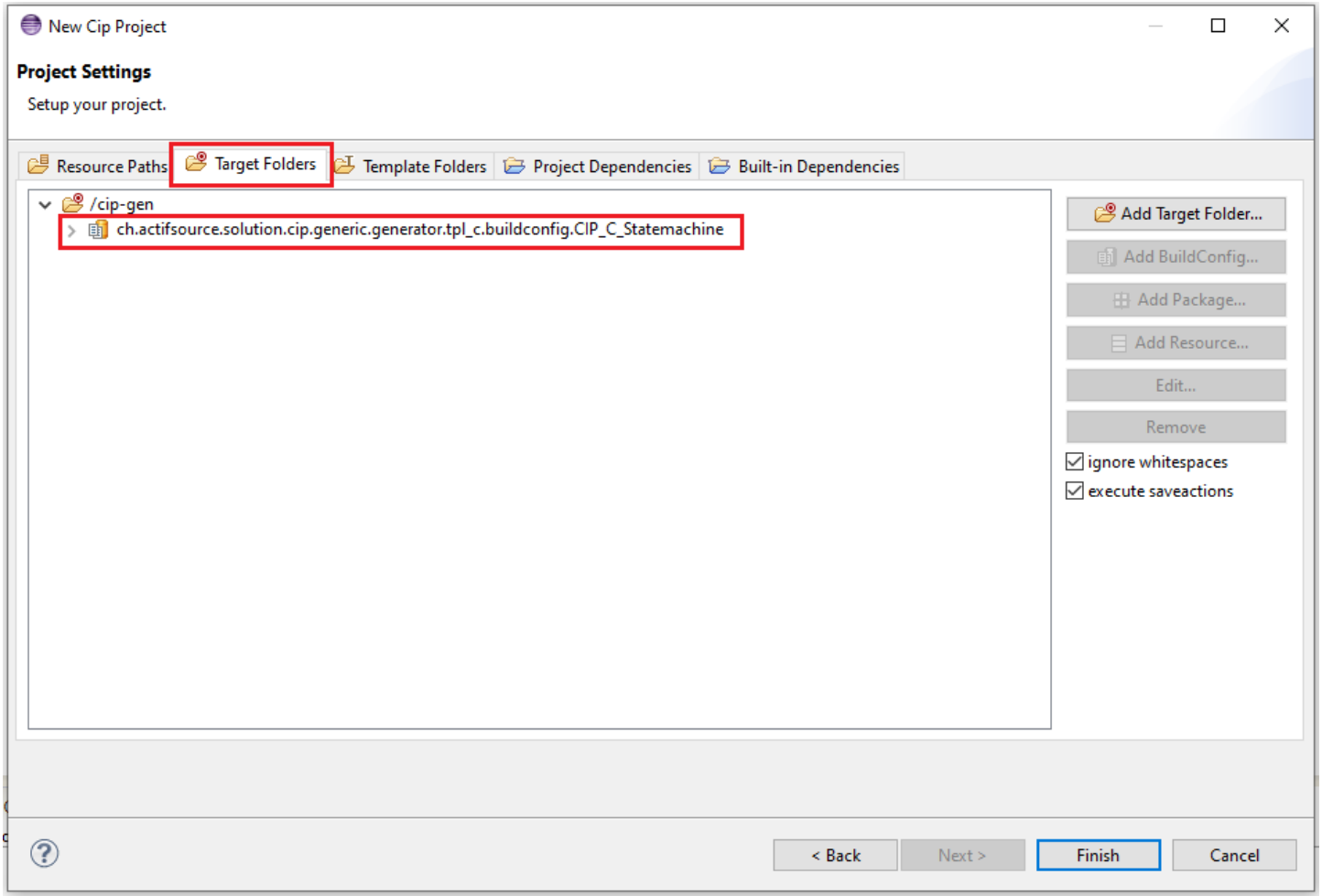
- Create a new CIP Project with the CIP Project wizard



- Prepare a new **Actifsource/CIP Project** using the Actifsource CIP wizard
  - File/new/other
  - Actifsource/CIP Project
- Click *Next*



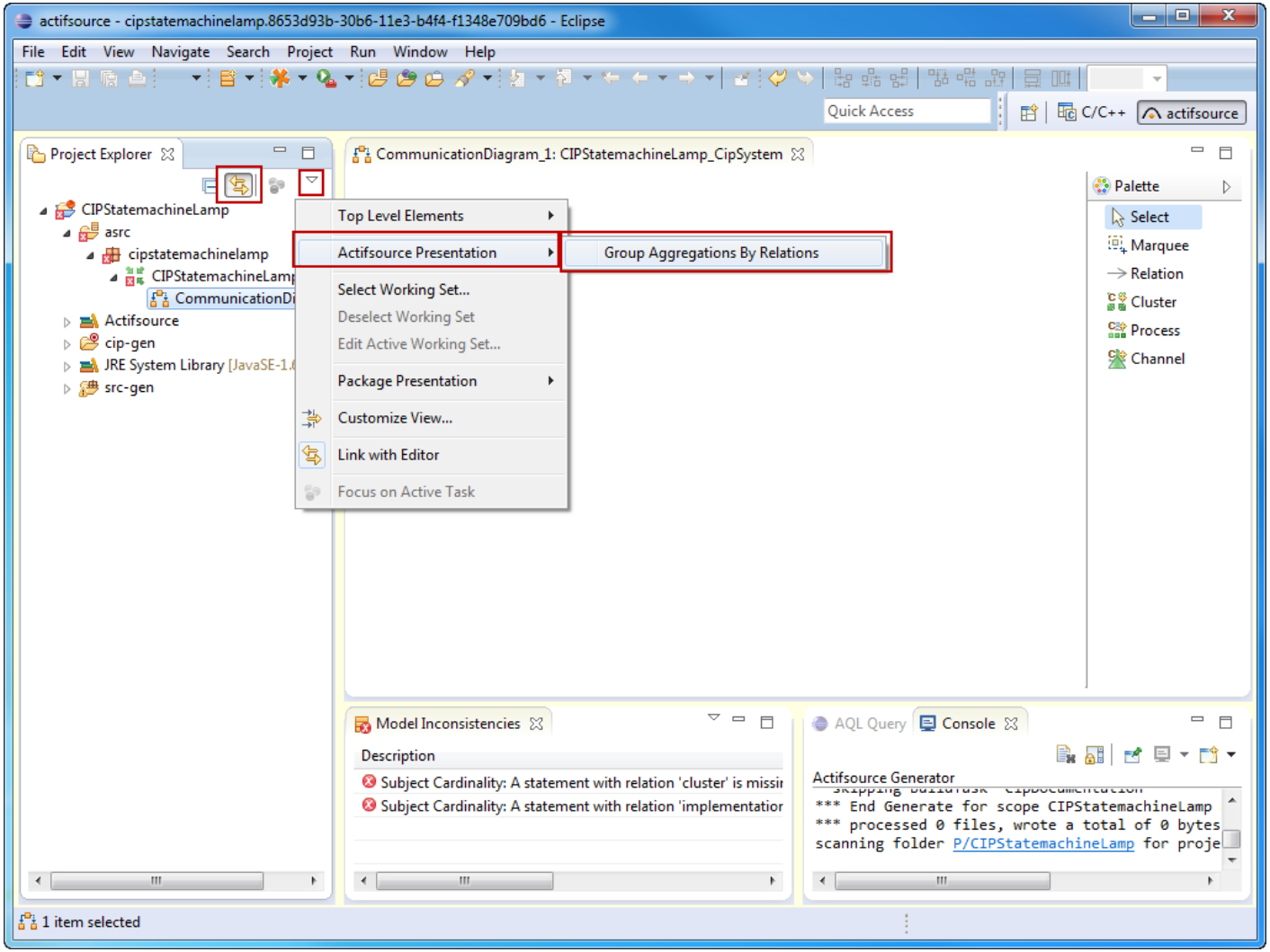
- Specifiy *Project name*
- Specify *Project type*
- Click *Next*



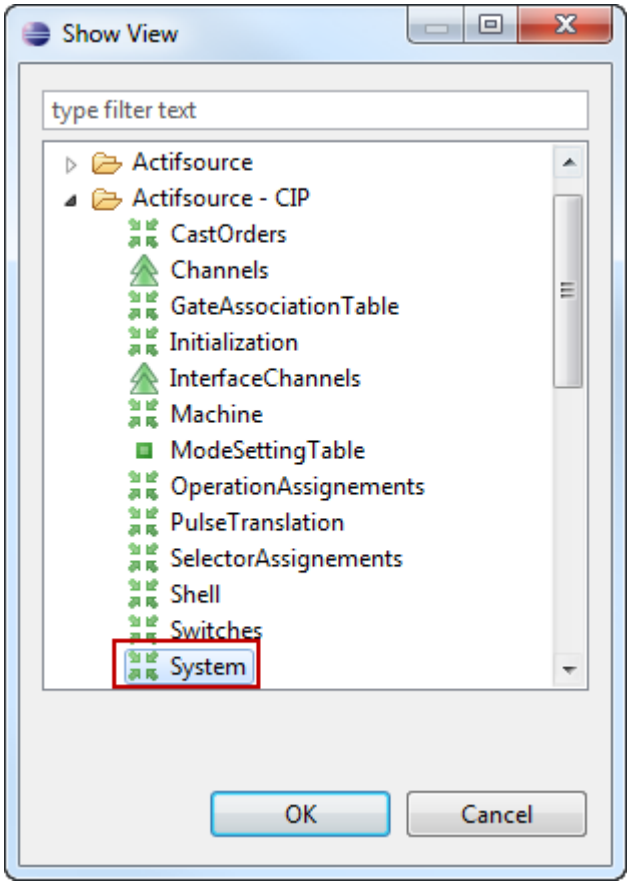
ⓘ Note that the BuildConfigs in TargetFolder are equivalent to the previously selected project type

ⓘ You may add other build configs (i.e. test suites) as needed

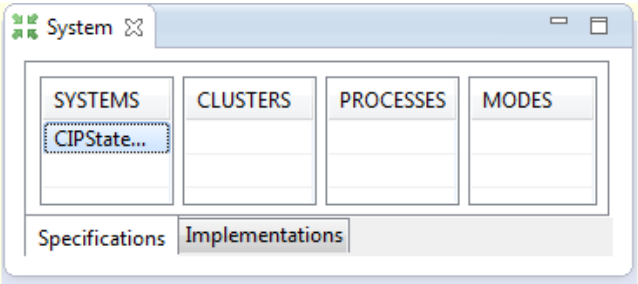
↳ Click *Finish*



- *Link with Editor*
- Enable *Actifsource Presentation* Flag Group Aggregations By Relations

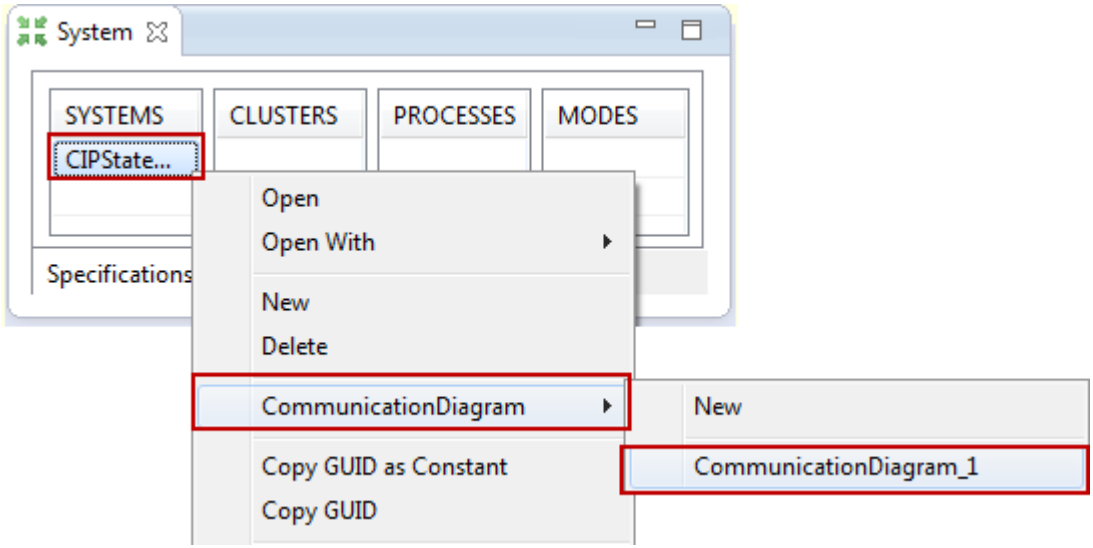


- Open *CIP System View*
  - Window/Show View/Other…
  - Actifsource – CIP / System

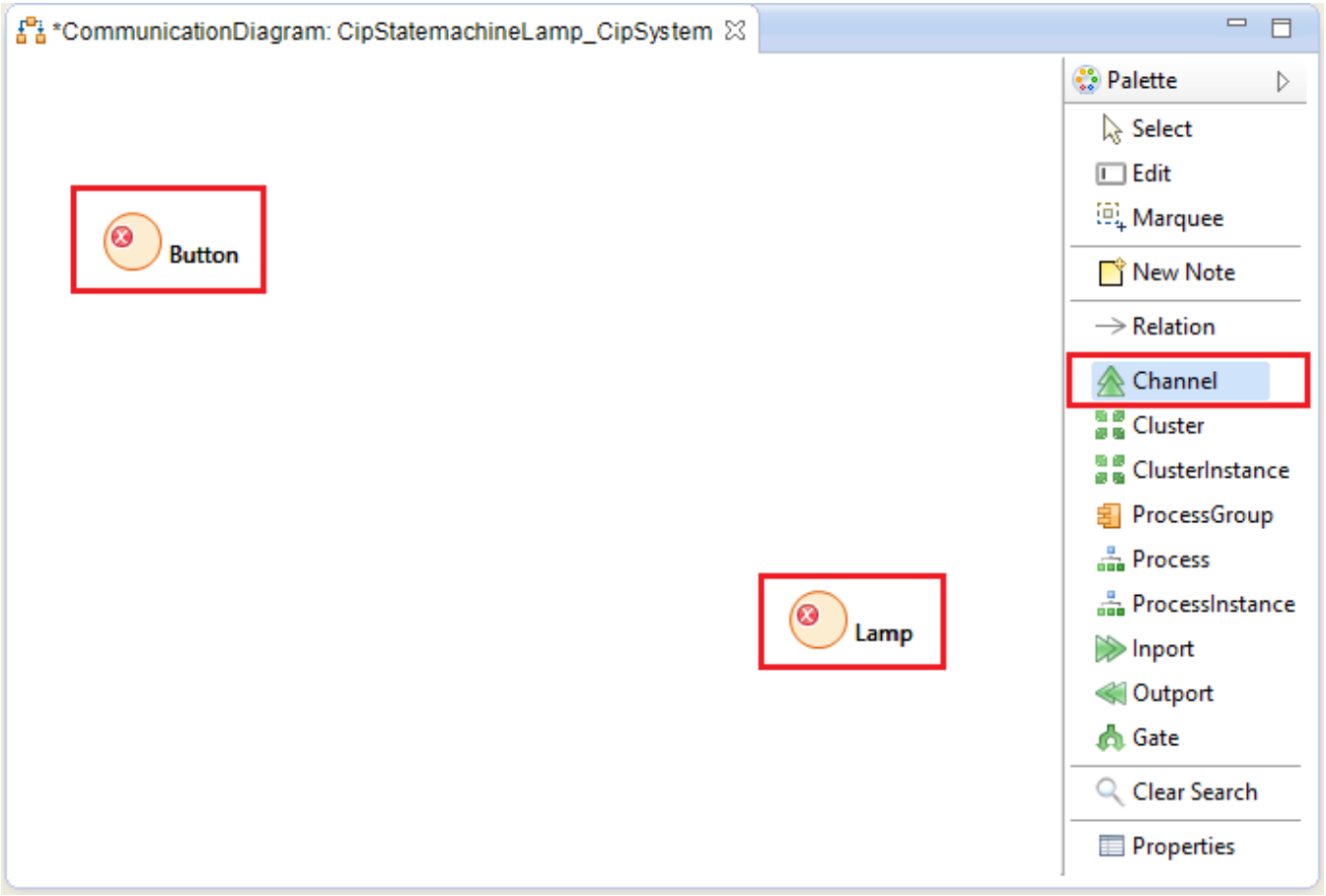


Part II: 10
Communicating with the Outer World

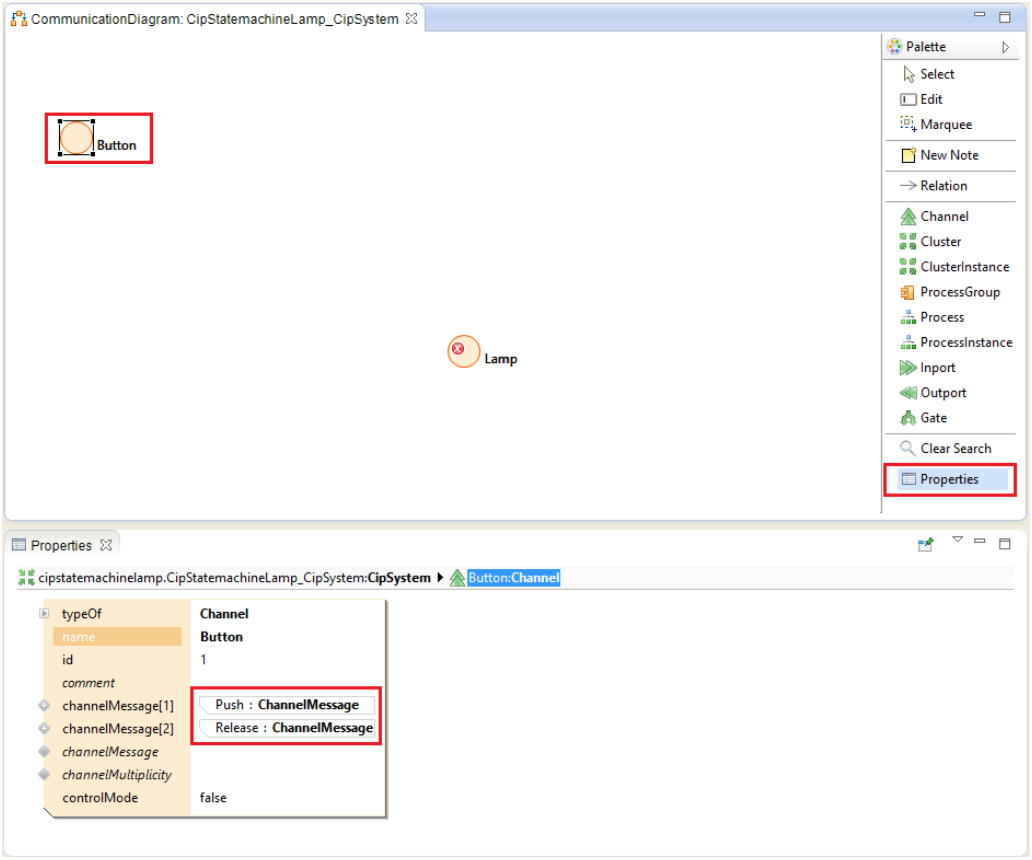
- Let’s communicate with the outer world
- Channels are providing messages from physical device



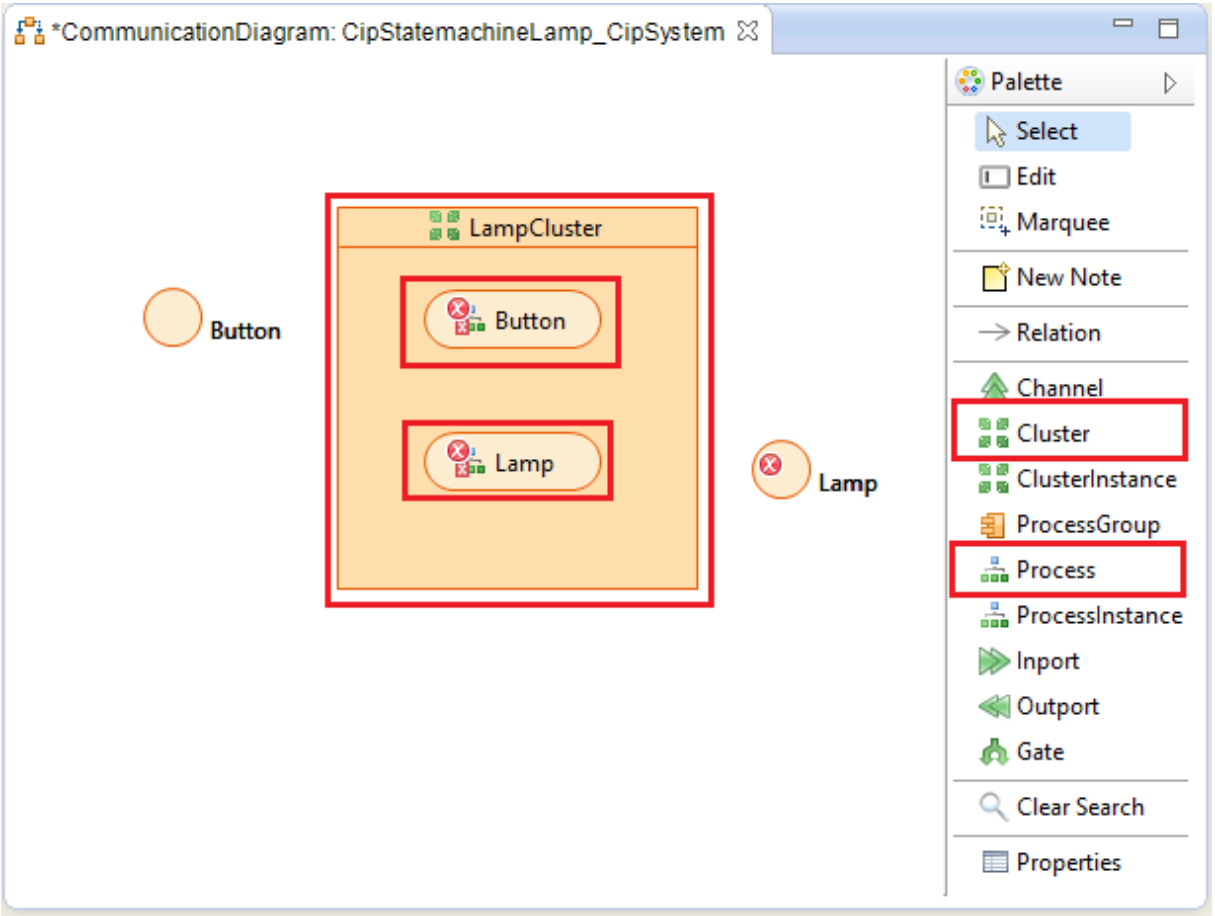
- Open the Communication Diagram (if not already open)
  - Right Click on System1 in the *System View*
  - Select *CommunicationDiagram* from the context menu
  - Open CommunicationDiagram_1



↳ Create two new **Channels** named Button and Lamp using the *Channel* tool from the *Palette*



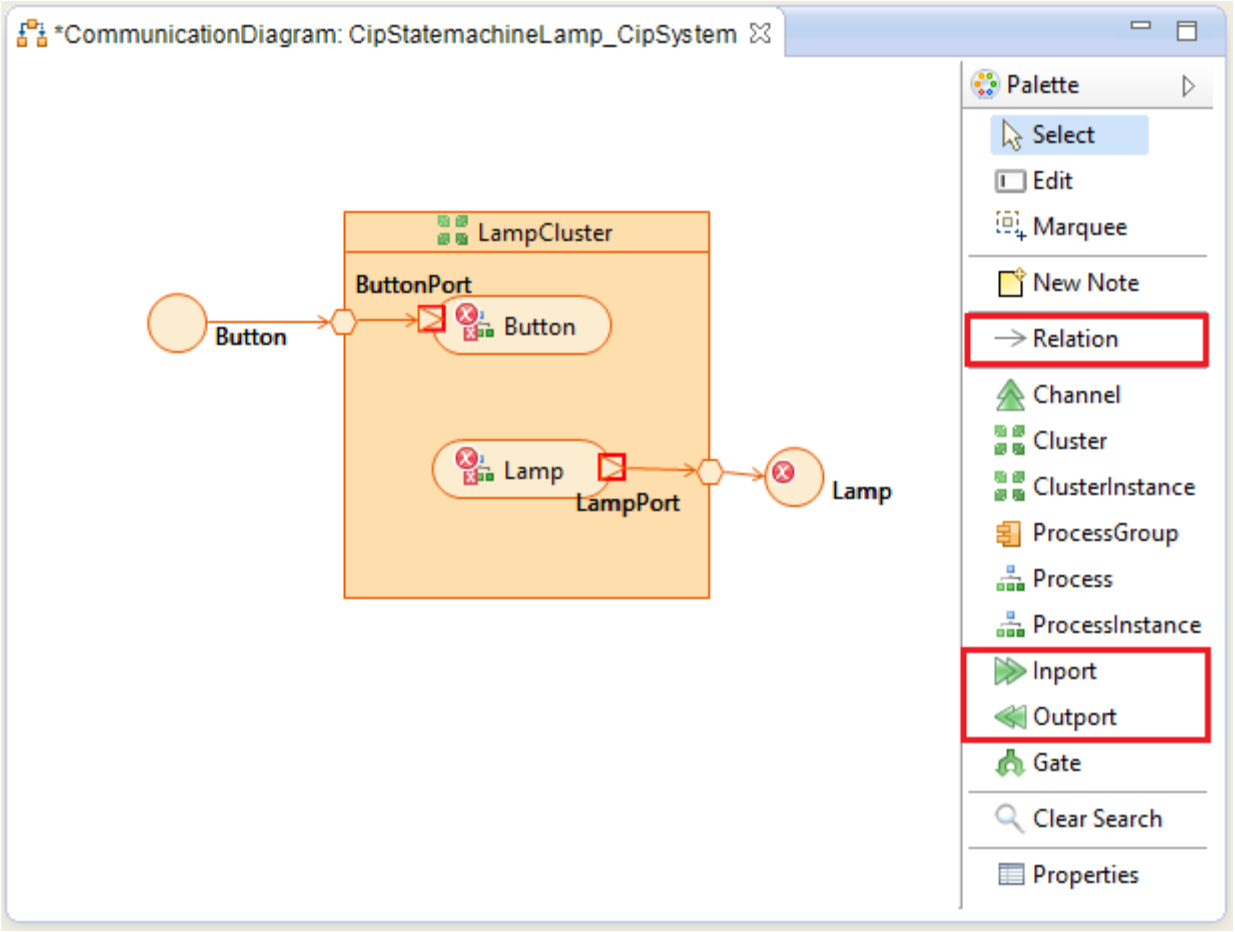
- ⓘ Arrange the Graphical Editor and the Resource Editor together on the same screen as shown above
- ↳ Add the two **ChannelMessages** Push and Release to the **Channel** Button
  - Ctrl+Click on the Button label
  - Add **ChannelMessage** Push and **ChannelMessage** Release
- ↳ Add the two **ChannelMessages** Bright and Dark to the **Channel** Lamp
  - Ctrl+Click on the Lamp label
  - Add **ChannelMessage** Bright and **ChannelMessage** Dark
- ⓘ Messages are given as function calls from the other world to the state machine and vice versa



ⓘ The CIP Method specifies that every physical process needs a logical counterpart in the model

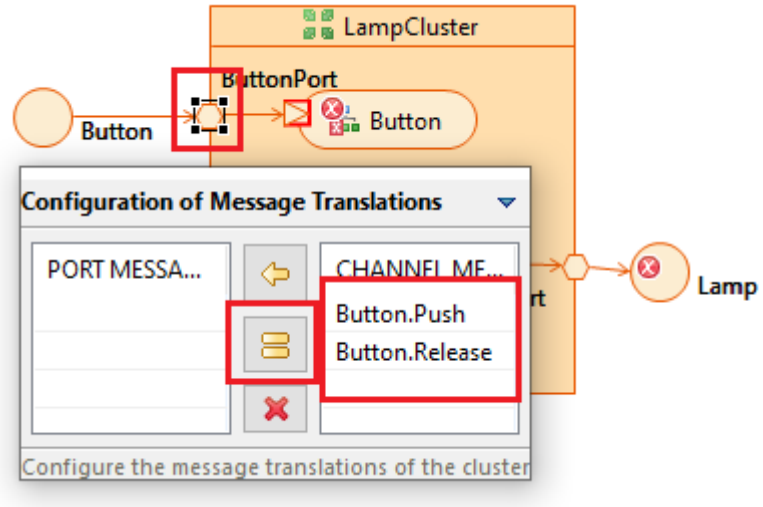
ⓘ Note that different Clusters may run on different processors. This allows you to design distributed state machines using the CIP Method.

↳ Add the two **Processes** Button and Lamp to the **Cluster** LampCluster



ⓘ Channels are Delivering Messages to a Process via Port. Doing so allows you to consider the Process to a self-consistent component.

- Create an **Inport** ButtonPort and a relation from the **Channel** Button to the **Port** ButtonPort
- Create an **Outport** LampPort and a relation from the **Port** LampPort to the **Channel** Lamp

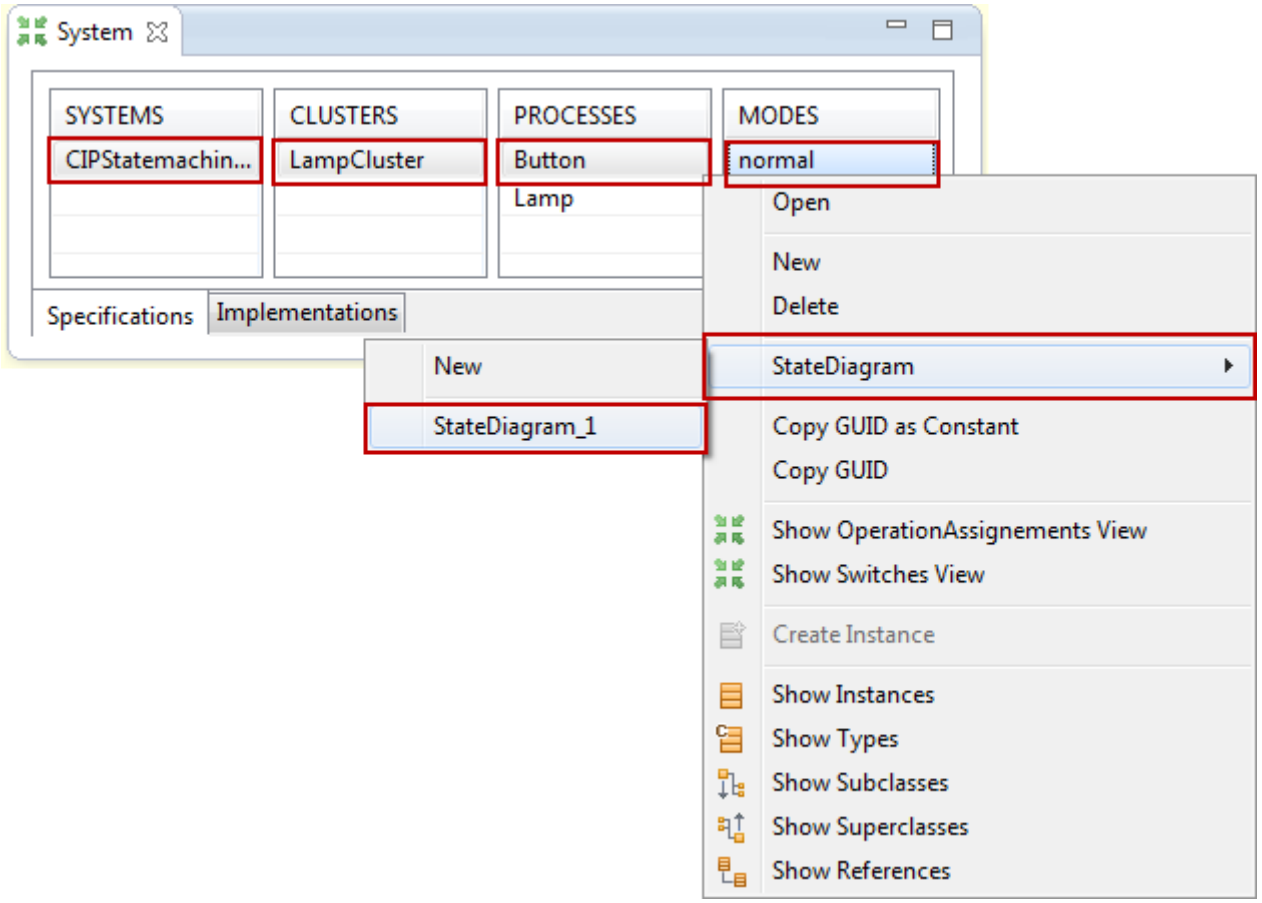


ⓘ Since every **Process** is a self-consistent component we have to specify a **Message** interface on the port to. The **=** tool in the *Message Translation* helps us to create the same messages as found on the **Channel** also on the corresponding **Port**.

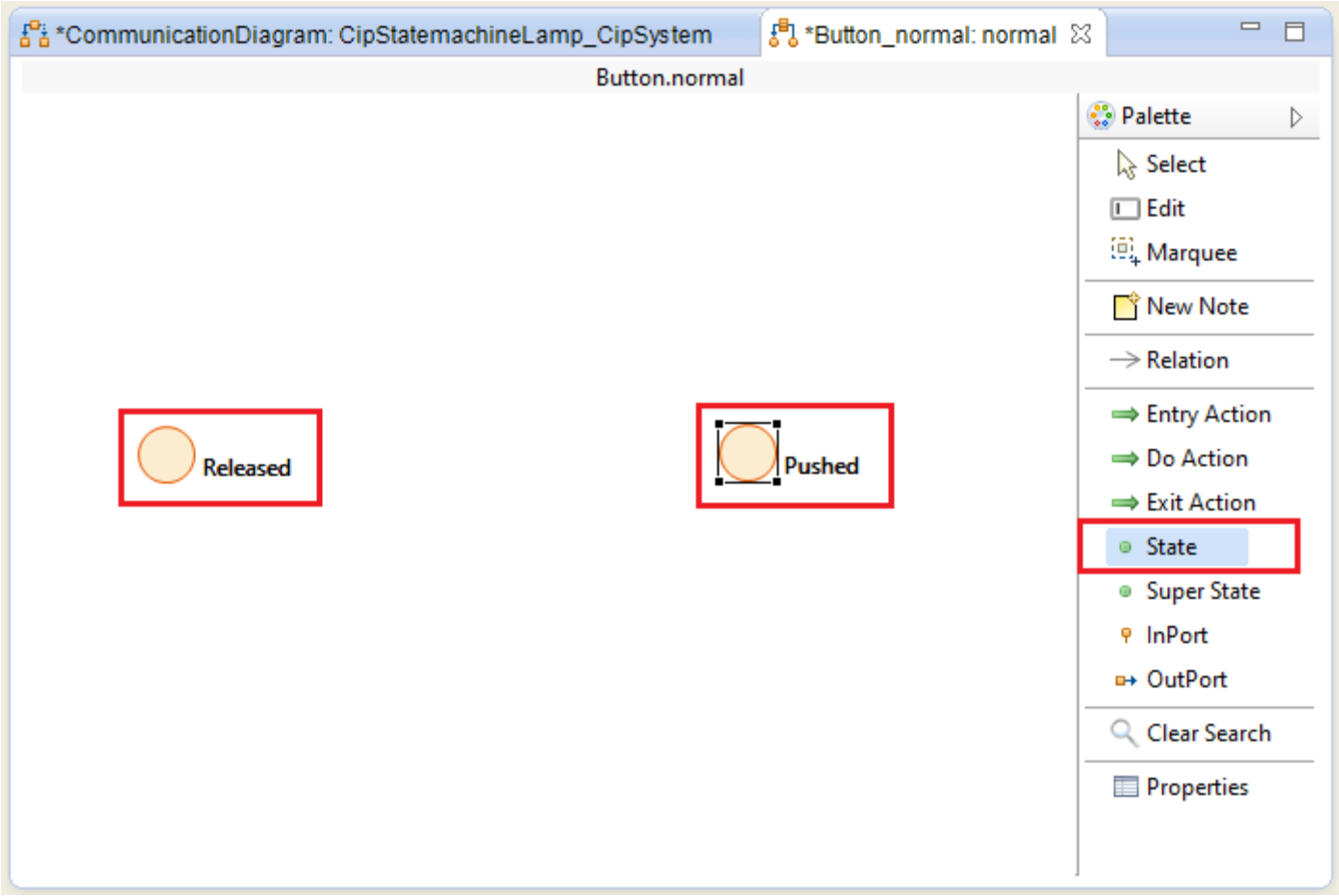
- Configure the *Message Translation* between the **Channel** Button and the **Process** Button
  - Double-Click on the hexagon of the relation between the **Channel** Button and the **Process** Button
  - Select the **ChannelMessage**s Button.Push and Button.Release
  - Use the =-Tool to create the corresponding **Messages** on the **Port** ButtonPort of the **Process** Button
- Configure the *Message Translation* between the **Process** Lamp and the **Channel** Lamp
  - Double-Click on the hexagon of the relation between the the **Process** Lamp and the **Channel** Lamp
  - Select the **ChannelMessage**s Lamp.Bright and Lamp.Dark
  - Use the =-Tool to create the corresponding **Messages** on the **Port** LampPort of the **Process** Lamp

Part III: Specify the State Machine

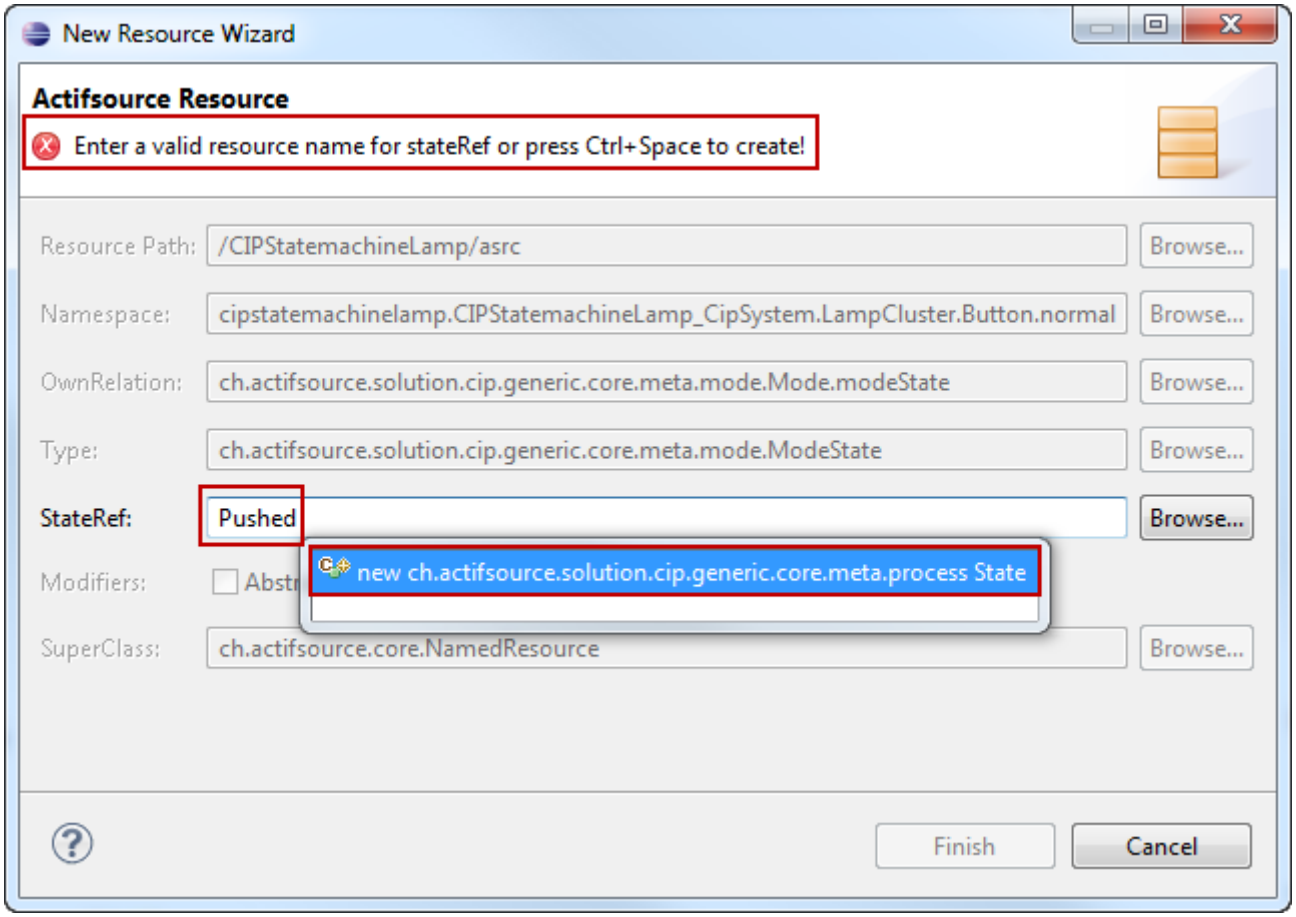
- We are now set to specify the state machines for each process
- Note that the CIP Method knows so called **Modes**
  - A Process can have one or more Modes
  - States are declared by the Process
  - Transitions are declared by the Mode
- Making this difference it becomes possible to provide several Modes for several situations
  - Normal Mode
  - Error Mode
  - Run-In Mode
  - Run-Out Mode
- There are the following rules
  - **States** are defined in the **Process**
  - **States** are shared for every **Mode**
  - **Transitions** are defined in the **Mode**



- Open the *StateDiagram* for **Process** Button
  - On the *System View* Right-Click on System1.Lamp.Button.normal
  - Select *StateDiagram*
  - Select StateDiagram_1



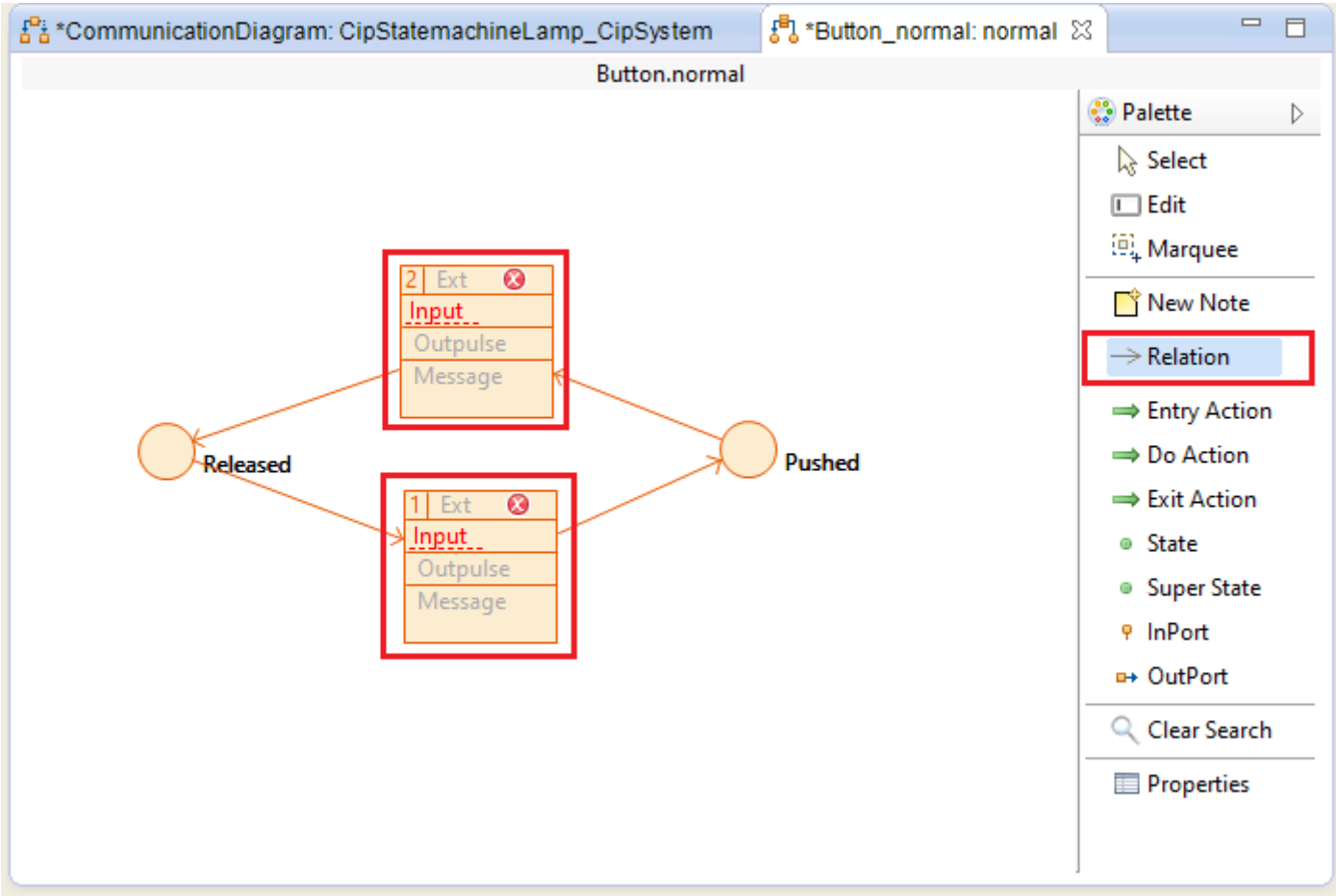
↳ Enter two new **States** Released and Pushed using the *Palette*



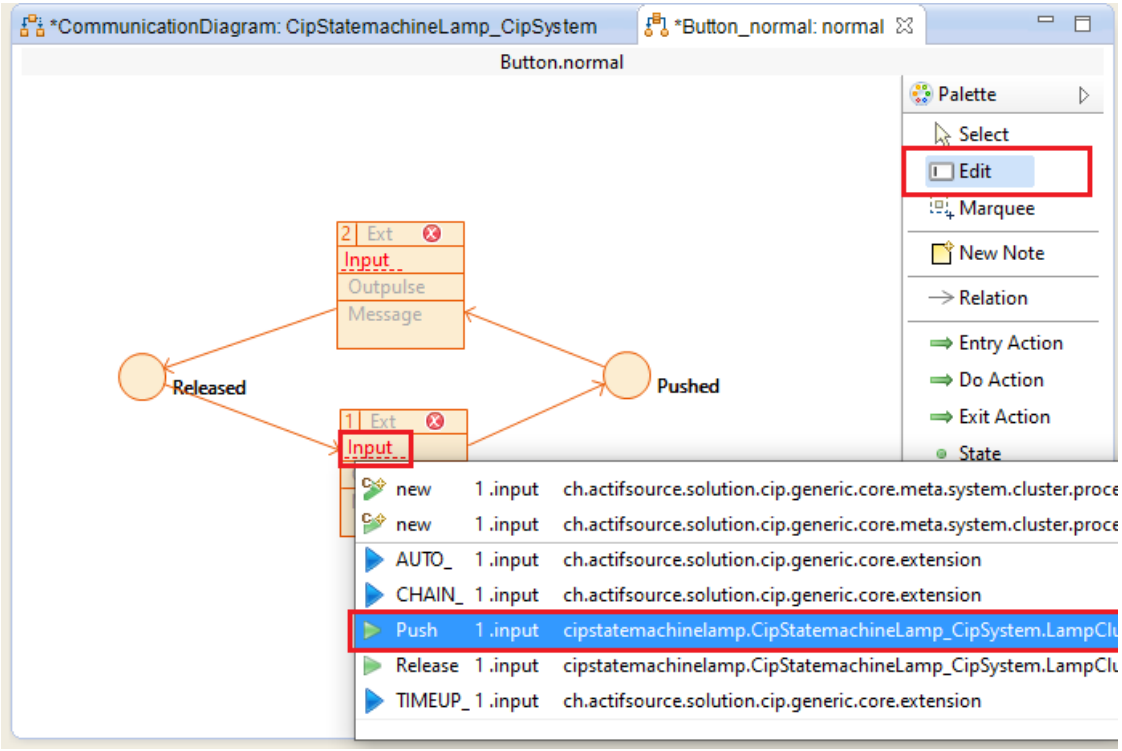
ⓘ State are shared for every mode

↳ Enter the desired **State** name Released and press Ctrl-Space

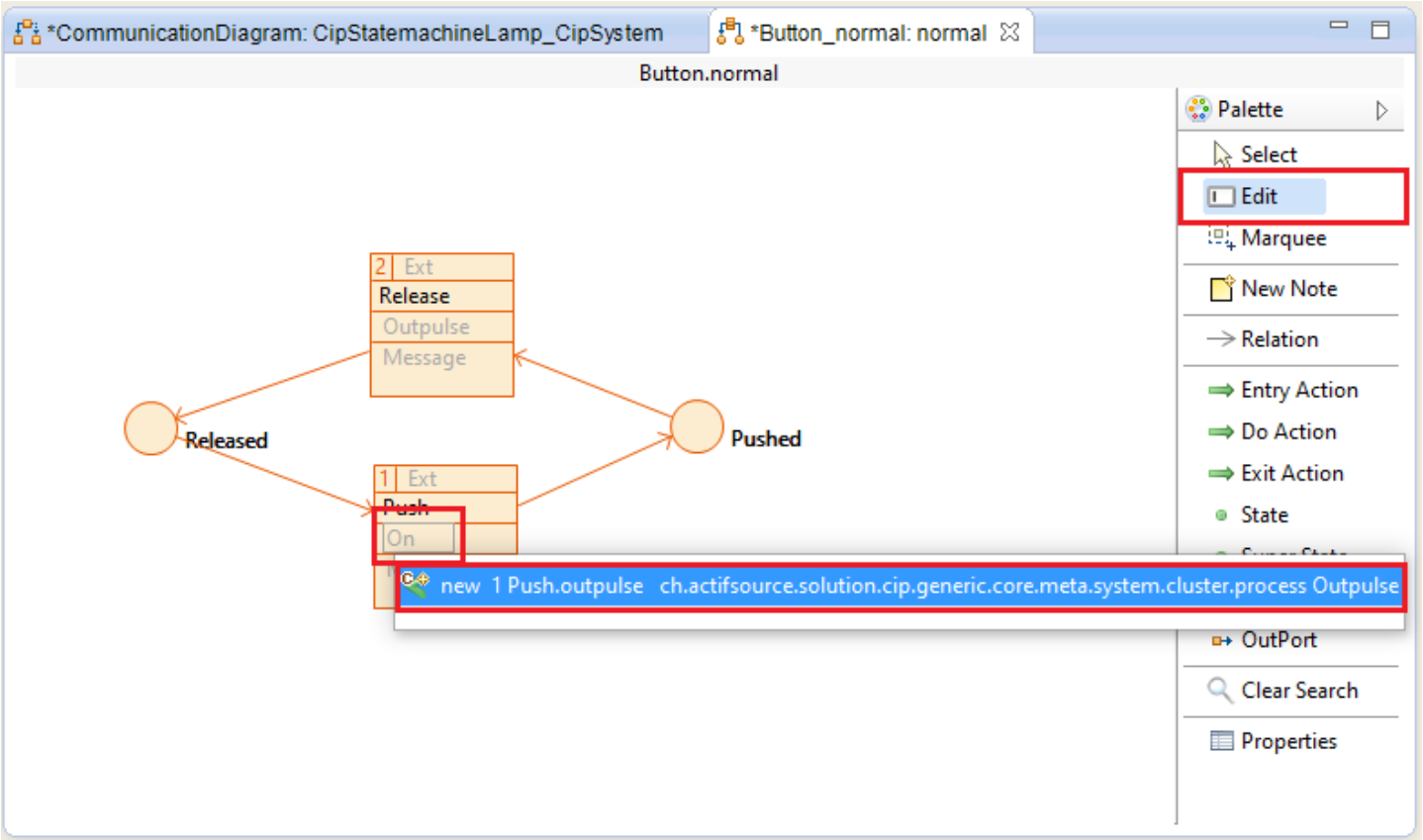
- Select an existing **State**
  or
- Create a new **State** (as we do in our example)



- Create a new **Transition** from **State** Released to **State** Pushed using the *Relation* Tool from the *Palette*
- Create a new **Transition** from **State** Pushed to **State** Released using the *Relation* Tool from the *Palette*

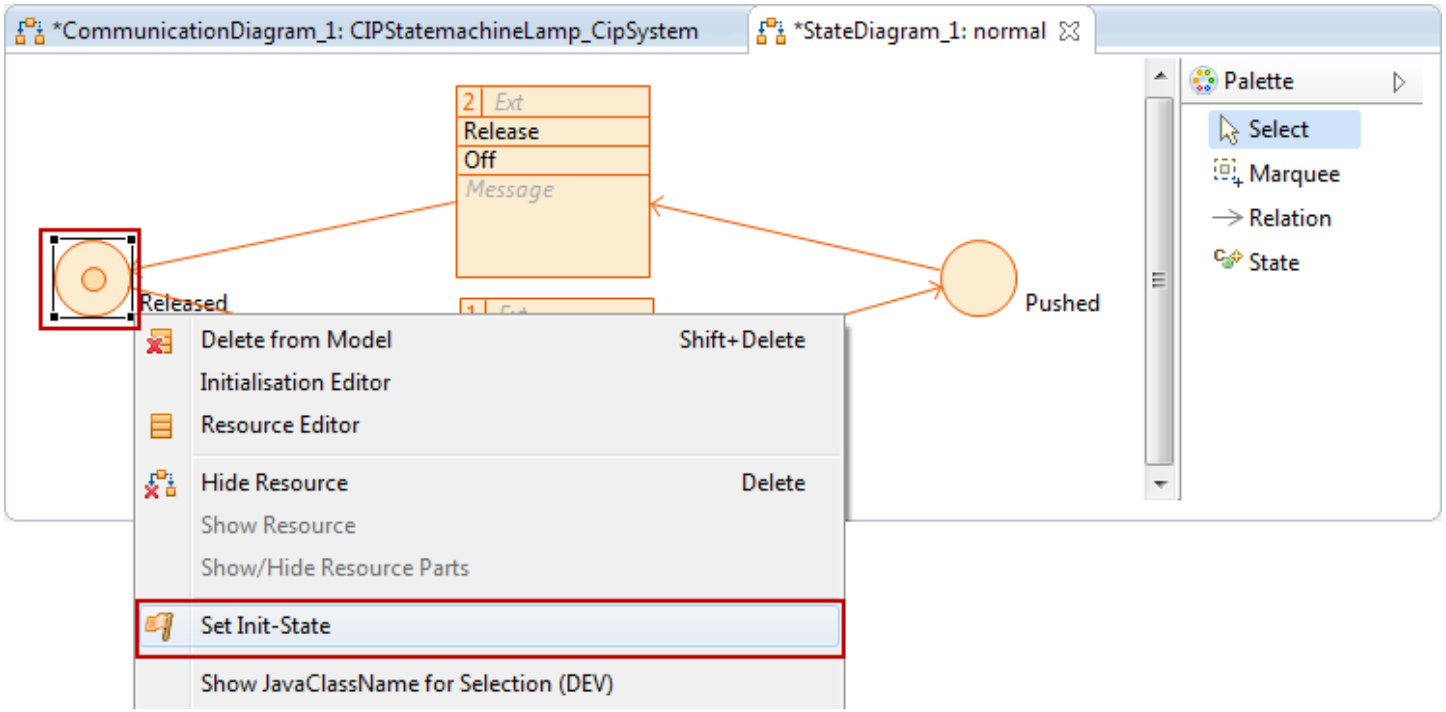


- ⓘ Every Transition needs an input to be triggered
- ⓘ Note that the Actifsource Validator marks all resources that are incomplete
- ↳ Add the input message to **Transition** from **State** Released to **State** Pushed
  - Ctrl-Klick on the italics label *Input*
  - Select the **InportMessage** Push
- ↳ Add the input message to **Transition** from **State** Pushed to **State** Released
  - Ctrl-Klick on the italics label *Input*
  - Select the **InportMessage** Release
- ⓘ Note that you now selecting the **Messages** that we have previously created on the **Port** Button using the =-Tool in the *Message Translation*

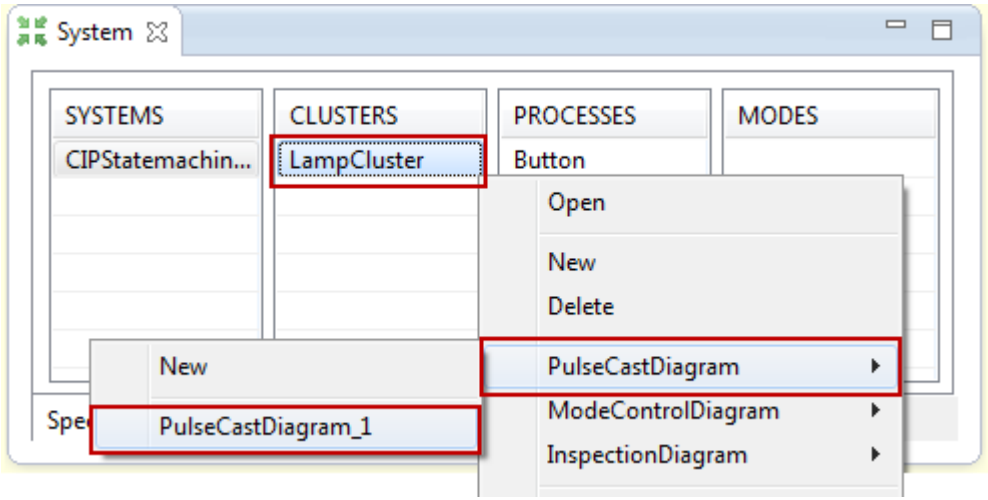


- ⓘ Use **Messages** to communicate with **Processes** from the outer world
- ⓘ Use **Pulses** to communicate between **Processes** within the same **Cluster**
- ↳ Add the **Outpulse** On to **Transition** from **State** Released to **State** Pushed
  - Ctrl-Klick on the italics label *Outpulse*
  - Enter the desired **Outpulse** named On and press Ctrl-Space
    - Select an existing **Outpulse**

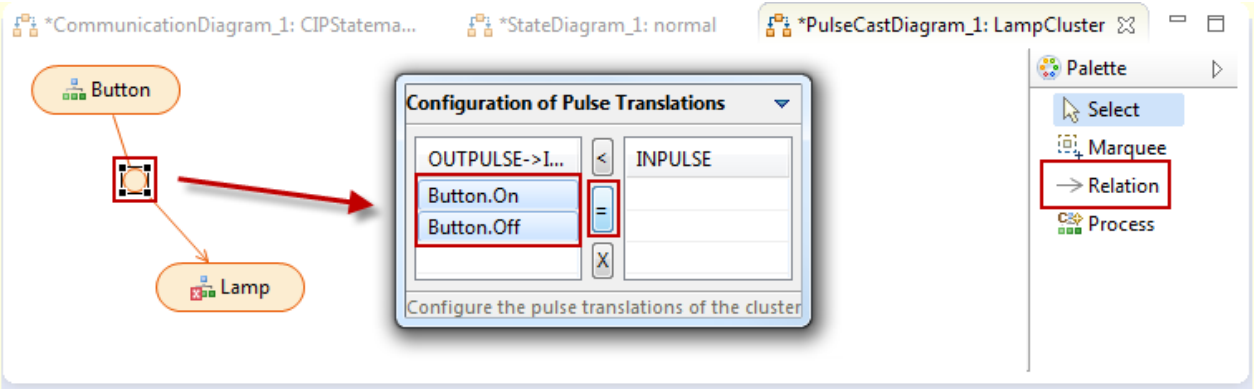
      or
    - Create a new **Outpulse** (as we do in our example)
- ↳ Add the **Outpulse** Off to **Transition** from **State** Pushed to **State** Released



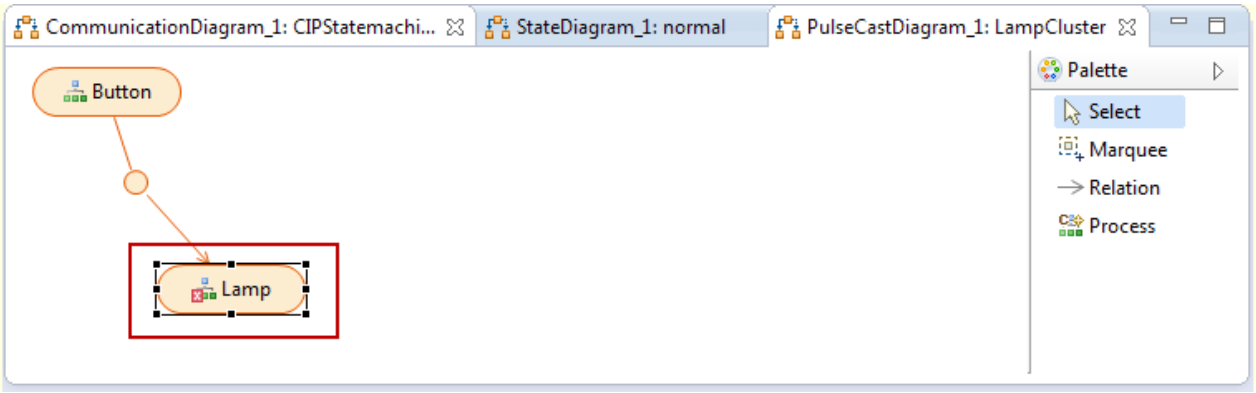
- Set the *Init-State* to specify the **State** to start with
  - Right-Click on **State** Released
  - Shape Actions/Set Init-State



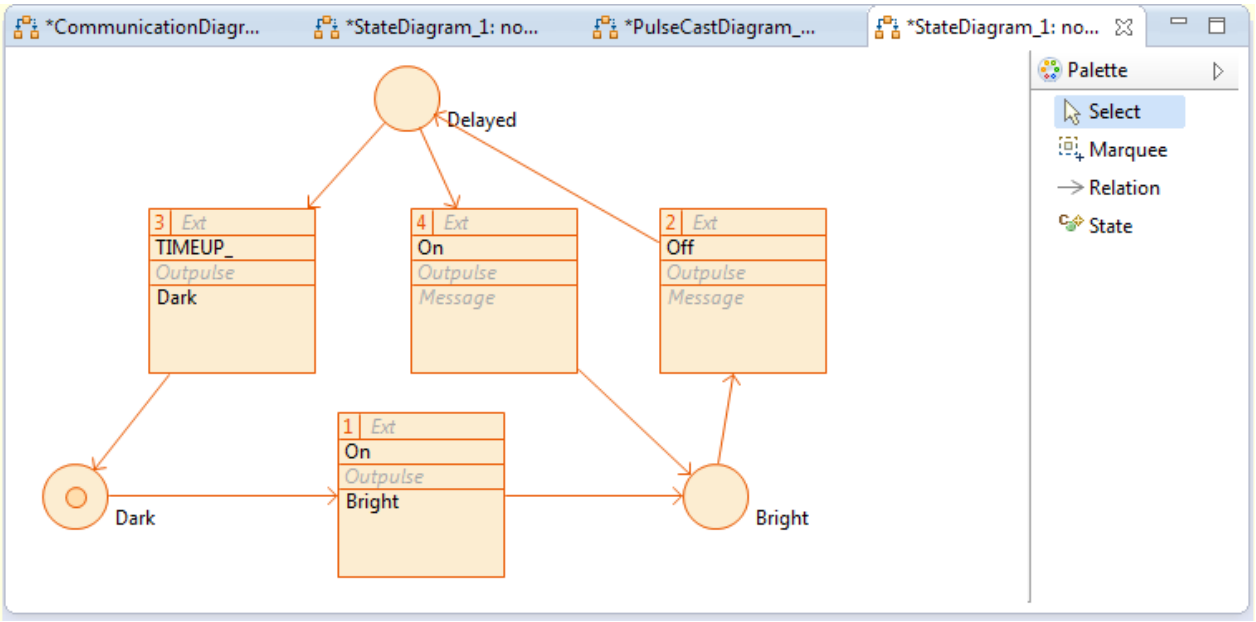
- ⓘ Use **Pulses** to communicate between **Processes** within the same **Cluster**
- ⓘ The *PulseCastDiagram* specifies which **Processes** sends **Pulses** to which other **Processes**
- ↳ Open the *PulseCastDiagram* for **Cluster** Lamp
  - On the *System View* Right-Click on System1.LampCluster
  - Select *PulseCastDiagram*
  - Select *PulseCastDiagram_1 (or create a new one if necessary)*



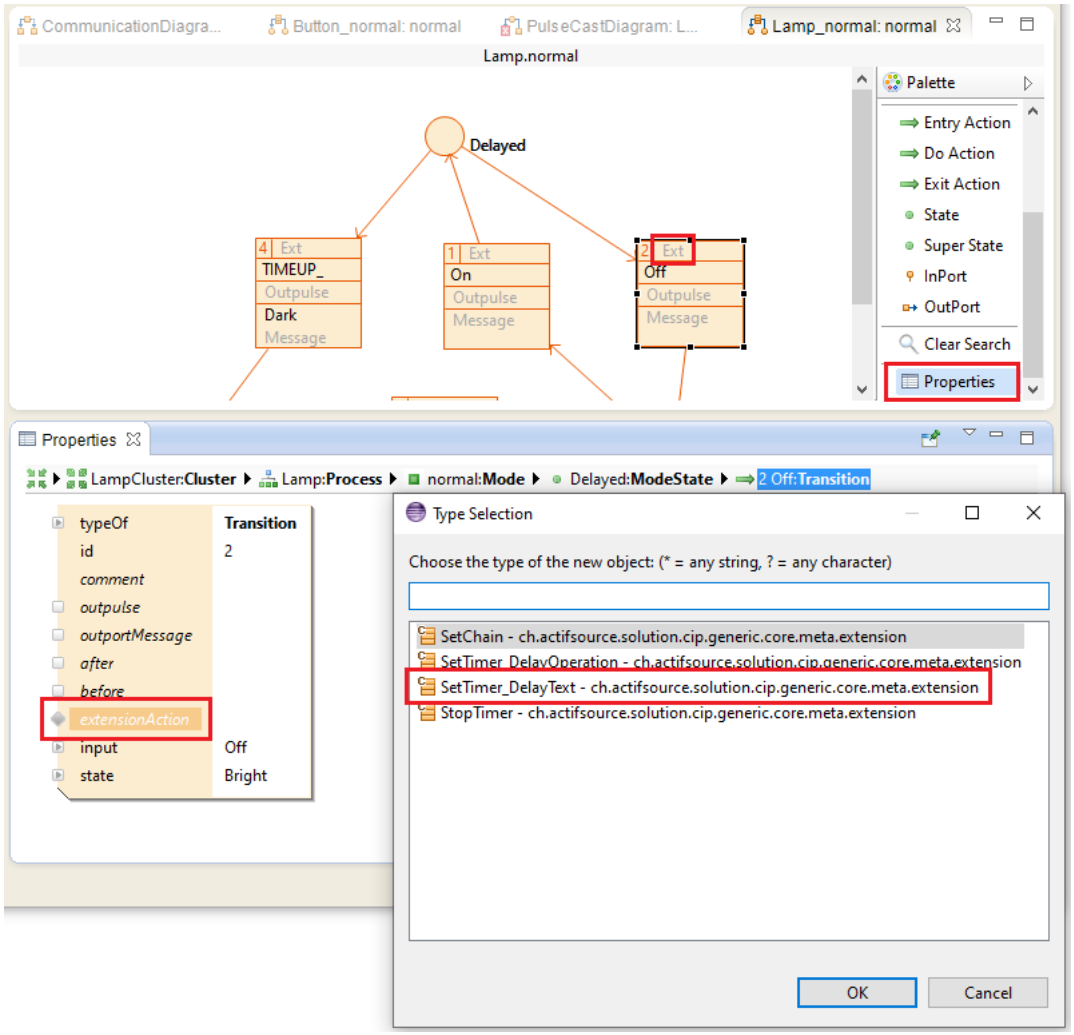
- Add the **Process** Button and the **Process** Lamp to your *PulseCastDiagram*
  - Right-Click on the Diagram
  - Show Resource
  - Select Button and Lamp
- Connect the **Process** Button and the **Process** Lamp using the *Relation* Tool from the *Palette*
- Configure the *Pulse Translation* between the **Process** Button and the **Process** Lamp
  - Double-Click on the circle of the relation between the the **Process** Button and the **Process** Lamp
  - Select the **Outpulses** Button.On and Button.Off
  - Use the **=**-Tool to create the corresponding **Inpulses** on the **Process** Lamp



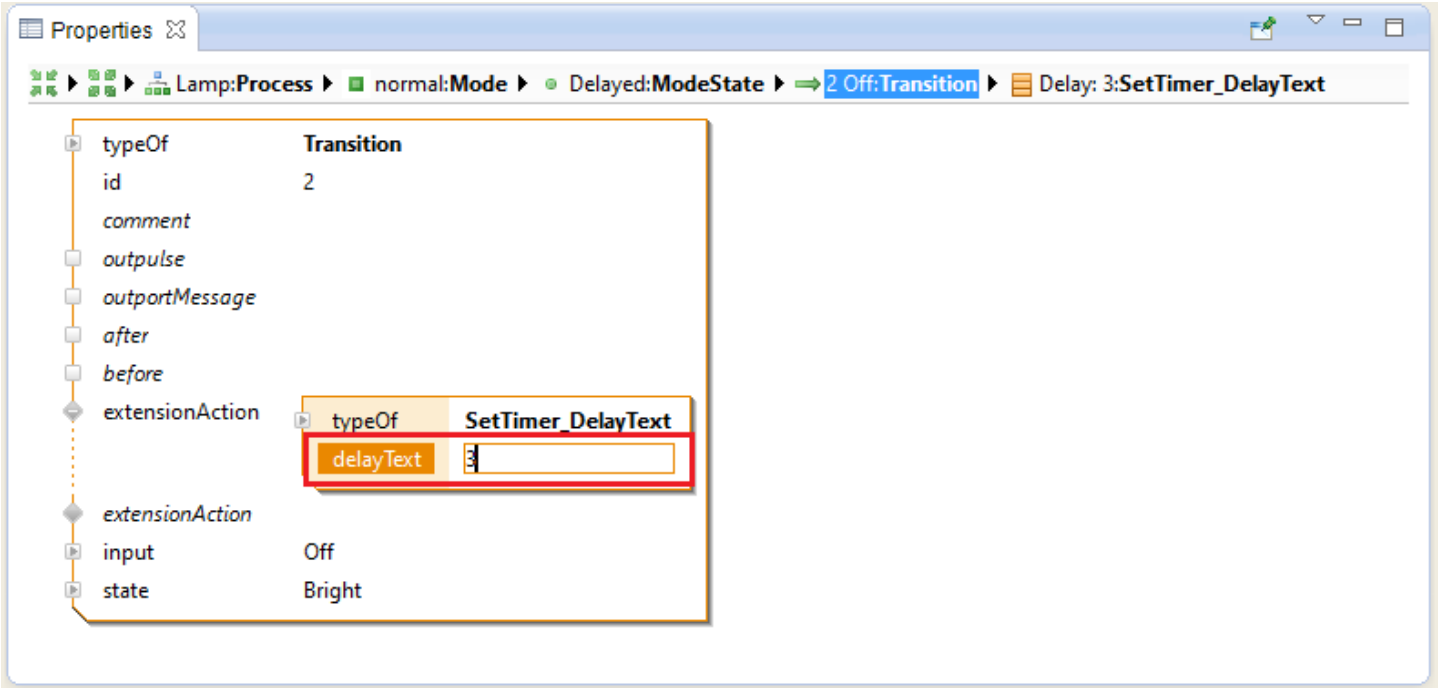
↳ Double-Click on **Process** Lamp to open the *StateDiagram*



- Open the *StateDiagram* for **Process** Lamp (if not already done)
  - On the *System View* Right-Click on System1.Lamp.Button.normal
  - Select *StateDiagram*
  - Select StateDiagram_1
- Create **States** Dark, Bright and Delayed
- Make **State** Dark the *Init-State*
- Create Transition as shown above
  - Select **Pulses** which have been created in the *Pulse Translation*
  - _TIMEUP is a special pulses emitted if timer expires
  - Select Lamp **Messages** to the outer world



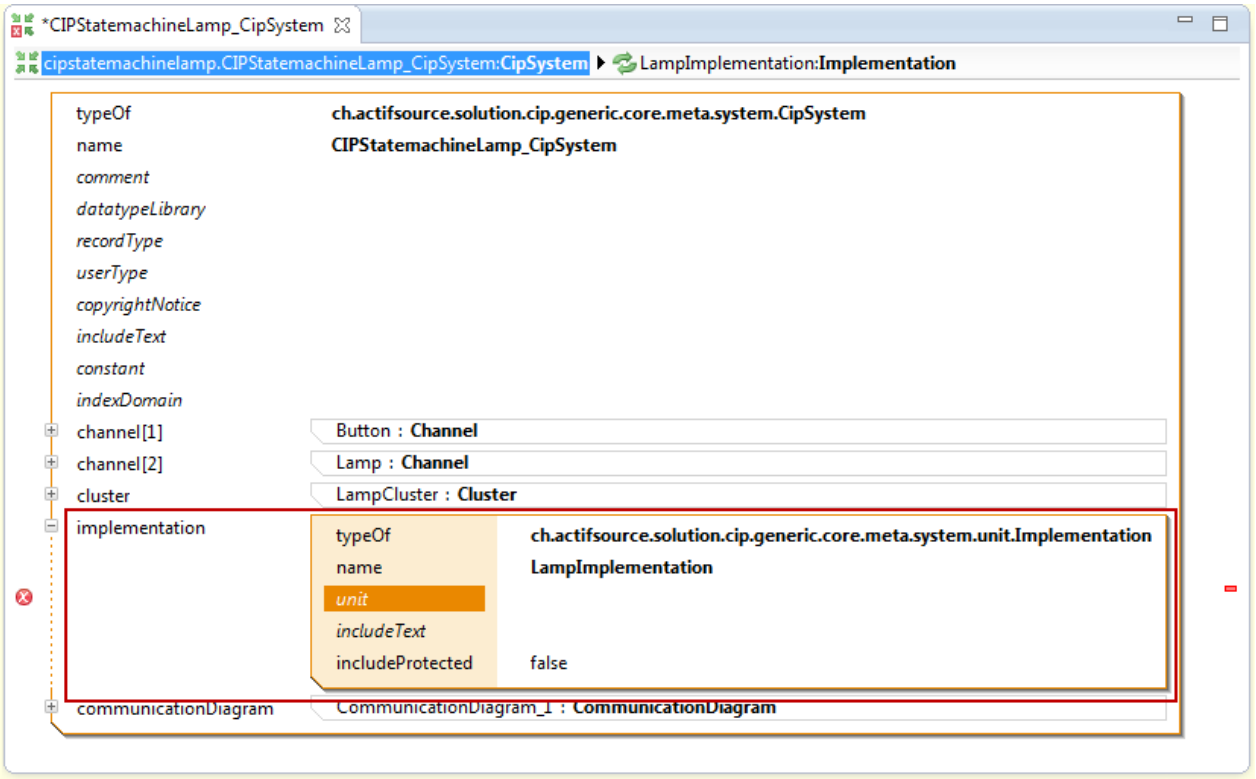
- Start Timer in Transition #2
  - Ctrl-Click in label *Ext*
  - Select SET_TIMER
  - Specify DelayOperation (see next page)
- Stop Timer in Transition #4
  - Ctrl-Click in label *Ext*
  - Select STOP_TIMER



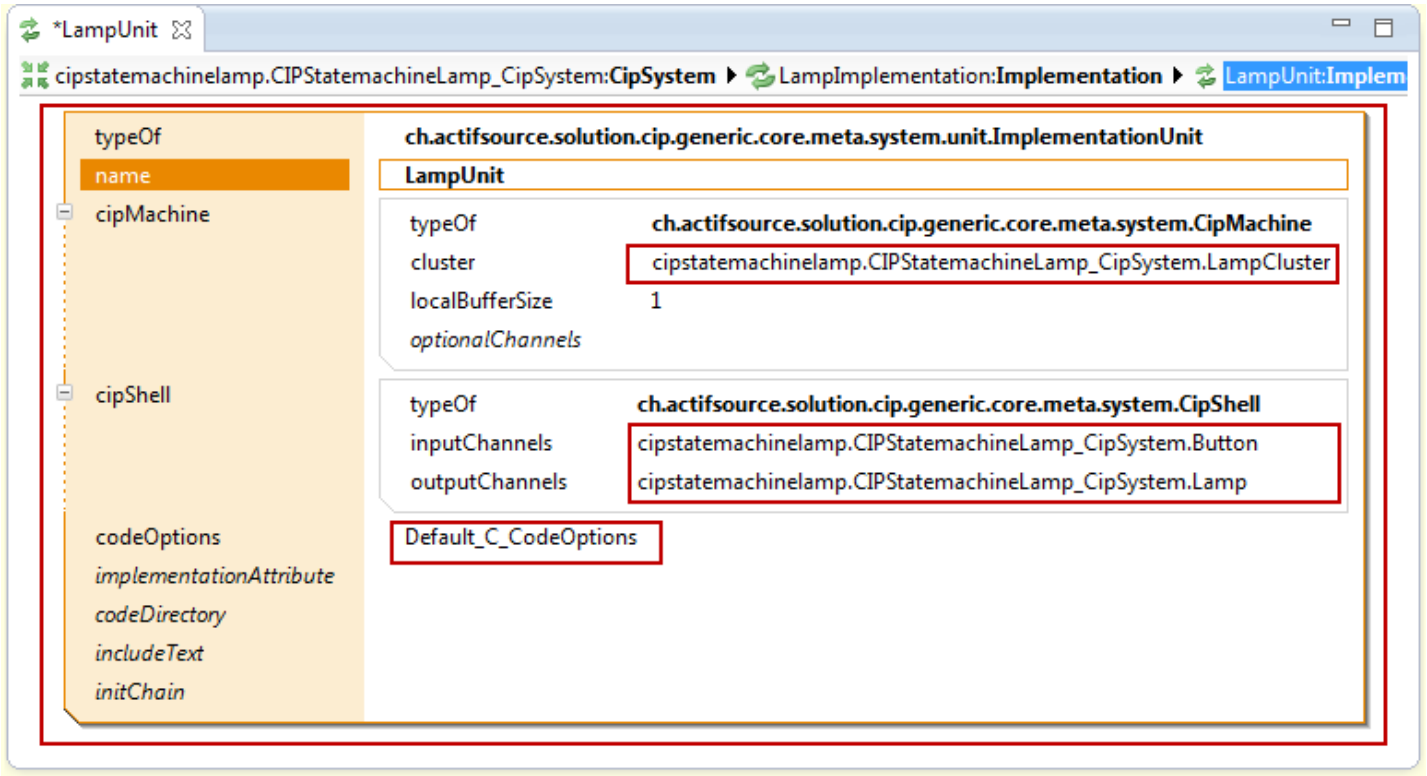
- Create a SetTimer_DelayText
- The DelayText shall return the delay in system ticks

Part IV: Generating State Machine Code

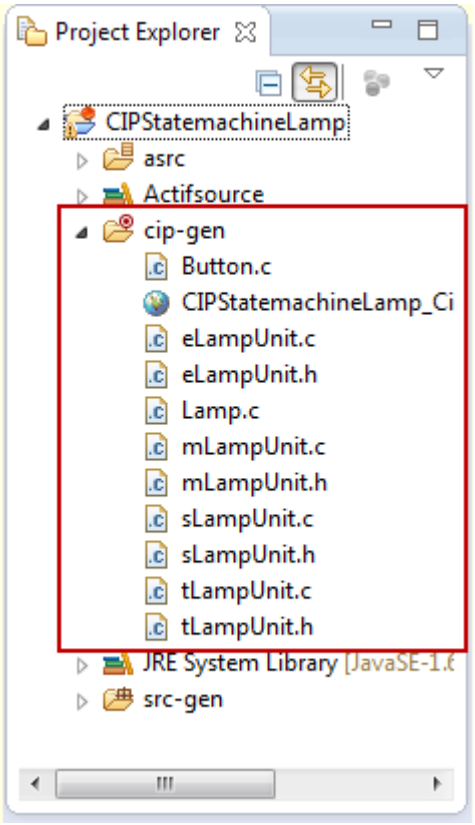
- We have to define the details for the state machine implementation to generate the code



- Create a new *Implementation* for **System** System1
  - On the *System View* Right-Click on System1
  - Create a new Implementation



- Create a new *Implementation* as shown above



- ⓘ Find the generated code in the folder *cip-gen*
- ⓘ Find the documentation (html) code in the folder *cip-gen*