Design, Monitoring and Operation of

Adaptive Networked Embedded Systems

D4.4 Implementation of ANES Tool Chain:

SW Prototype and User Manual

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Abstract (for dissemination)	This document describes the implementation and usage of the ANES tool chain. The document gives installation instructions on the tool chain. Nowadays almost everything can be downloaded from the tool vendor's site, so the document includes lot of URL links to help installation process. In addition, information on how to use DEMANES Design modelling language is provided. The aim of this section is to give an initial comprehension on the DEMANES modelling. The full details of the DEMANES modelling language is out of the scope of this document. However, full details are available in the deliverable of its own. The ANES tool chain is constructed using Open Source based and Commercially available tools. The data exchange between these tools is based on files. These files are using DEMANES XML format. The special generators are used to generate these files. Further, some parts of the application source code can be generated. The information on both generators is included.
Keywords	DEMANES, ANES Tool Chain, User Manual, DEMANES Design process

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Executive summary

This deliverable is the user manual of the ANES tool chain developed in DEMANES project. The user manual provides information on what kind of tools is included, how they interact, how to install and how to use the tool chain.

The tool chain includes tools for modelling and simulating, but fully detailed description is out of the scope of this user manual, as these are techniques of their own field.

The tools belonging to the tool chain are available on commercial or the open source basis. All tools have comprehensive documentation available. Thus there is no need to repeat everything. As a result, the main purpose of this user manual is to show a tool chain user where to download tools and how to get started. An overview of all tools proposed to the ANES tool chain is given in deliverable D4.2.

The main target audience of this user manual are developers, technical support and people who are interested in using or are planned to use the DEMANES design process in their software development.

The ANES tool chain is supporting all DEMANES design phases. The interoperability of the tools that belongs the tool chain is based on DEMANES XML files. This solution enables to change a single tool if needed providing that DEMANES XML file support is available. In addition, the solution makes possible to add more tools in the ANES tool chain later and offer an alternative for a user. Thus a tool network can be constructed. As a result a flexible tool chain is available for developing reconfigurable and adaptive applications.

ABBREVIATIONS

Term	Meaning
ADT	Android Development Tools
API	Application Program Interface
CPU	Central Processing Unit
COTS	Commercial off-the-shelf
GCC	GNU Compiler Collection
GCJ	GNU Compiler for Java
GNU	GNU’s Not Unix! (Unix like operating system developed in GNU project)
HTTPS	Hypertext Transfer Protocol Secure
IAR	IAR Systems (A Swedish company)
IP	Internet Protocol
IDE	Integrated Development Environment
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
Java VM	Java Virtual Machine
JDK	Java Development Kit
JIP API	Jennet-IP API
JRE	java runtime environment
JVM	Java Virtual Machine
NXP	NXP Semiconductors N.V.
OS	Operating System
OTAP	Over the air programming
RCS	Revision Control System
SDK	Software Development Kit
TI	Texas Instruments
UI	User Interface
UML	Unified Modeling Language
URL	Uniform Resource Locator
USB	Universal Serial Bus
VCS	Version Control System
XML	Extensible Markup Language
6LoWPAN	IPv6 over Low Power Wireless Personal Area Networks
7-zip	Open Source file compression/decompression software

1. Introduction

This document is the user manual of the ANES tool chain. The main parts of the tool chain are constructed by using commercially available and open source based tools. In addition, generators to enable data exchange from tool to a next tool in the tool chain are provided with 3rd party tools. The tool chain supports DEMANES design process developed in DEMANES project.

This document provides instructions on how to get tools and install them, how to create models using DEMANES modelling language. As tool installation procedures and versions can change in a time, the instructions on installation are general in nature and a reader of this document is assumed to get up to date information at the moment of installation using links provided in this document and search engines In addition, information on how to use DEMANES modelling language embedded in Papyrus and MetaEdit+ tools is included.

The main target audience of this user manual are developers how want to produce adaptive and reconfigurable distributed applications using a variety of sensors and mobile devices. Also, people who are interested in technology providing these features or are planning to adopt DEMANES design process, can find this document useful. This user manual provides information on the structure and usage of the ANES tool chain to a technical support people, who need to execute the installation procedure to get ANES tool chain up and working or need to know what kind of support developers using ANES tool chain could need.

2. ANES Tool Chain Components

The tool chain is presented in Figure 1.

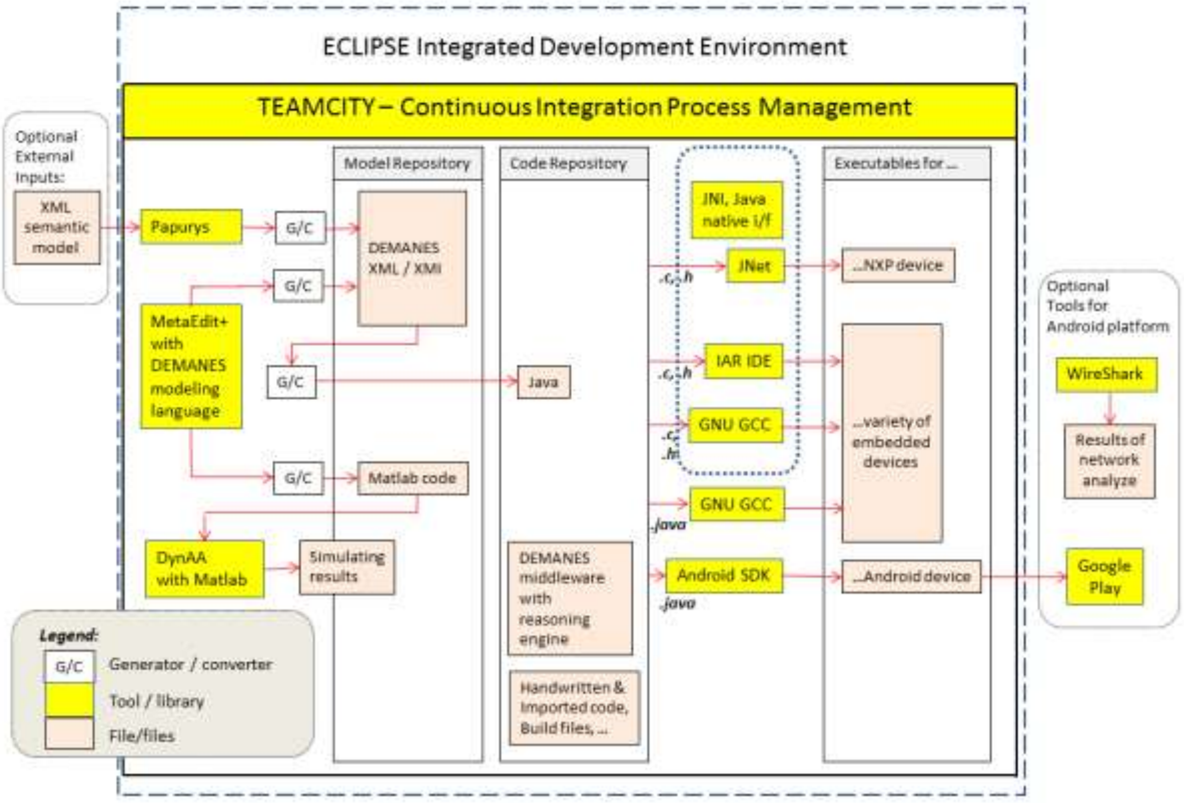

ECLIPSE Integrated Development Environment
TEAMCITY – Continuous Integration Process Management
Optional External Inputs:
XML semantic model
Papurys
G/C
Model Repository
DEMANES XML / XMI
Code Repository
JNI, Java native i/f
JNet
Executables for ...
...NXP device
MetaEdit+ with DEMANES modeling language
Java
IAR IDE
GNU GCC
...variety of embedded devices
Matlab code
DynAA with Matlab
Simulating results
DEMANES middleware with reasoning engine
Handwritten & imported code, Build files, ...
Android SDK
...Android device
Optional Tools for Android platform
WireShark
Results of network analyze
Google Play
.c, .h
.java
Legend:
Generator / converter
Tool / library
File/files

Figure 1: Construction of ANES tool chain.

The ANES tool chain is composed on the number of tools, which are integrated together by using file based data exchange. The ANES tool chain supports DEMANES development process by providing tools for each phase of the process.

2.1. Modelling and Simulation

Papyrus and MetaEdit+ are tools for the modelling phase. The modelling is based on modeling language that is normally used with these tools, but in addition, a DEMANES specific modelling language extension is included in the tools for providing the modelling of adaptivity and reconfiguration functionalities.

The DEMANES specific XML file is used to bring design for Java source code generation. Both Papyrus and MetaEdit+ are using generators of their own to output a DEMANES XML file. That file is used to further on to generate the source code.

MetaEdit+ can also be used to generate Matlab code for simulating purposes. DynAA with Matlab is used for simulation. Simulation allows system designers e.g. to test design using a variety of devices and configurations to validate the design.

2.2. APPLICATION IMPLEMENTATION AND DELIVERY

The code generation is not providing the complete source code of application. in addition to generated Java code, handwritten and imported source code is needed as well as DEMANES middleware. The middleware contain functionalities e.g. for adaptivity and reconfiguration. The aim of the middleware is to speed up and simplify an application development. The middleware includes a reasoning engine and but, depending on an application domain, different reasoning engines must be used.

The C, C++ and Java programming languages can be used to implement DEMANES applications. If C is used, then Java Native Interface (JNI) must be used to access DEMANES middleware. If Java is used, then there are no extra requirements for using DEMANES middleware. In addition to run DEMANES middleware, JAVA VM is needed.

Optionally, when development is targeted to Android devices, WireShark and Google Play can be used for the network analyze and delivering applications.

2.3. PROCESS MANAGEMENT

TeamCity can be used to aid the whole DEMANES design process. The tool helps to maintain Continuous Integration Process Management on software development. Activities needed in developing can be triggered and set up for automatic tasks, thus saving time and increasing the process quality. TeamCity is used to invoke tools in the ANES tool chain and thus it acts as a wrapper for the tools.

All tools, except optional Android tools, can be set up to run under Eclipse integrated development environment (IDE). They are installed using Eclipse plugins.

3. ANES Tool Chain Installation

This chapter is to provide information on where to find, purchase and download tools belonging to ANES tool chain. The chapter is divided into two main sections, the one for the Open Source based tools and the other one commercially available COTS tools. As DEMANES project is not producing the whole tool chain but rather relies the number of 3rd party tools, these installation instructions are general in nature. Things will change in a time. Thus there is information on the tool manufacturer's websites and how to get license at the time of writing included in this chapter.

3.1. OPEN SOURCE TOOLS

3.1.1. Installation of 6LoWPAN

In order to create firmware for embedded devices with wireless capabilities (concretely for 6LoWPAN technology), the stack library is required. Manufactures provide a set of libraries containing these libraries, examples and tools. Some of the options available in the market are listed below:

NXP Semiconductors: Jennet

Application firmware is developed in ‘C’ using the industry standard license free Eclipse IDE and NXP's GNU based C/C++ tool chain.

NXP provides an executable file, which includes:

- JENNET

JenNet provides a “mesh-under” networking approach, offering a self-healing, self-forming, scalable and robust networking layer, supporting the 6LoWPAN, IP and UDP technologies.

- JIP API

The JIP API provides an easy-to-use, table-orientated method for communicating between IP-based devices both inside and outside the wireless network
The JIP API is based on the SNMP model and so supports SET/GET commands to configure MIB settings, as well as a TRAP primitive to report status events and conditions.

- FLASH PROGRAMMER

Tool used to download the firmware image to the device.

Texas Instruments:

CC2530 from Texas Instruments (TI), has a port (https://github.com/g-oikonomou/contiki-sensinode) [1], where we can find the 6LoWPAN implementation for TI chip. To develop firmware, IAR Embedded Workbench for 8051 should be used. In order to create and download the firmware image, we need the following tools:

- INSTANT CONTIKI 2.5:

http://sourceforge.net/projects/contiki/files/Instant%20Contiki/Instant%20Contiki%202.5/ [2]

The operating system for embedded devices, which provides powerful low-power Internet communication. Contiki supports fully standard IPv6 and IPv4, along with the recent low-power wireless standards: 6lowpan, RPL, CoAP. With Contiki's ContikiMAC and sleepy routers, even wireless routers can be battery-operated.

- SDCC 3.0.3 SMALL DEVICE C COMPILER SUITE

http://sdcc.sourceforge.net/snap.php [3]

Libraries required to compile Contiki OS.

- SMART RF FLASH PROGRAMMER

http://www.ti.com/tool/flas-programmer [4]

Tool from Texas Instruments, necessary to download the image to devices, if not OTAP is allowed.

- USB FIRMWARE LIBRARY

Set of functionalities to communicate with dongle devices, in order to configure and use the USB channel.

- Texas Instrument PACKET SNIFFER (OPTIONAL)

http://www.ti.com/tool/packet-sniffer [5]

Tool from TI used to capture message traffic on channel. It's very useful on development stage, or to observe the packets exchanges.

3.1.2. Installation of GNU GCC

Due the platform where the firmware will run is different that the platform where is developed, we need a tool able to generate code from for example 8051 architecture in x32 or x64 platform. Options available in the market are:

NXP Semiconductors:
The jennet executable file provided by NXP, contains GNU-based tool chain - C compiler.

Texas Instruments:

The compiler is provided by IAR environment, which generates code from the 8051 architecture.

3.1.3. Installation of Android SDK

Android SDK is installed as an Eclipse Plugin. The Eclipse installation must be Eclipse Kepler SR2 to permit the installations of Papyrus 0.10.2, MARTE 1.1, View and Stylesheet compatible Download "Eclipse Modeling Kepler SR2" (.zip) bundle from [https://www.eclipse.org/downloads/]. [6]

Install Eclipse with subsequent instructions: Installing Eclipse is relatively easy, but does involve a few steps and software from at least two different sources. Eclipse is a Java-based application and, as such, requires a Java runtime environment (JRE) in order to run.

3.1.3.1 Install a JVM

Regardless of your operating system, you will need to install some Java virtual machine (JVM). You may either install a Java Runtime Environment (JRE), or a Java Development Kit (JDK), depending on what you want to do with Eclipse. If you intend to use Eclipse for Java development, then you should install a JDK (the JDK includes--among other useful things--the source code for the standard Java libraries). If you aren't planning to use Eclipse for Java development and want to save some disk space, install a JRE.

If you are using Windows, you may already have a JRE installed, but upgrading won't hurt.
If using Linux, read this:

- GCJ will NOT work.
- Also see: Installing JRE 1.6.0 (Update x) as the Default Runtime in Linux.

3.1.3.2 JRE/JDK Sources

There are several sources for a JRE/JDK. Here are some of the more common/popular ones (listed alphabetically):

- IBM JDK
  http://www.ibm.com/developerworks/java/jdk/ [7]

- OpenJDK
  http://openjdk.java.net/ [8]

- Oracle JDK
  http://www.oracle.com/technetwork/java/javase/downloads/ [9]

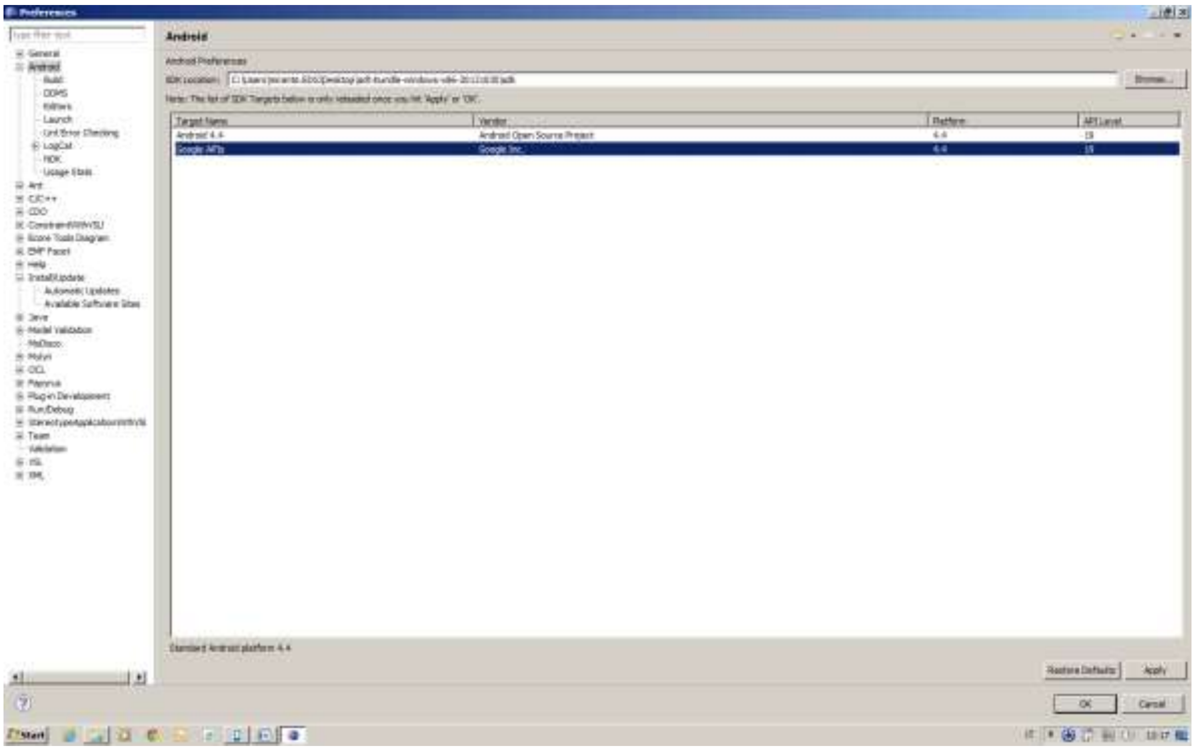
- Eclipse 4.3 (Kepler)
  https://www.eclipse.org/downloads/index-developer.php?release=kepler [10]

Eclipse 4.3 (Kepler) was released in June 2013. A Java 6 JRE/JDK is recommended for Eclipse 4.3. More information concerning tested configurations for Eclipse 4.3 is provided here:

- Download Eclipse from the Eclipse Downloads Page (See, link above).
- The download will be delivered as a compressed (i.e. a ".zip", or ".tar.gz") file. Decompress this file into the directory of your choice (e.g. "c:\Program Files\Eclipse" on Windows). You can optionally create a shortcut of the executable file ("eclipse.exe" on Windows, or "eclipse" on Linux).

Note that there is a known problem with the built-in decompression utility on all current versions of Windows. We recommend that you use a more robust decompression utility such as the open source 7-zip when decompressing an Eclipse download. Some people report success when initially decompressing Eclipse into a root directory (e.g. c:\) and then moving it to a more appropriate home (e.g. c:\Program Files\Eclipse).

To install Android SDK, we must extend Eclipse. Use the *Help > Install new software...* menu option to add Kepler features to your Eclipse installation (you can, for example, use this option to add C/C++ development support.



Android

Android Preferences

SDK Location: [illegible]

Note: The list of SDK Targets below is only reloaded once you hit 'Apply' or 'OK'.

Target Name	Vendor	Platform	API Level
Android 4.4	Android Open Source Project	4.4	19
Google APIs	Google Inc.	4.4	19

Standard Android platform 4.4

Figure 2: Android Preferences dialog

3.1.3.3 ADT SDK Plugin

Android offers a custom plugin for the Eclipse IDE, called Android Development Tools (ADT). This plugin provides a powerful, integrated environment in which to develop Android applications. It extends the capabilities of Eclipse to let you quickly set up new Android projects, build an application UI, debug your application, and export signed (or unsigned) application packages (APKs) for distribution.

- Download the ADT Plugin
- Start Eclipse, then select *Help > Install New Software*.
- Click Add, in the top-right corner.

- In the Add Repository dialog that appears, enter "ADT Plugin" for the *Name* and the following URL for the *Location*: https://dl-ssl.google.com/android/eclipse/ [11].

  Note: The Android Developer Tools update site requires a secure connection. Make sure the update site URL you enter starts with HTTPS.

- Click OK.
- In the Available Software dialog, select the checkbox next to Developer Tools and click *Next*.
- In the next window, you will see a list of the tools to be downloaded. Click *Next*.
- Read and accept the license agreements, then click *Finish*.
- If you get a security warning saying that the authenticity or validity of the software can't be established, click OK.
- When the installation completes, restart Eclipse and Configure the ADT.

3.1.3.4 Configure the ADT Plugin

Once Eclipse restarts, you must specify the location of your Android SDK directory:

- In the "*Welcome to Android Development*" window that appears, select *Use existing SDKs*.
- Browse and select the location of the Android SDK directory you recently downloaded and unpacked.
- Click Next.
- Your Eclipse IDE is now set up to develop Android applications, but you need to add the latest SDK platform tools and an Android platform to your environment. To get these packages for your SDK, continue to *Adding Platforms and Packages*.

3.1.3.5 Install the Google Play Services SDK

To install the Google Play services SDK for development:

- Launch the SDK Manager in one of the following ways: in Eclipse (with ADT), select *Window > Android SDK Manager* or double-click the SDK Manager.exe file at the root of the Android SDK directory.
- Install the Google Play services SDK.
- Scroll to the bottom of the package list, expand *Extras*, select *Google Play services*, and install it. The Google Play services SDK is saved in your Android SDK environment at *<android-sdk>/extras/google/google_play_services/*.

  Note: Google Play services 4.0.30 (released November 2013) and newer versions require Android 2.3 or higher. If your application supports Android 2.2, you can continue development with the Google Play services SDK, but must instead install Google Play services for Froyo from the SDK Manager.

- Using Eclipse, import the library project into your workspace. *Click File* > *Import*, select *Android* > *Existing Android Code* into Workspace, and browse to the copy of the library project to import it.

3.1.4. Installation of Wireshark

Wireshark is Open Source network packet analyzer used for network troubleshooting, network analysis, software and communications protocol development. Wireshark allows the user to see all network interface traffic visible in Graphical User Interface and analyze network packets. Wireshark provide releases for Windows, OS X and Linux platforms. Wireshark also provide source code for developing the user's own modified version of packet capture tool. Wireshark installation packages and source codes can be downloaded from Wireshark website (http://wireshark.org/) [12].

3.2. COTS TOOLS

3.2.1. Installation of IAR tools

IAR tools are available from IAR Systems AB (headquarters in Sweden). There are a variety of different type licenses available such as Stand alone, Mobile, Network and Global. Stand alone licence is assigned to a single PC whereas Mobile licence is assigned to dongle and can be used with multiple computers by a single developer. Network and Global licences are for teams and difference between these licenses is the number of sites where license can be used. Details of different licences are available from the company's web site (http://www.iar.com) [13].

IAR Systems is using a portal called My Pages, where customers download and manage their licences. It is possible to download 30 days trial licence and then purchase to actual licence for a quick start. Instruction on how to install software is available On Line.

3.2.2. Installation of Papyrus

This paragraph describes how to install and configure Papyrus so that can be used to design DEMANES systems by using UML models with the DEMANES UML Profile. The instructions assume a basic knowledge of the Eclipse IDE environment usage.

3.3.2.1 Prerequisites for Papyrus installation

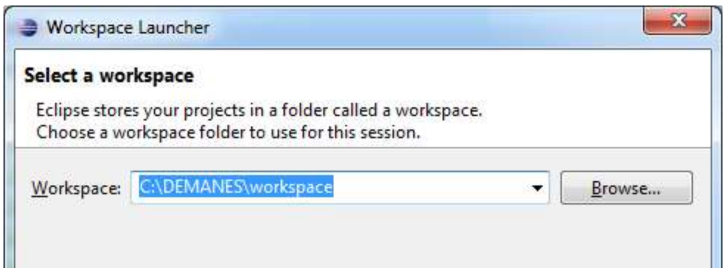
- Any Operating System supported by the Eclipse IDE must be installed before installing Papyrus. The instructions are relative to installing on a Windows, but they can be easily adapted to install Papyrus also on Linux or Mac platforms;
- Java Runtime Environment version 7 update 55 or better must be installed before installing Papyrus. JRE is available from www.java.com [14], installed on the workstation (This is actually an Eclipse IDE prerequisite). See 3.1.3.2 for more details;

3.3.2.2 Components to install

- Package "Eclipse Modeling Tools", version Kepler-SR2 (packaged distribution downloadable from https://www.eclipse.org/downloads/ [15], e.g. eclipse-modeling-kepler-SR2-win32-x86_64.zip).
- Eclipse "Papyrus 0.10.2" modeling component, installable from within Eclipse Modeling tools;
- UML Profile "MARTE 1.1", installable from within Papyrus tool;
- Papyrus "View Stylesheet" extension, installable from within Papyrus tool;
- UML Profile "DEMANES 0.0.30", com.akhela.demanes.uml.profile-0.0.30.zip, **available from DEMANES SVN repository**;
- DEMANES Palette plug-in 1.0, com.akhela.demanes.papyrus.palette_1.0.0.201404160951.jar, **available from DEMANES SVN repository**.

3.3.2.3 Install Papyrus

1. Download the "Eclipse Modeling Kepler SR2" package archive from Eclipse download site. Take care to choose the binary version (32/64 bits) that matches the one of the Java runtime environment installed on the target workstation.
2. Extract the archive contents on local disk, say to C:/DEMANES (but any folder you like can be used instead). Archive contents will be produced under the folder C:/DEMANES /eclipse;
3. Execute (double click) the file C:/DEMANES/eclipse/eclipse.exe
4. Choose a workspace location for your IDE, e.g. C:/DEMANES /workspace:


Workspace Launcher

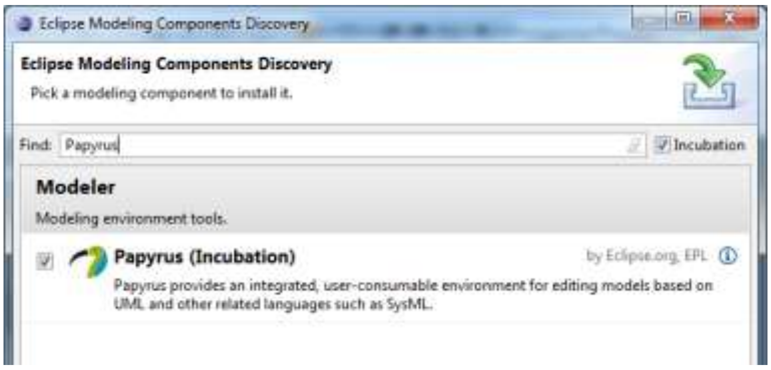
Select a workspace

Eclipse stores your projects in a folder called a workspace.
Choose a workspace folder to use for this session.

Workspace: C:\DEMANES\workspace

Figure 3 : The workspace selection dialog in Papyrus

5. On the IDE Welcome screen, select [*Option Help-->Install Modelling Components*]
6. In the following "*Eclipse Modelling Component Discovery*" window, select the Papyrus component then click on "*Finish*" button


Eclipse Modeling Components Discovery

Eclipse Modeling Components Discovery
Pick a modeling component to install it.

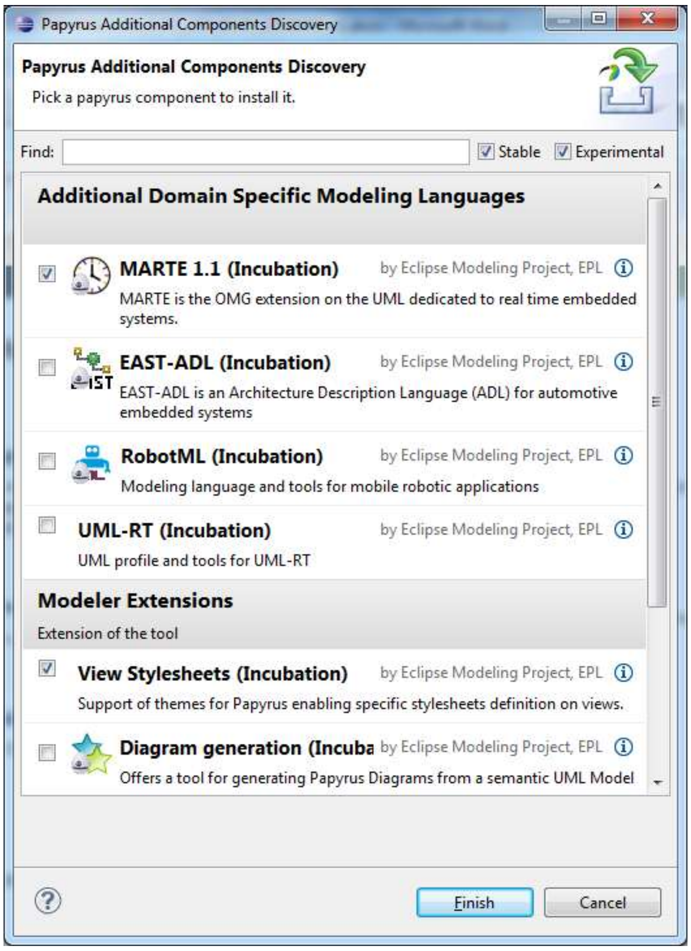
Find: Papyrus [✓ Incubation]

Modeler
Modeling environment tools.

[✓] Papyrus (Incubation) by Eclipse.org, EPL
Papyrus provides an integrated, user-consumable environment for editing models based on UML and other related languages such as SysML.

Figure 4: Eclipse Modeling Component Discovery window

7. Follow (*Next, Next, Finish*) the subsequent Installation wizard, always accepting the default options and finally accepting the license terms, when requested. Then wait for installation to complete
8. Accept restart of Eclipse, then, on the new IDE Welcome screen, select *Option [Help-->Install Papyrus Additional Components]*
9. In the following "*Papyrus Additional Component Discovery*" window, select "*MARTE 1.1*" and "*View Stylesheets*" components:


Papyrus Additional Components Discovery

Papyrus Additional Components Discovery
Pick a papyrus component to install it.

Find: [✓ Stable] [✓ Experimental]

Additional Domain Specific Modeling Languages

[✓] MARTE 1.1 (Incubation) by Eclipse Modeling Project, EPL
MARTE is the OMG extension on the UML dedicated to real time embedded systems.

[ ] EAST-ADL (Incubation) by Eclipse Modeling Project, EPL
EAST-ADL is an Architecture Description Language (ADL) for automotive embedded systems

[ ] RobotML (Incubation) by Eclipse Modeling Project, EPL
Modeling language and tools for mobile robotic applications

[ ] UML-RT (Incubation) by Eclipse Modeling Project, EPL
UML profile and tools for UML-RT

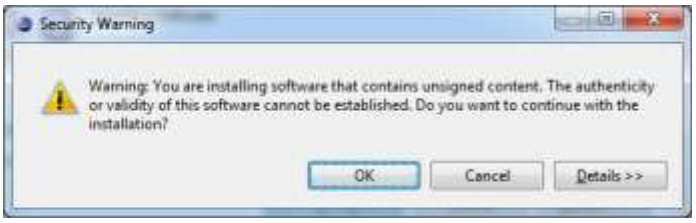
Modeler Extensions
Extension of the tool

[✓] View Stylesheets (Incubation) by Eclipse Modeling Project, EPL
Support of themes for Papyrus enabling specific stylesheets definition on views.

[ ] Diagram generation (Incuba by Eclipse Modeling Project, EPL
Offers a tool for generating Papyrus Diagrams from a semantic UML Model

Figure 5: Additional Components Discovery window in Papyrus

10. Follow again (*Next, Next, Finish*) the installation wizard, always accept the default options and finally accept the license terms. When requested, accept the installation of unsigned content.



Warning: You are installing software that contains unsigned content. The authenticity or validity of this software cannot be established. Do you want to continue with the installation?

Figure 6: Security Warning Dialog for unsigned content

11. Accept restart of Eclipse
12. Now the IDE installation is ready to use Papyrus Tool and MARTE Profile

3.3.2.4 Install DEMANES Plugin on Papyrus

The DEMANES Modeling Palettes are provided as an Eclipse Plugin that should be installed on your IDE

1. Ensure Eclipse IDE is not running;
2. Copy the DEMANES plugin (com.akhela.demanes.papyrus.palette_1.0.0.201404160951.jar) [17] into the C:/DEMANES/eclipse/dropins/plugins folder (You should find that the dropins folder is already present under the Eclipse installation folder, but eventually you need to create the plugins folder).
3. The DEMANES plugin will be now available under your IDE at the next start

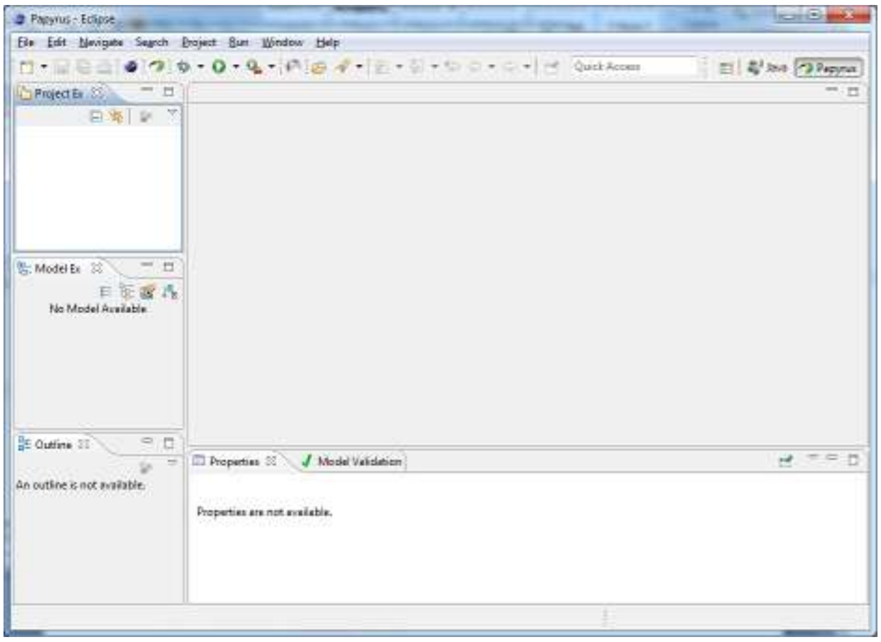
3.3.2.5 Install DEMANES UML Profile

The DEMANES UML Profile provides a mapping of the DEMANES Modelling Language into the context of UML modelling. This way it is possible to create UML models which use the same concepts available under the DEMANES ML, and can be translated to and from an equivalent model constructed with that language.

To be used under the Papyrus tool, the DEMANES UML Profile should be installed as a project under the same Papyrus workspace used to build the DEMANES design models

1. Start Eclipse IDE
2. Choose your workspace location

3. Go to IDE workbench and open the Papyrus perspective



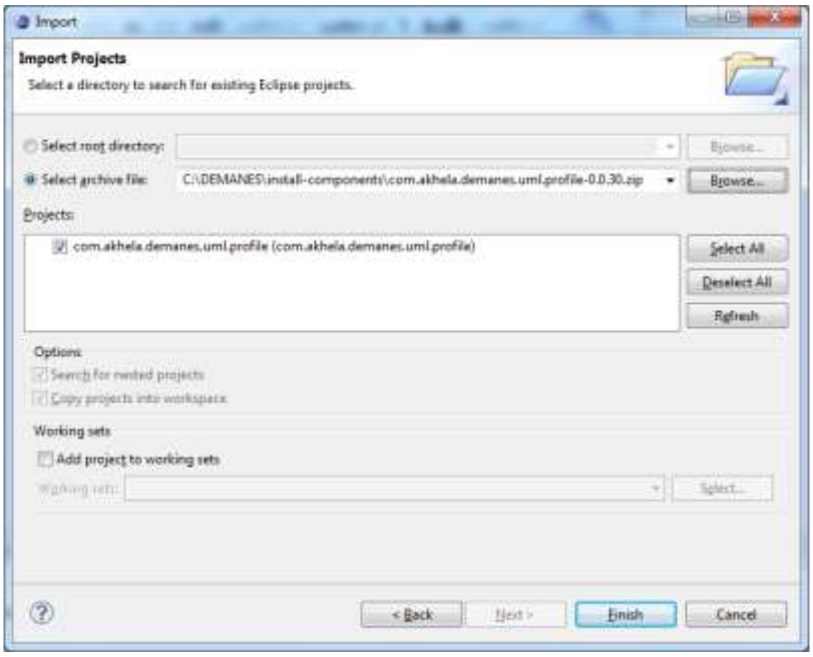
No Model Available.

An outline is not available.

Properties are not available.

Figure 7: The Papyrus perspective in Eclipse

4. From the Project Explorer, Select [*RightClick-->Import...*] option
5. In the "Import" window, choose [*General-->Existing Projects Into Workspace*] option, then [*Next*]
6. In the subsequent windows, choose the "Select archive file" option, specify the position of file [com.akhela.demanes.uml.profile-0.0.30.zip] and then choose to import the unique project contained



Import Projects

Select a directory to search for existing Eclipse projects.

Select root directory:

Select archive file: C:\DEMANES\install-components\com.akhela.demanes.uml.profile-0.0.30.zip

Projects:

☑ com.akhela.demanes.uml.profile (com.akhela.demanes.uml.profile)

Options

☑ Search for nested projects

☑ Copy projects into workspace

Working sets

☐ Add project to working sets

Working sets:

Figure 8: Project Import Dialog

7. Click [*Finish*] to complete the import. In the workspace, you can now find a Papyrus project named "*com.akhela.demanes.uml.profile*", containing two Papyrus models:
    a. **demanes.profile**: containing the DEMANES UML Profile definition;
    b. **demanes.samples**: containing several examples on how to use the DEMANES Profile to design DEMANES systems.

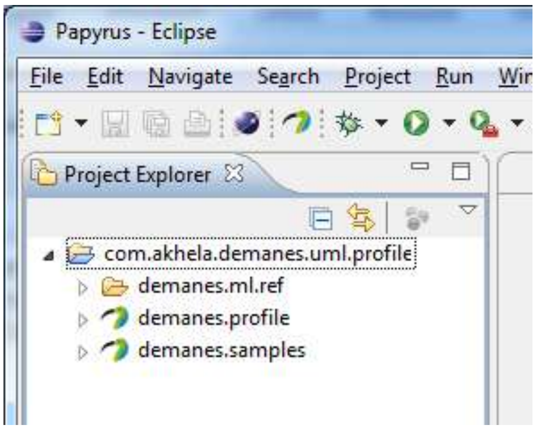


Figure 9: Model selection under com.akhela.demanes.uml.profile

8. The DEMANES Profile is now available to be used into your DEMANES system design models;

NOTE: In order to maintain compatibility and interoperability with the other DEMANES Tools, the contents of the **DEMANES UML Profile model should not be modified**.

3.3.2.6 Apply the DEMANES UML Profile to a UML Model

This chapter shows how to prepare a Papyrus UML Model to use the DEMANES UML Profile.

1. Start Eclipse IDE
2. Ensure you have the DEMANES UML Profile loaded into your workspace (see chapter above)
3. Create the Papyrus Project which will contain your DEMANES model(s)
4. [*File-->New-->Papyrus Project*]

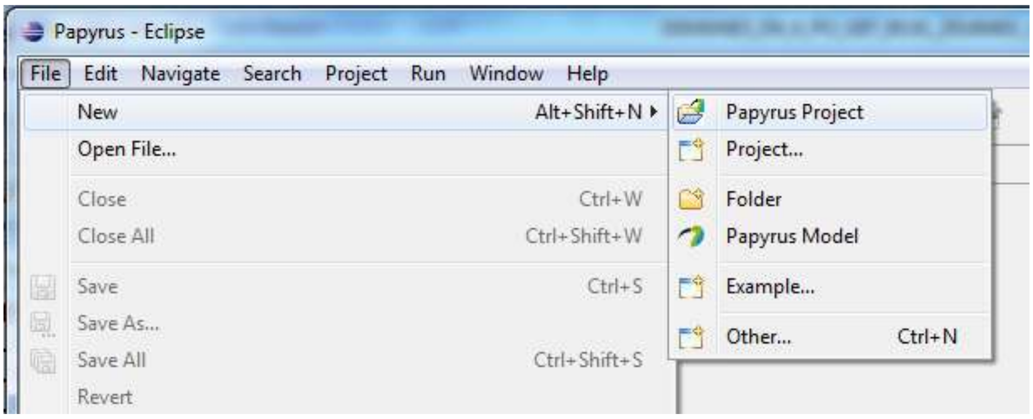


Figure 10: The start of the new project

5. In the next windows, choose the name for your project, then click [*Next*]
6. Select Diagram Language "*UML*"

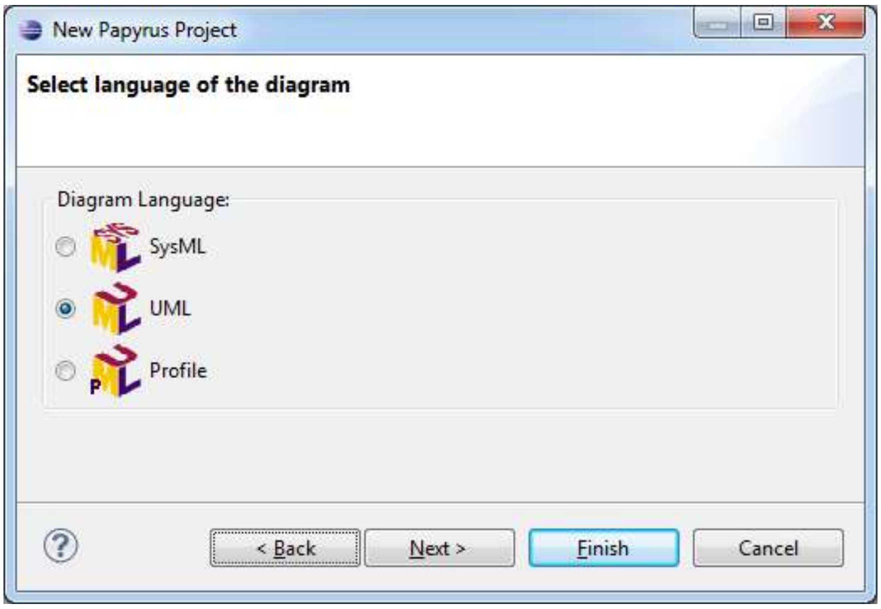


Diagram Language: SysML ( ) UML [✓] Profile ( )

Figure 11: Model Diagram language selection

7. Click [*Finish*]
8. The new project will appear under the workbench, containing an empty UML model "*model*"
9. Double click on the model to open it

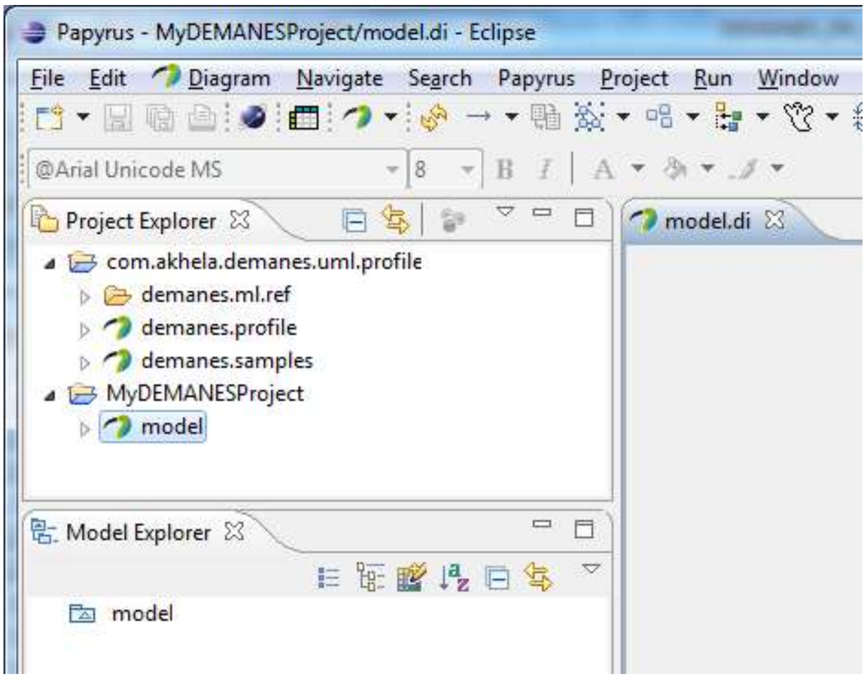

Papyrus - MyDEMANESProject/model.di - Eclipse
File Edit Diagram Navigate Search Papyrus Project Run Window
@Arial Unicode MS
8
Project Explorer
com.akhela.demanes.uml.profile
demanes.ml.ref
demanes.profile
demanes.samples
MyDEMANESProject
model
Model Explorer
model
model.di

Figure 12: The new model is visible in Project Explorer

10. In the "Model Explorer", click in the root model element to select it
11. In the model "Property" view (lower panel of the IDE), select the section "*Profile*"

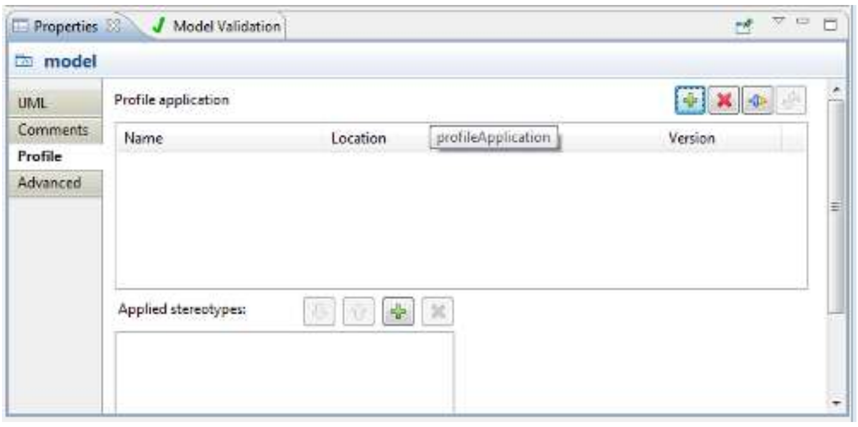


Figure 13: The Model Property view

12. Click in the button to apply a (local) profile to the model

13. In the "Apply Profile.." window, select the "*demanes.uml.profile*", and click , then [*OK*]

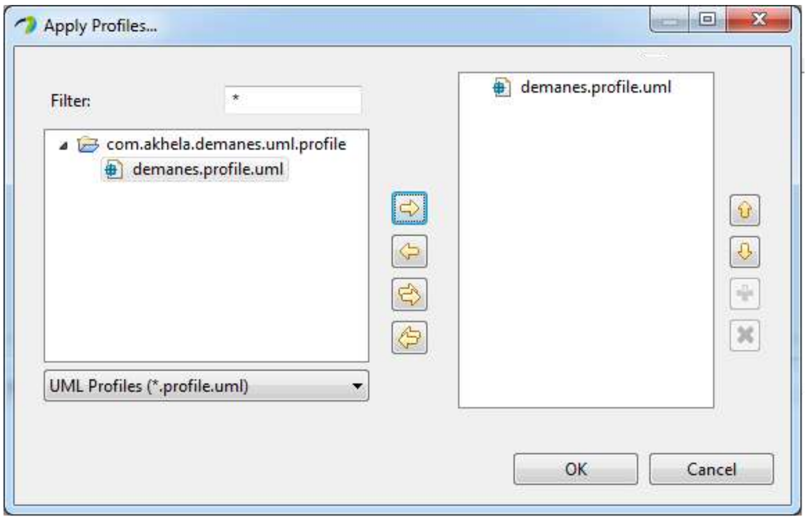
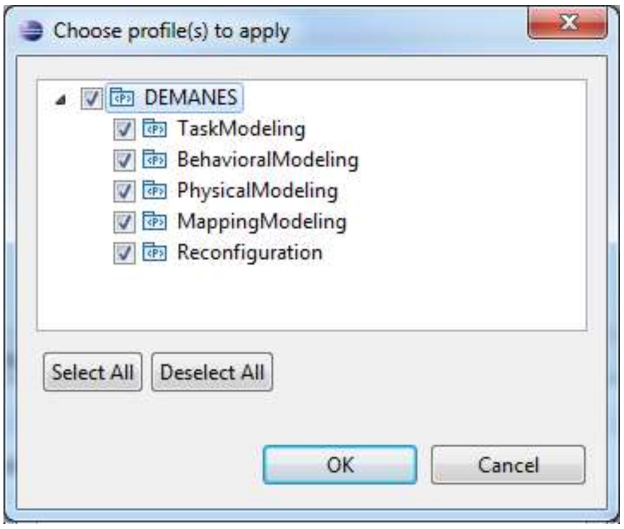


Figure 14: Apply Profile window

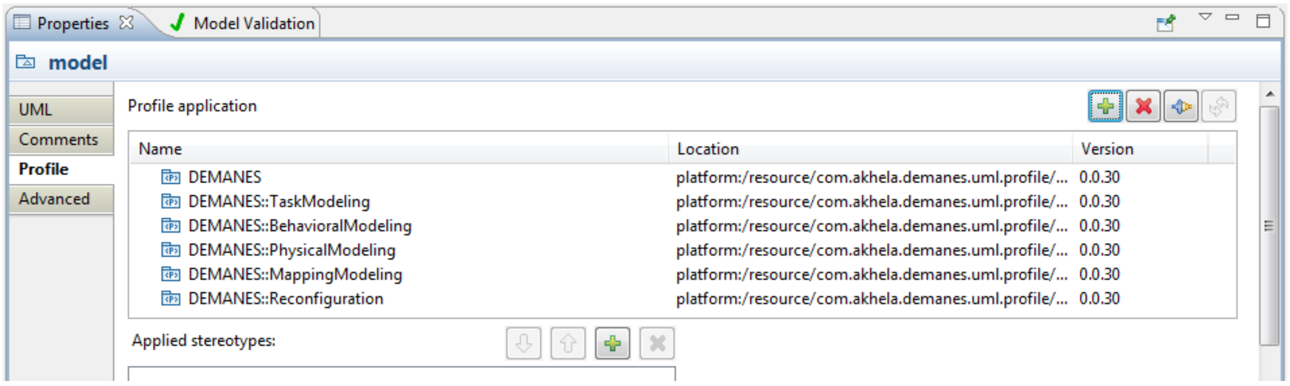
14. In the following "Choose profile(s) to apply" windows, select all the elements, then [*OK*]



- [✓] DEMANES
  - [✓] TaskModeling
  - [✓] BehavioralModeling
  - [✓] PhysicalModeling
  - [✓] MappingModeling
  - [✓] Reconfiguration

Figure 15: Choose Profile window

15. The applied profiles will appear in the "Profile application" section of the model "Property" window



Name	Location	Version
DEMANES	platform:/resource/com.akhela.demanes.uml.profile/...	0.0.30
DEMANES::TaskModeling	platform:/resource/com.akhela.demanes.uml.profile/...	0.0.30
DEMANES::BehavioralModeling	platform:/resource/com.akhela.demanes.uml.profile/...	0.0.30
DEMANES::PhysicalModeling	platform:/resource/com.akhela.demanes.uml.profile/...	0.0.30
DEMANES::MappingModeling	platform:/resource/com.akhela.demanes.uml.profile/...	0.0.30
DEMANES::Reconfiguration	platform:/resource/com.akhela.demanes.uml.profile/...	0.0.30

Figure 16: Model Property Window

16. Now you can use the DEMANES Profile in your model

3.3.2.7 DEMANES system modelling using DEMANES UML Profile

Once the DEMANES modelling palette is installed and the DEMANES Profiles applies to an UML model, the DEMANES specific tabs will appear within diagram palette, when an appropriate diagram is opened.

DEMANES specification models are mainly represented by means of "Composite Structure Diagrams". Modelling Language entities inside diagrams are represented by applying the appropriate stereotype to the base UML entities, depending on the specific model type is being specified (Task Model, Physical Model). The customized palettes help to build diagrams by drag & drop elements with the appropriate stereotype already applied.

3.3.2.7.1 Task Modelling

Task models are represented by mean of "Composite Structure Diagrams"

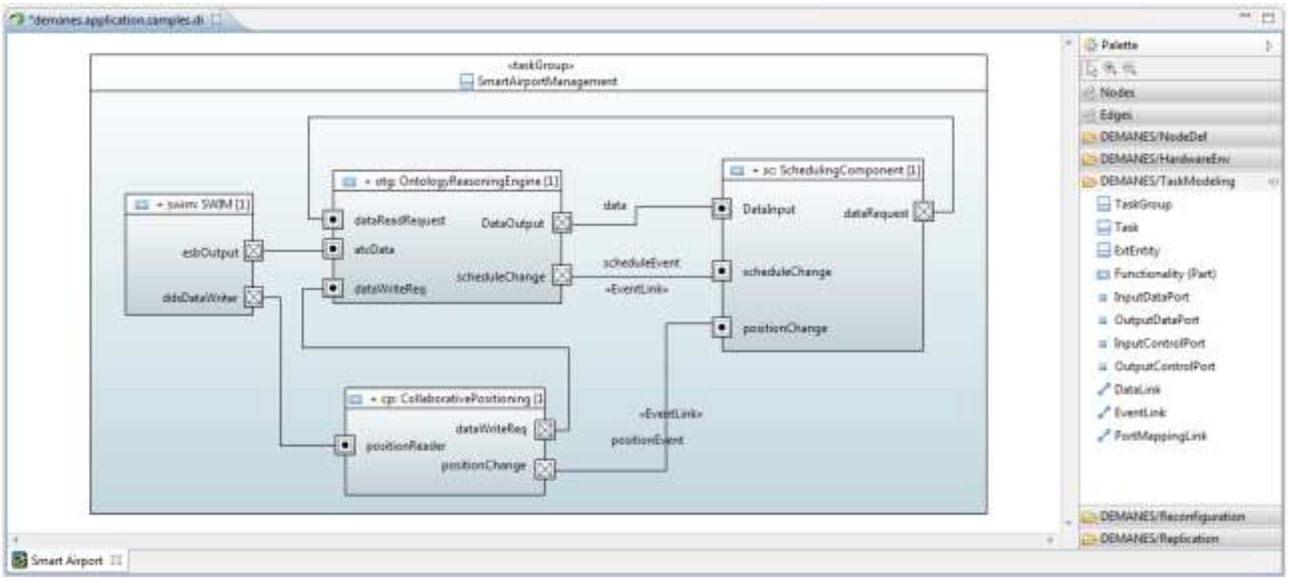


Figure 17: A sample of task group diagram

and a "Class Diagram" can help to specify the Task and TaskGroup (Classes) that will be used in the final Composite Structure Diagrams.

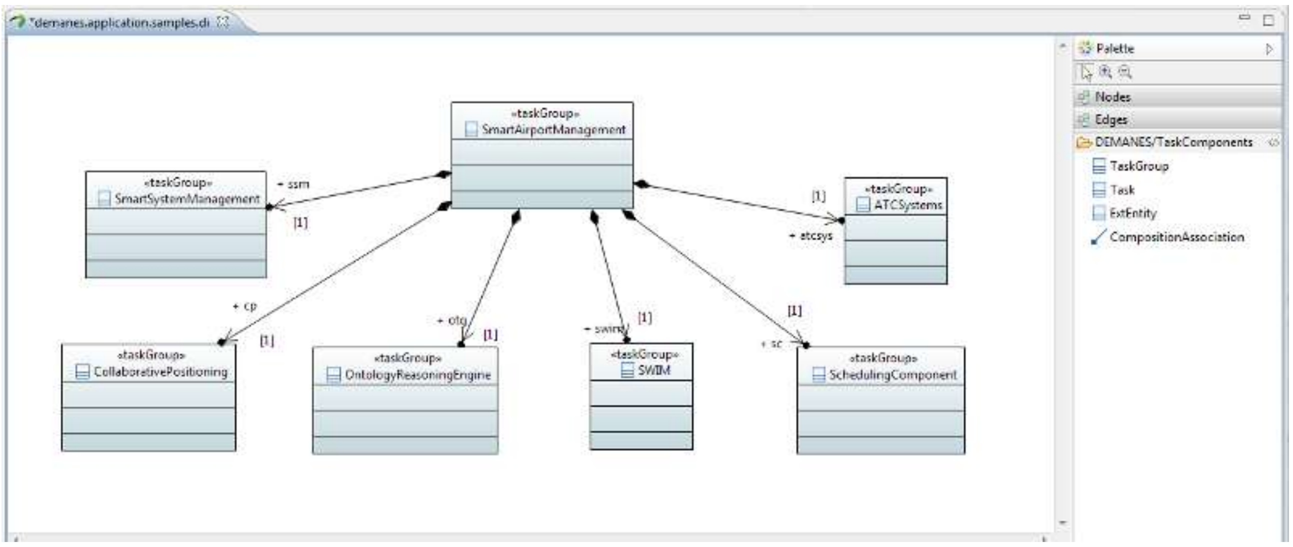

*demanes.application.samples.di
«taskGroup» SmartAirportManagement
«taskGroup» SmartSystemManagement
+ ssm
[1]
«taskGroup» ATCSystems
[1]
+ atcsys
+ cp
[1]
+ otg
[1]
+ swim
[1]
[1]
+ sc
«taskGroup» CollaborativePositioning
«taskGroup» OntologyReasoningEngine
«taskGroup» SWIM
«taskGroup» SchedulingComponent
Palette
Nodes
Edges
DEMANES/TaskComponents
TaskGroup
Task
ExtEntity
CompositionAssociation

Figure 18: A Sample of Class Diagram

3.3.2.7.2 Replication

Replication is represented by means of dedicated "*Replicator*" (applied to UML Parts) and "*ReplicationConstraint*" (applied to UML Constraints) stereotypes

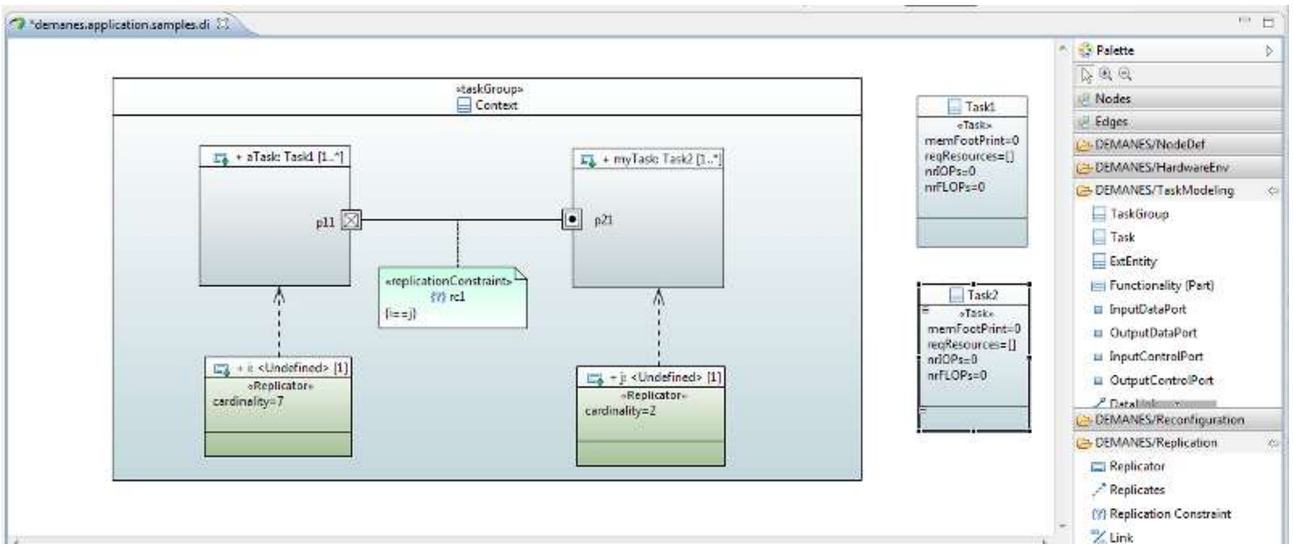


Figure 19: Representation of a replicator in a task group

3.3.2.7.3 Reconfiguration

Reconfiguration is represented by means of dedicated stereotypes applied to Ports (*ReconfIssuer* and *ReconfHandler*) and to PortLinks (*ReconfLink*):

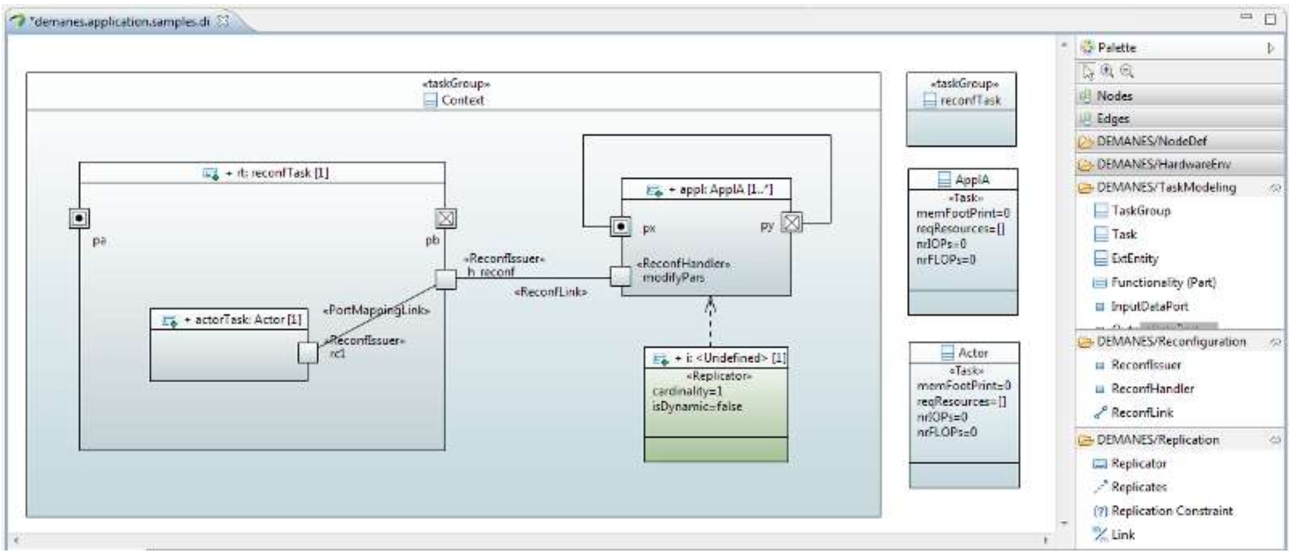


Figure 20: A representation of reconfiguration in a task group

3.3.2.7.4 Behaviour

Behaviour is specified by means of Activity Diagrams, by using appropriate stereotypes for activity states. The stereotype attributes allow also to specify interaction with containing Task Ports

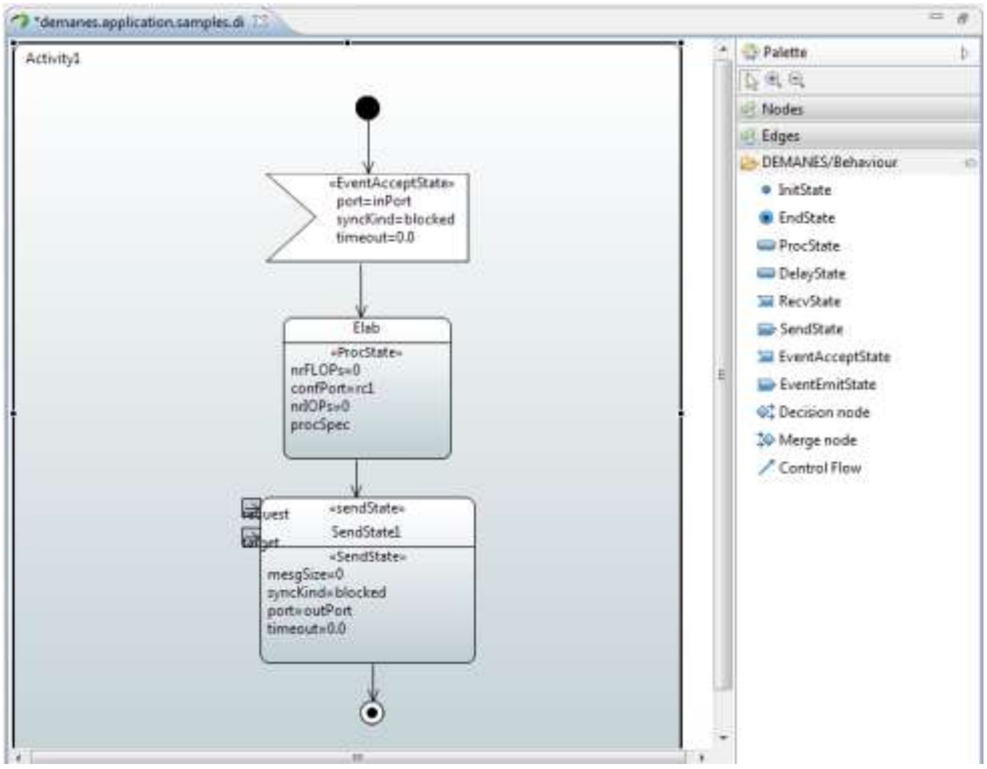
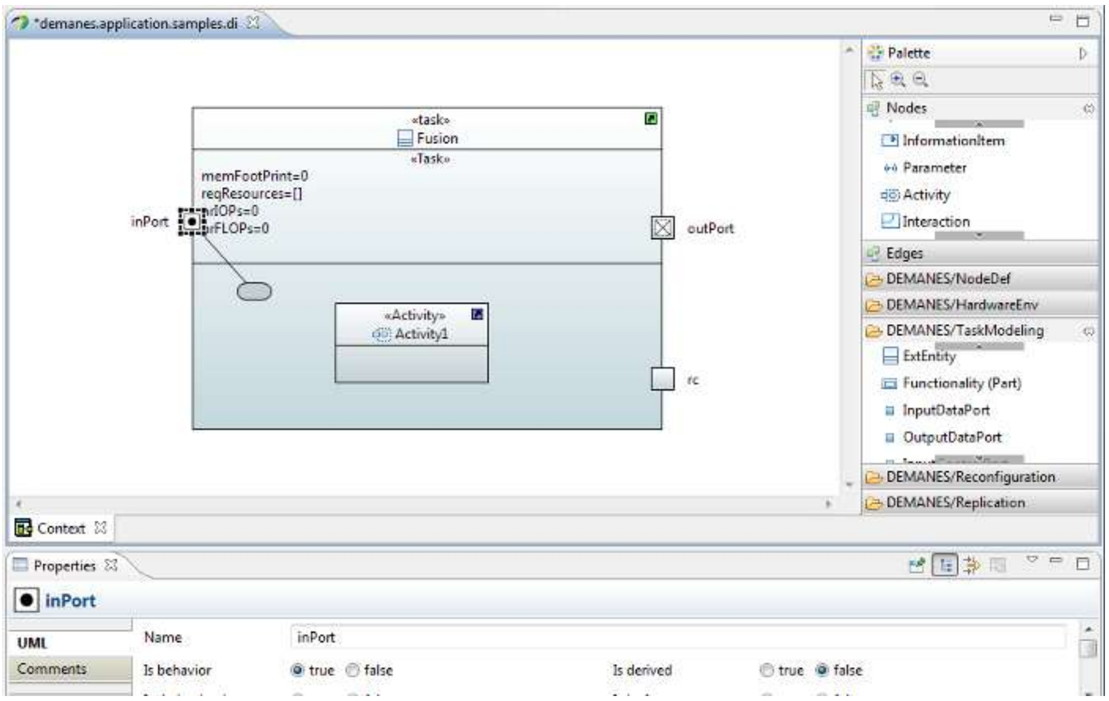


Figure 21: A sample of an activity diagram

The connection between a Task and its Behaviour can be represented in the Task Model, and the connection between a Port and the Behaviour can be represented by specifying the "*Is behaviour*" property for the Port



Name	inPort		
Is behavior	[✓ true] false	Is derived	true [✓ false]

Figure 22: A connection between task and behaviour models

3.3.2.7.5 Physical Modelling

Physical models are represented by mean of "Composite Structure Diagrams", either specification of HardwareEnv and NodeDef is supported by predefined stereotypes

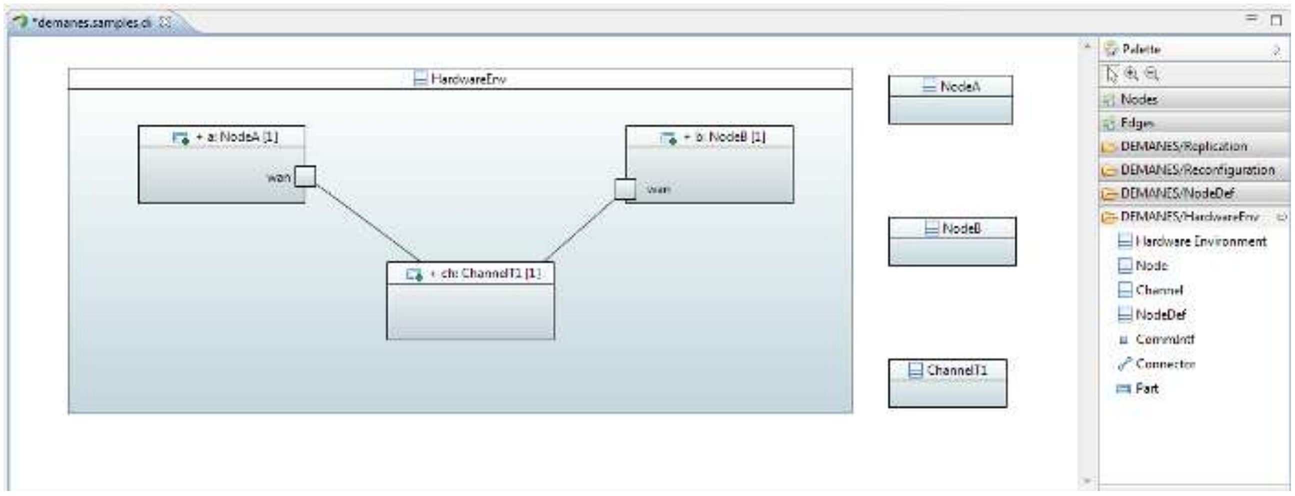


Figure 23: A sample of a physical model, hardware environment

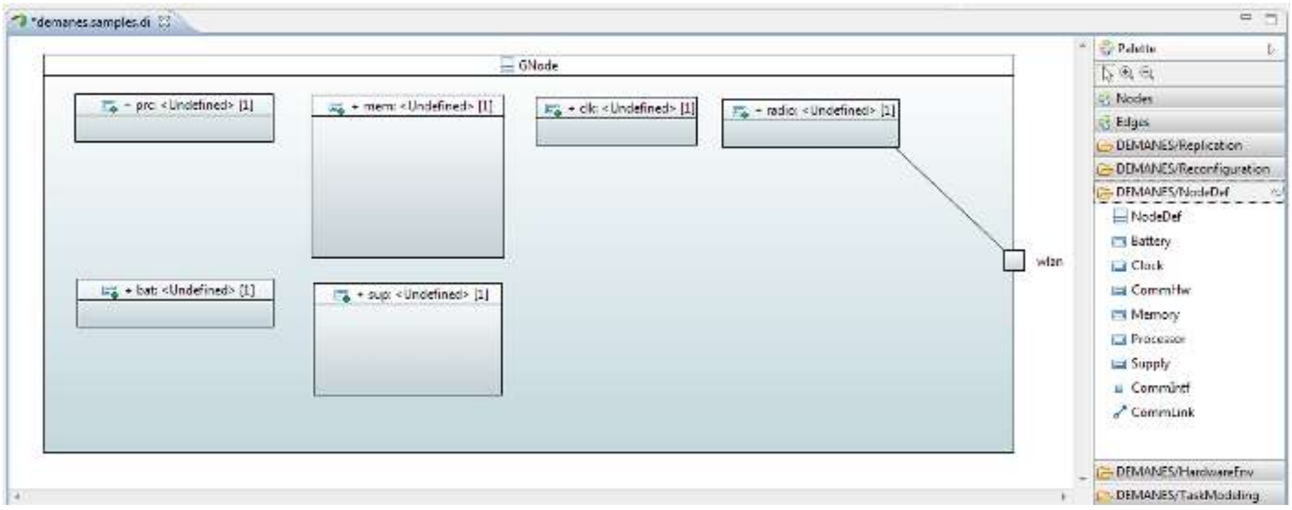


Figure 24: A sample of a physical model, node definition

3.2.3. Installation of MetaEdit+

MetaEdit+ is a tool that in addition to modelling enables a designer to develop a domain-specific modelling language. DEMANES project has developed a modelling language extension to be used with MetaEdit+. Thus, in addition to modelling with the tool, the modelling language extension must be installed to get the full DEMANES modelling language available. The tool is available from Metacase. There are a variety of licenses available. Licenses are available for single or multi-users versions as well as according to needed functionality. There is also a one year Introductory and Academic Edition license available. The details of different licences are available from the company site: http://metacase.com [16].

The tool licences are delivered electronically. The software can be downloaded from the company's download page and get installed at any time. The tool is activated using a license key and License Manager software. The license key is received from Metacase when payment is received. A customer receives installation instructions, license agreement and License Manager Instructions along with the licence key.

3.2.4. Installation of TeamCity

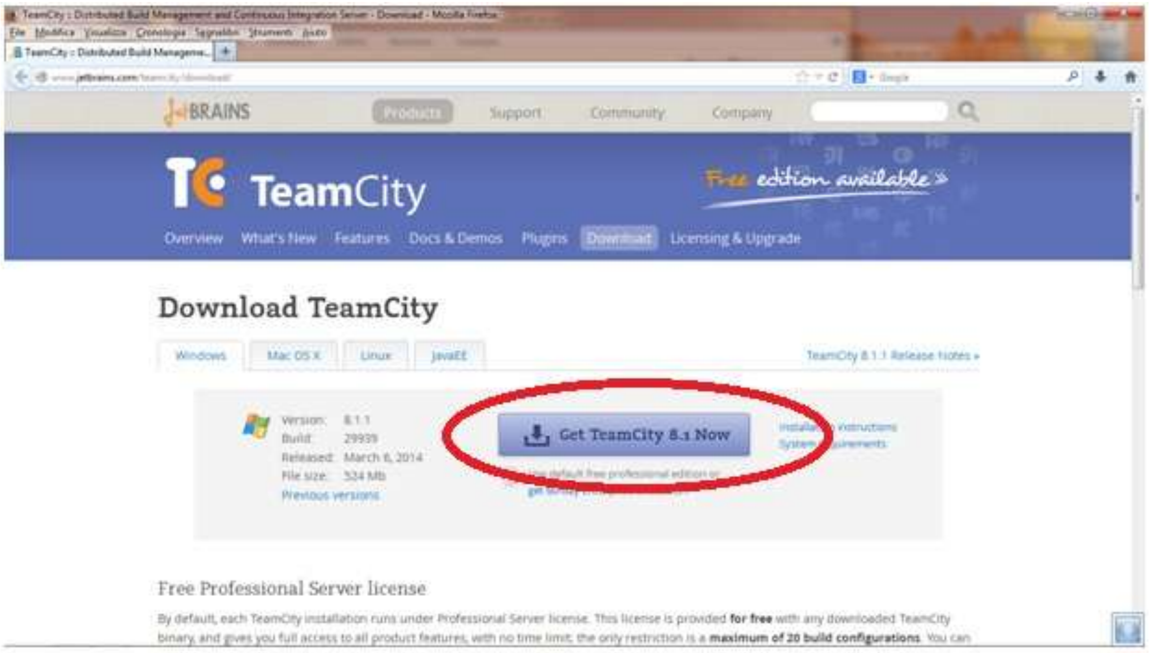
The following paragraphs are including information on TeamCity, how to get installation package, how to install the software and how to configure and set up a project.

3.3.4.1 General information

TeamCity is based on a client-server architecture, where in the server is to be exposed the User Interface (UI) which allows to manage all steps of a Task and the clients are the specialized agents which perform the concrete operations of a Build Task.

3.3.4.2 Downloading installation package

TeamCity installation package is identical to both Professional and Enterprise Editions and is available for download at http://www.jetbrains.com/teamcity/download/ [17] page for Windows, Linux and MacOS operating systems. Here we chose the one for MS Windows operating system.



Download TeamCity

Version: 8.1.1
Build: 29939
Released: March 6, 2014
File size: 324 Mb

Free Professional Server license

By default, each TeamCity installation runs under Professional Server license. This license is provided **for free** with any downloaded TeamCity binary, and gives you full access to all product features, with no time limit; the only restriction is a **maximum of 20 build configurations**. You can

Figure 25: The download page of Team City

3.3.4.3 Package clarification

As previously explained before, TeamCity is a client-server system which consists of one User Interface (the server part) and one or more instances of Build Agents (the client's part).

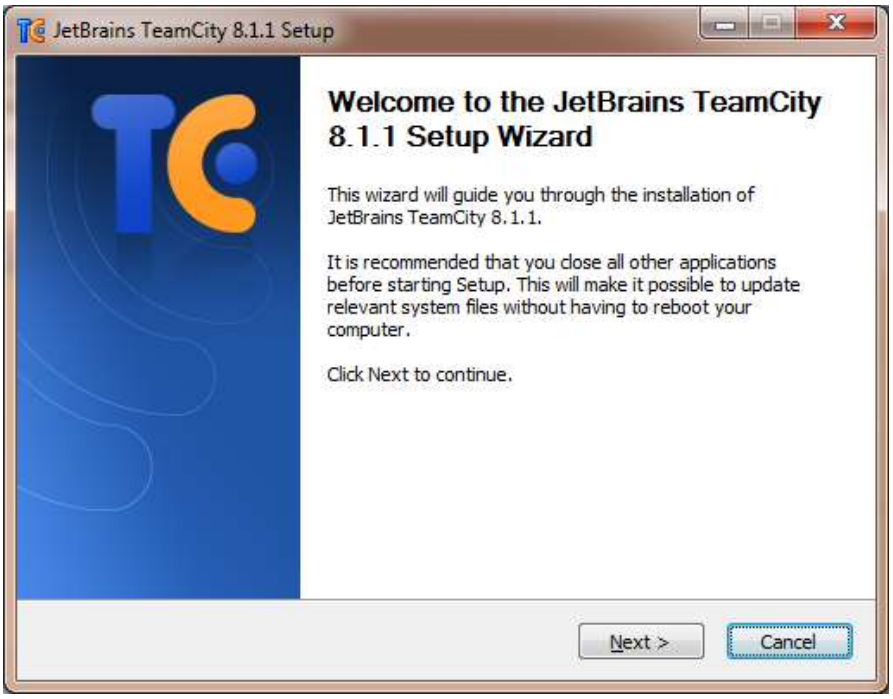
The package installation is unique to both parts and in particular the following description refers to the installation of the UI and a Build Agent in the same machine. Although the TeamCity server distribution is installed with a default build agent that runs on the same machine as the server, this setup may result in degraded TeamCity web UI performance, and if your builds are CPU-intensive, it is recommended to install the build agent on separate machines or ensure that there is enough CPU/memory/disk throughput on the server machine.

In case you need to have multiple instances of Build Agents, you need to repeat the installation procedure.

3.3.4.4 Installation procedure

To start the installation, double click on the Team City icon package previously downloaded.

The welcome panel is showed and then click on "*Next*" and "*I agree*" (to accept terms of license) buttons.



JetBrains TeamCity 8.1.1 Setup

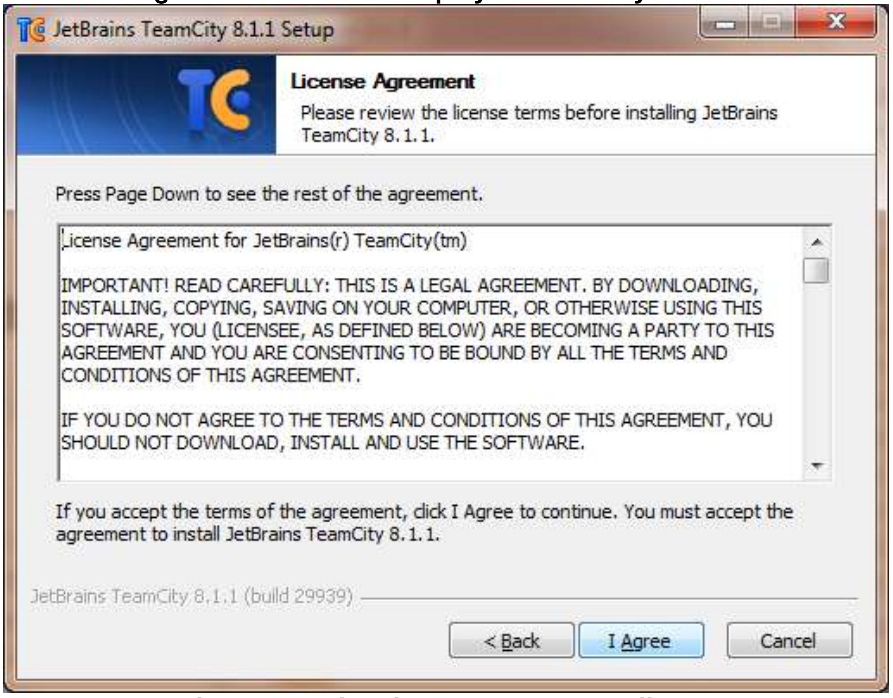
Welcome to the JetBrains TeamCity 8.1.1 Setup Wizard

This wizard will guide you through the installation of JetBrains TeamCity 8.1.1.

It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer.

Click Next to continue.

Figure 26: Welcome display of TeamCity Installer



JetBrains TeamCity 8.1.1 Setup

License Agreement

Please review the license terms before installing JetBrains TeamCity 8.1.1.

Press Page Down to see the rest of the agreement.

License Agreement for JetBrains(r) TeamCity(tm)

IMPORTANT! READ CAREFULLY: THIS IS A LEGAL AGREEMENT. BY DOWNLOADING, INSTALLING, COPYING, SAVING ON YOUR COMPUTER, OR OTHERWISE USING THIS SOFTWARE, YOU (LICENSEE, AS DEFINED BELOW) ARE BECOMING A PARTY TO THIS AGREEMENT AND YOU ARE CONSENTING TO BE BOUND BY ALL THE TERMS AND CONDITIONS OF THIS AGREEMENT.

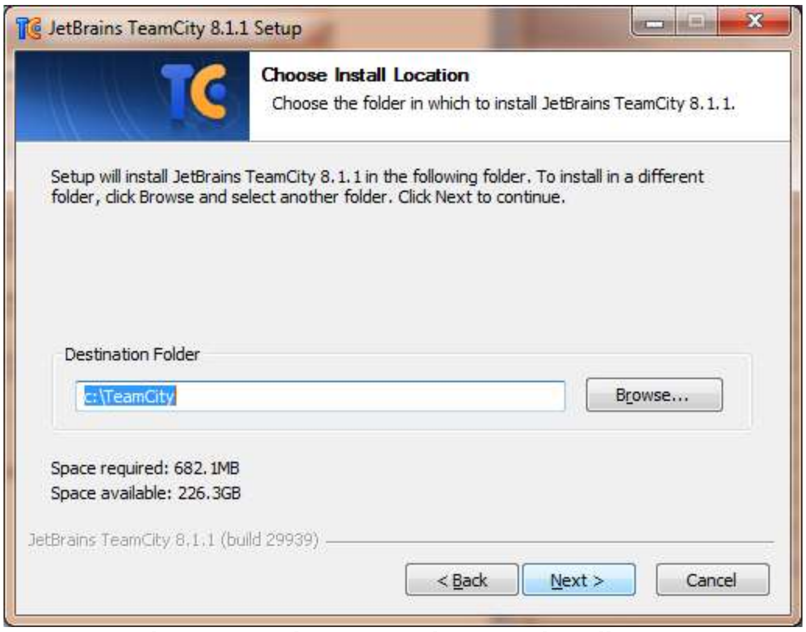
IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS OF THIS AGREEMENT, YOU SHOULD NOT DOWNLOAD, INSTALL AND USE THE SOFTWARE.

If you accept the terms of the agreement, click I Agree to continue. You must accept the agreement to install JetBrains TeamCity 8.1.1.

JetBrains TeamCity 8.1.1 (build 29939)

Figure 27: The License Agreement dialog

Continue selecting the location of installation (default settings can be kept):


JetBrains TeamCity 8.1.1 Setup

Choose Install Location

Choose the folder in which to install JetBrains TeamCity 8.1.1.

Setup will install JetBrains TeamCity 8.1.1 in the following folder. To install in a different folder, click Browse and select another folder. Click Next to continue.

Destination Folder: c:\TeamCity

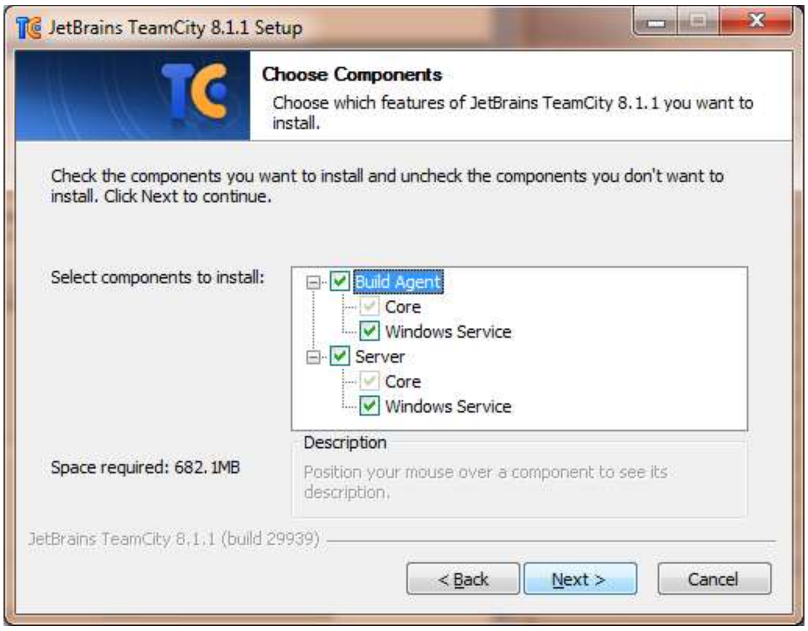
Space required: 682.1MB
Space available: 226.3GB

JetBrains TeamCity 8.1.1 (build 29939)

Figure 28: The Installation location dialog

Then you have to choose what you want to install: here we continue to install both parts of the system.

Remember to uncheck the part you do not want to install a specific one you repeat the installation procedure in the same or different machine.


JetBrains TeamCity 8.1.1 Setup

Choose Components

Choose which features of JetBrains TeamCity 8.1.1 you want to install.

Check the components you want to install and uncheck the components you don't want to install. Click Next to continue.

Select components to install:

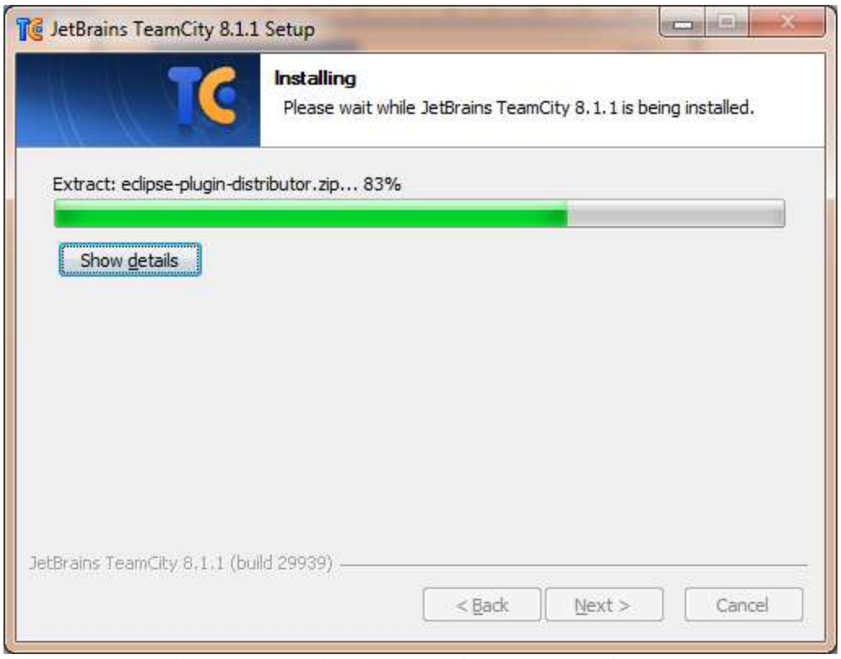
- ✓ Build Agent
  - ✓ Core
  - ✓ Windows Service
- ✓ Server
  - ✓ Core
  - ✓ Windows Service

Space required: 682.1MB

Description: Position your mouse over a component to see its description.

JetBrains TeamCity 8.1.1 (build 29939)

Figure 29: The custom installation dialog



JetBrains TeamCity 8.1.1 Setup

Installing

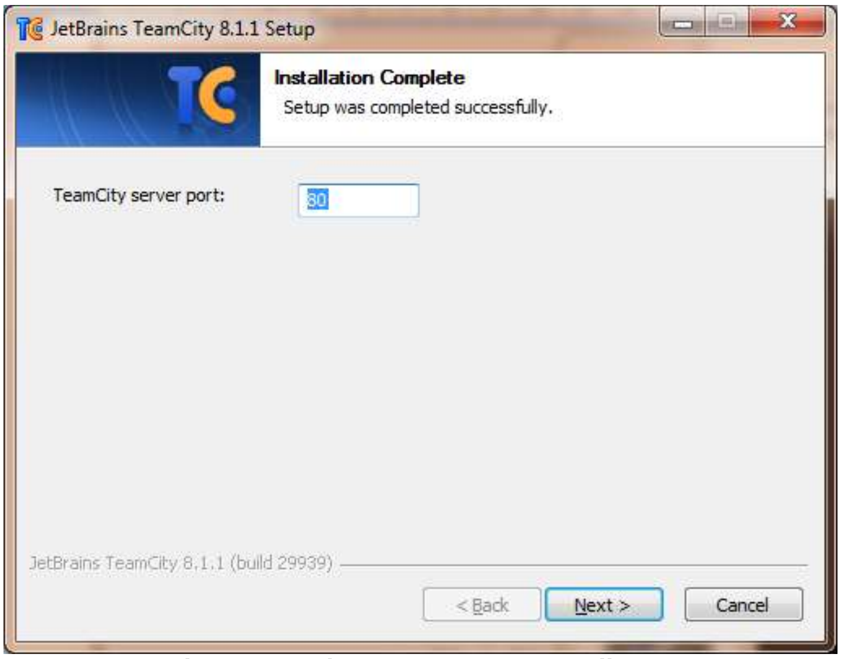
Please wait while JetBrains TeamCity 8.1.1 is being installed.

Extract: eclipse-plugin-distributor.zip... 83%

JetBrains TeamCity 8.1.1 (build 29939)

Figure 30: The installation status dialog

Once installation is completed, you have been prompted to setup Sever port properties and Build Agent service account (default settings can be kept).



JetBrains TeamCity 8.1.1 Setup

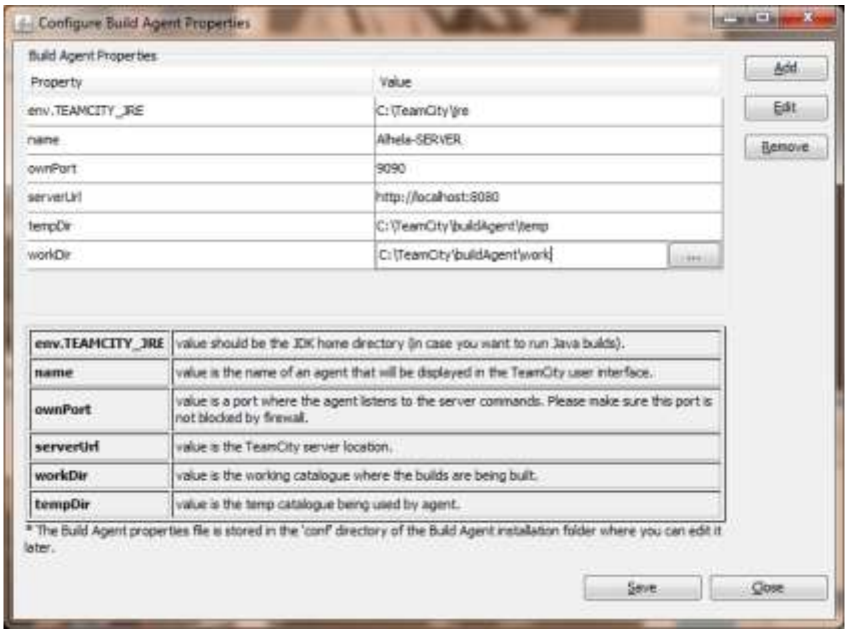
Installation Complete

Setup was completed successfully.

TeamCity server port: 80

JetBrains TeamCity 8.1.1 (build 29939)

Figure 31: The server port setup dialog



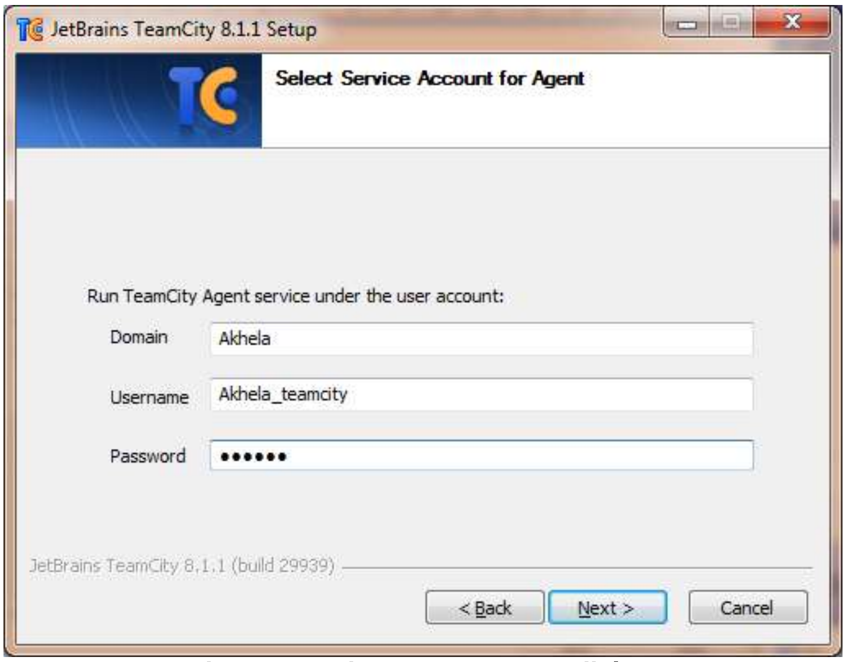
Build Agent Properties

Property	Value
env.TEAMCITY_JRE	C:\TeamCity\jre
name	Alhela-SERVER
ownPort	9090
serverUrl	http://localhost:8080
tempDir	C:\TeamCity\buildAgent\temp
workDir	C:\TeamCity\buildAgent\work

env.TEAMCITY_JRE	value should be the JDK home directory (in case you want to run Java builds).
name	value is the name of an agent that will be displayed in the TeamCity user interface.
ownPort	value is a port where the agent listens to the server commands. Please make sure this port is not blocked by firewall.
serverUrl	value is the TeamCity server location.
workDir	value is the working catalogue where the builds are being built.
tempDir	value is the temp catalogue being used by agent.

* The Build Agent properties file is stored in the 'conf' directory of the Build Agent installation folder where you can edit it later.

Figure 32: The settings of a Build Agent


JetBrains TeamCity 8.1.1 Setup
Select Service Account for Agent
JetBrains TeamCity 8.1.1 (build 29939)
< Back
Next >
Cancel

Run TeamCity Agent service under the user account:

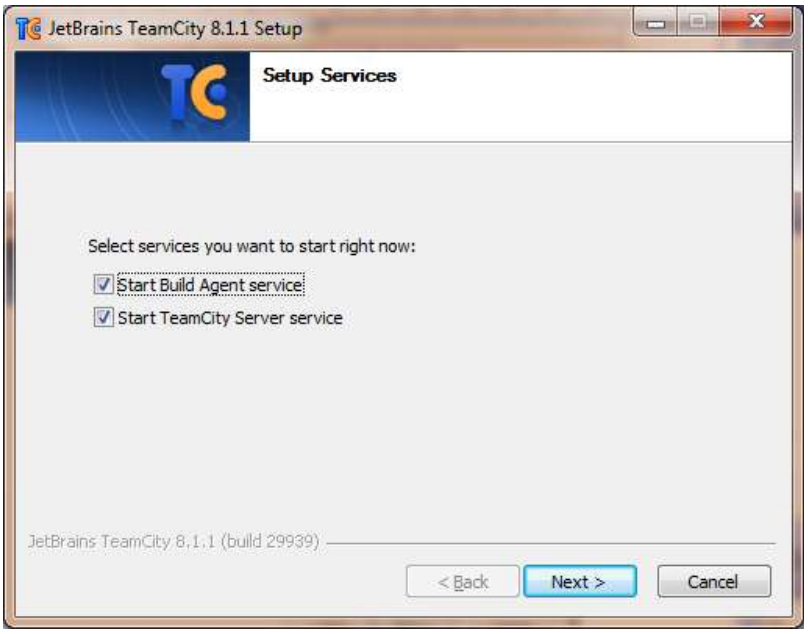
Domain: Akhela

Username: Akhela_teamcity

Password: ••••••

Figure 33: The account setup dialog

Finally, a request for the services you are interested to start and the installation procedure is completed.


JetBrains TeamCity 8.1.1 Setup

Setup Services

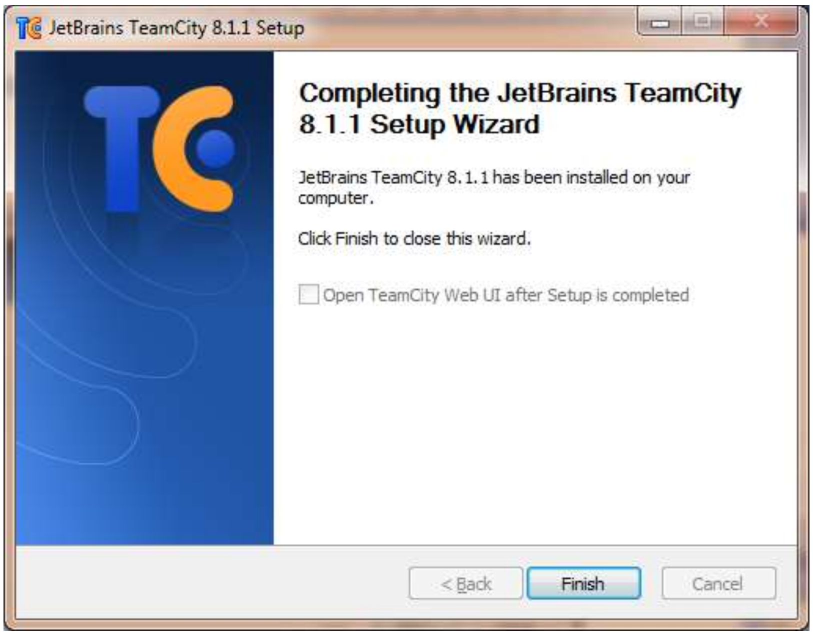
Select services you want to start right now:

[✓] Start Build Agent service

[✓] Start TeamCity Server service

JetBrains TeamCity 8.1.1 (build 29939)

Figure 34: The service setup dialog


JetBrains TeamCity 8.1.1 Setup

Completing the JetBrains TeamCity 8.1.1 Setup Wizard

JetBrains TeamCity 8.1.1 has been installed on your computer.

Click Finish to close this wizard.

[ ] Open TeamCity Web UI after Setup is completed

Figure 35: The setup complete dialog

3.3.4.5 Build Task configuration

Once the TeamCity system is installed, the continuous integration system needs to be populated with Tasks whose manage developing/testing/validation phases in a software lifecycle development.

Here is an example for a Task creation guide.

From an Internet browser, type the machine name address (or IP number too) where the TeamCity UI has been installed and use the administrative credentials to log in.

3.3.4.5.1 Task creation

Go to the Administrative section and click on Create project button on the upper right side of the window.

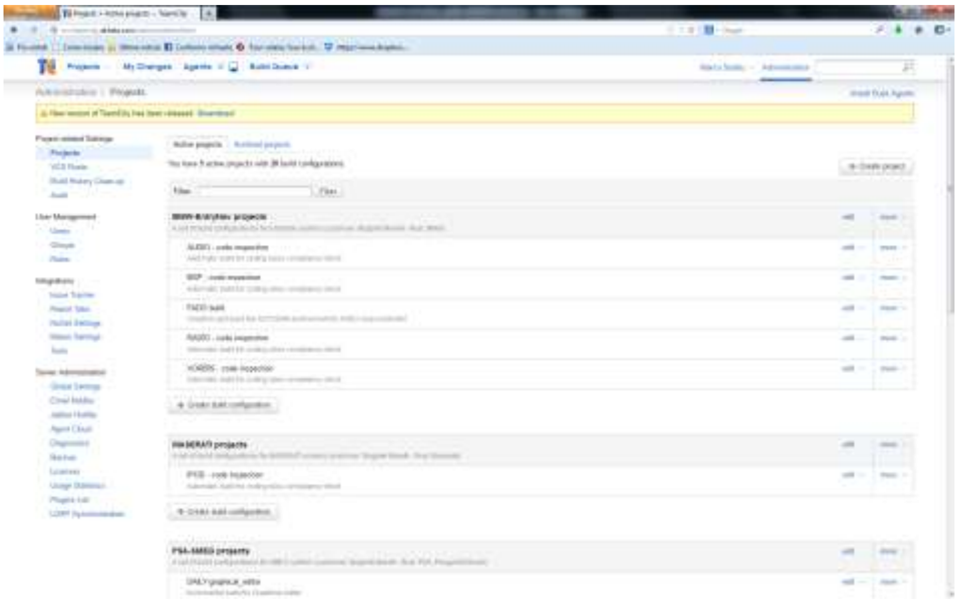
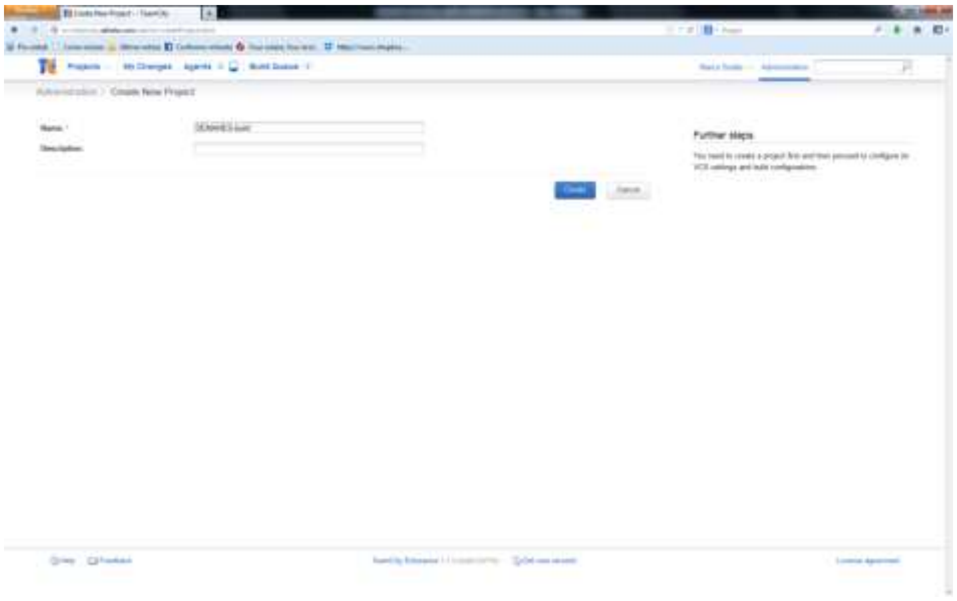


Figure 36: Task creation

3.3.4.5.2 Naming a Task

You are asked to choose a name for the Project and eventually a brief description of it.



Administration / Create New Project

Name: * DEMANES-build

Description:

Create Cancel

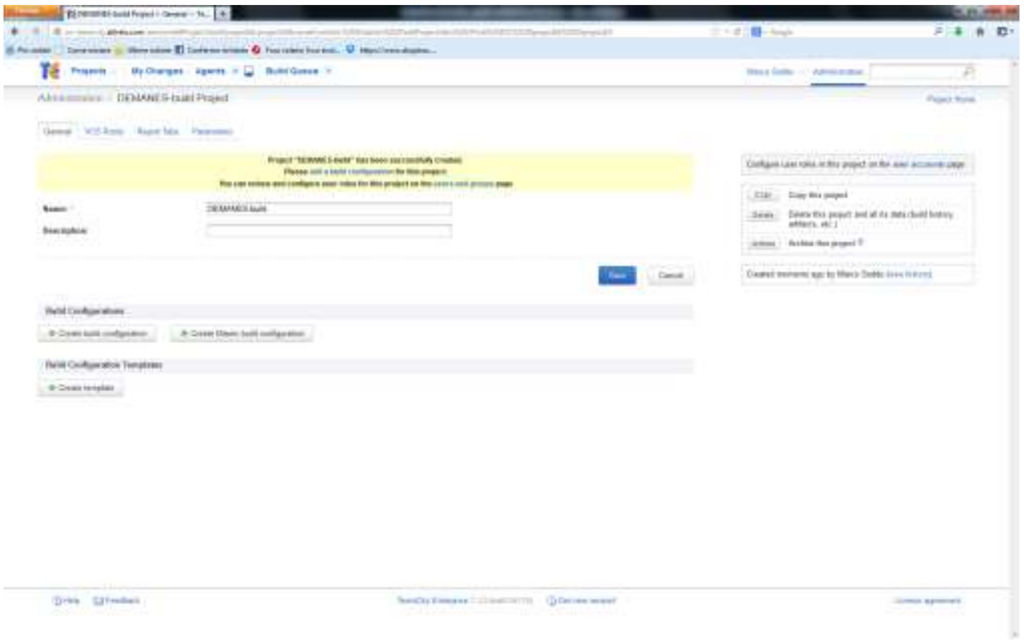
Further steps

You need to create a project first and then proceed to configure its VCS settings and build configurations.

Figure 37: Task naming

3.3.4.5.3 Task Configuration setting

Associate a Build Configuration where you set details for the Build Task to be created just clicking to the **Create build configuration** button.



Administration / DEMANES-build Project

Project "DEMANES-build" has been successfully created.

Please add a build configuration for this project.

You can review and configure user roles for this project on the users and groups page.

Name: * DEMANES-build

Description:

Save Cancel

Build Configurations

+ Create build configuration

+ Create Maven build configuration

Build Configuration Templates

+ Create template

Copy this project

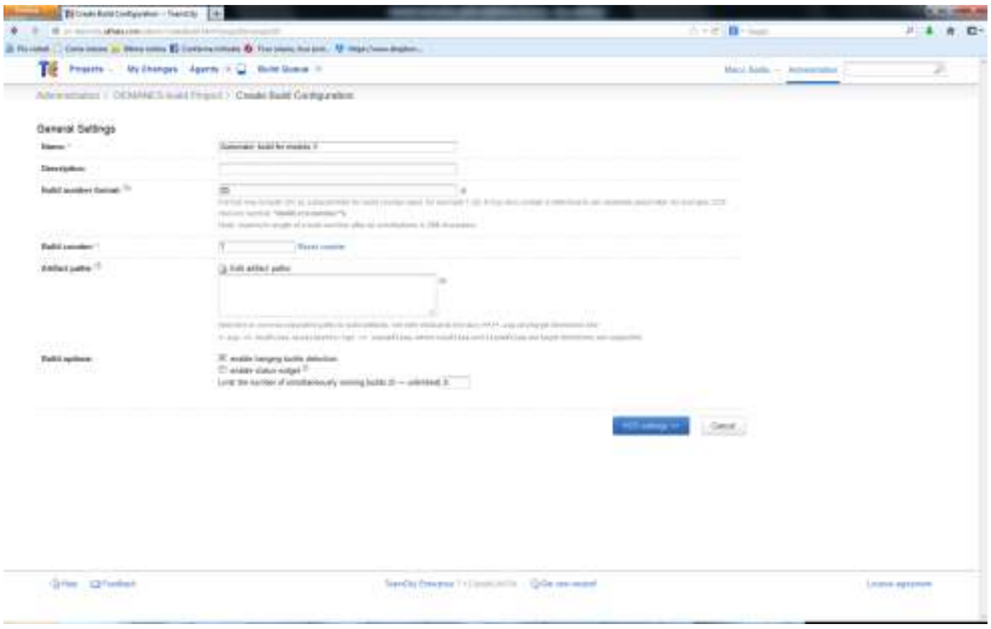
Delete this project and all its data (build history, artifacts, etc.)

Archive this project

Figure 38: Task Configuration

3.3.4.5.4 General settings

Some default values are already prompted on the General Settings page but the **Name** field needs to be filled only.
If necessary, both artifact rename and stored location rename are possible.


Administration > DEMANES build Project > Create Build Configuration

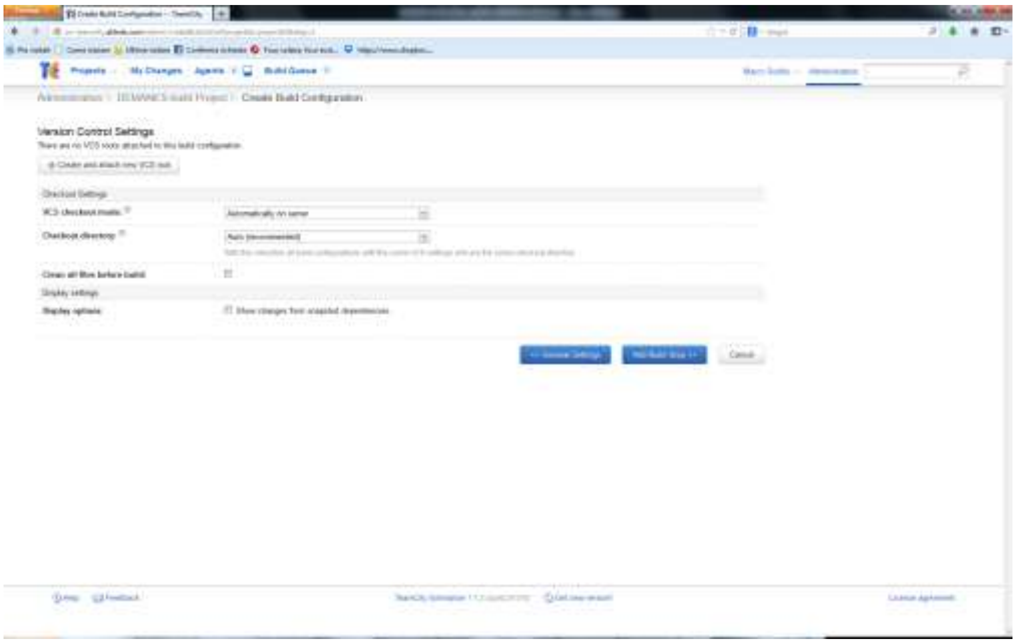
General Settings

Name: *	Automatic build for module X
Description:	
Build number format:	[illegible]
Build counter: *	1
Artifact paths:	Edit artifact paths
Build options:	[✓] enable hanging builds detection; enable status widget; Limit the number of simultaneously running builds (0 — unlimited) 0

Figure 39: General Settings window

3.3.4.5.5 VCS repository hook

In this step, the user can select the repository to be linked to (several Version Control System are managed).


Administration > DEMANES build Project > Create Build Configuration

Version Control Settings

There are no VCS roots attached to this build configuration.

Create and attach new VCS root

Checkout Settings

VCS checkout mode:	Automatically on server
Checkout directory:	Auto (recommended)
Clean all files before build:	☐

Display settings

Display options:	☐ Show changes from snapshot dependencies

Figure 40: Setting a CVS link

Here is an example with Subversion (mandatory fields to be set are **URL**, **User name** and **Password** ones).

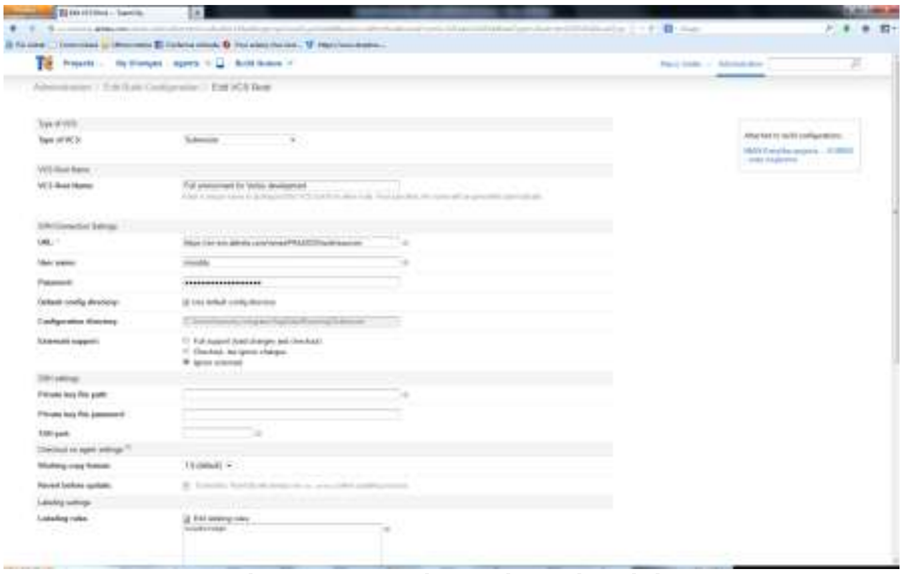


Figure 41: Setting Subversion link

3.3.4.5.6 Interface type selection

We reached the core of the setting procedure: the Build Steps settings. It is represented by a script which executes a list of sequential shell commands (DOS, bash, Maven, IntelliJ DEA, MSBuild, and so on).

First choose the type of interface it is intended to be used (here the Command Line example is shown)

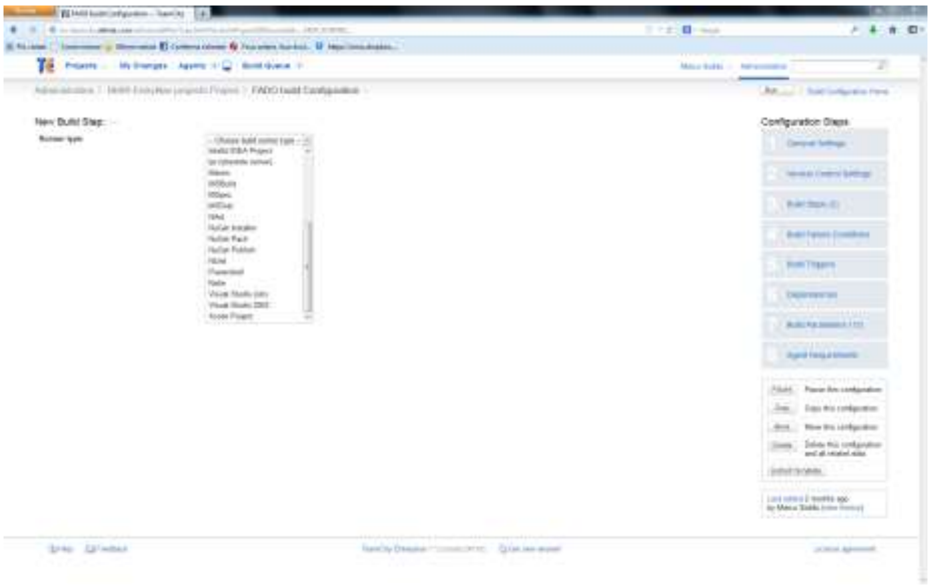


Figure 42: Setting the type of an interface

3.3.4.5.7 Command line configuration

And then continue to set path to working directory, the script name with the parameters (if any).

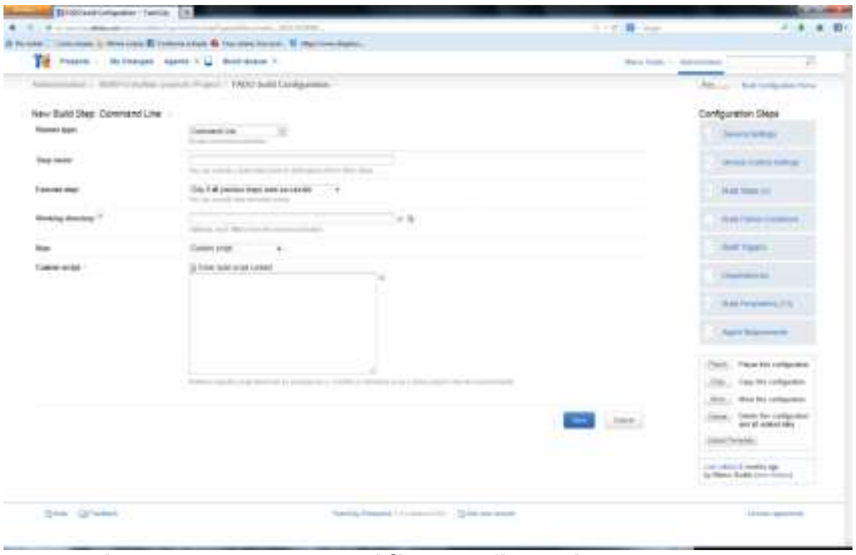


Figure 43: A command line configuration parameters

If needed, multiple instances of build script association are possible: you only need to repeat the previous step description.

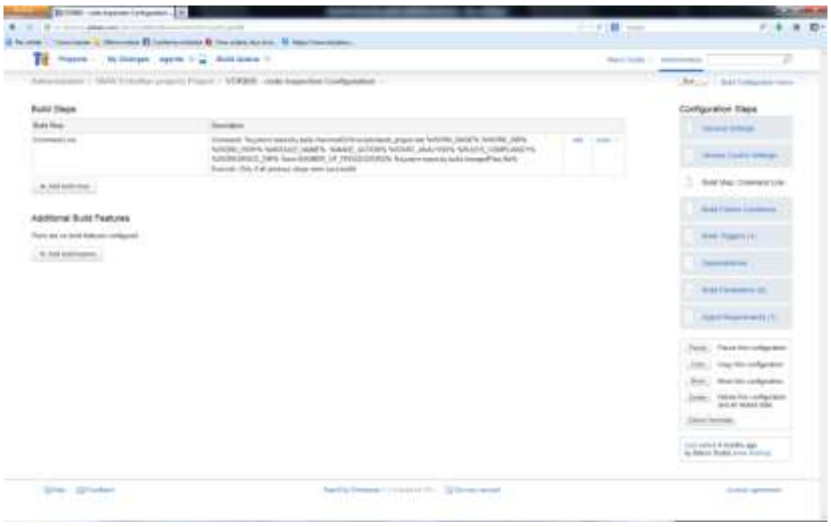
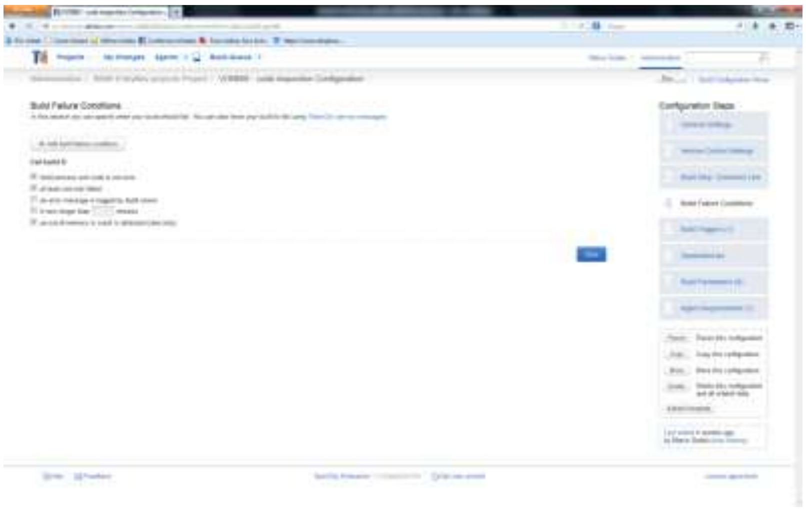


Figure 44: Additional Build Features

3.3.4.5.8 Build failure conditions settings

You are now asked to specify when the Build Task fails.

Default settings are already in place, just decide if they match.


Build Failure Conditions

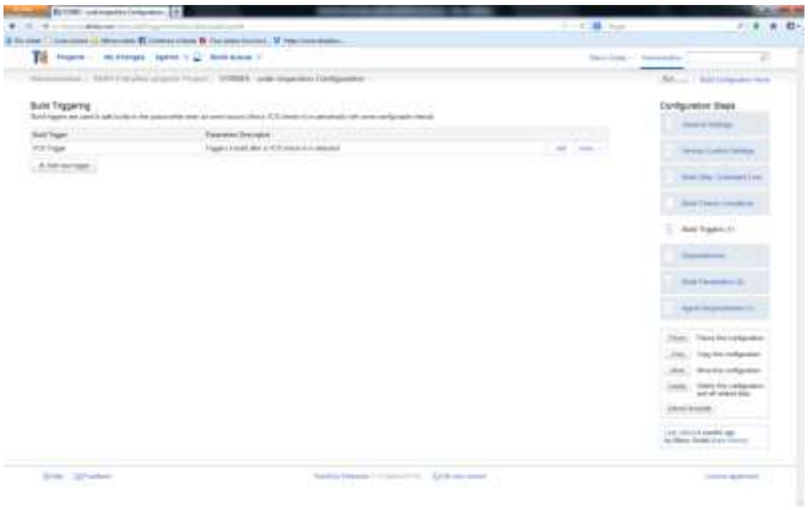
Configuration Steps

Figure 45: Build Failure condition configuration parameters

3.3.4.5.9 Trigger settings

With the following step, you can set the way to trigger the Build Task. Here you have to decide how the Build Task starts.

Several possibilities are available, event driven (after a RCS action performed by developers, end of a previous Build Task, etc.) or due to a time occurrence (specific date and time settings).


Build Triggering

Configuration Steps

Figure 46: Build Trigger Window

3.3.4.5.10 Task dependencies

Build Task dependencies can be set in the following window. Build configurations linked by snapshot dependency will take sources on the same moment of time. The build of this configuration will run after all the dependencies are built. If necessary, the dependencies will be triggered automatically.

Figure 47: Task Dependency window

3.3.4.5.11 Environment Variables settings

Environment variables, system proprieties and configuration parameters can be set to be used when invoking the build script which performs the sequential shell commands.

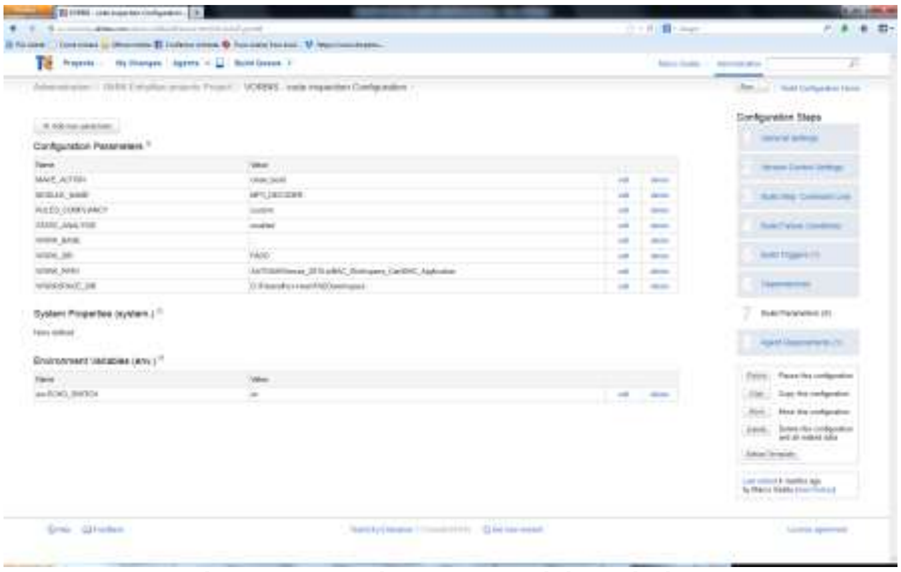


Figure 48: Environment Variable window

3.3.4.5.12 Agent setup

Finally, you can choose the agent characteristics where to run the Build Task.

As mentioned at the beginning, TeamCity is a client-server architecture where the client is represented by the agent installed in specific machines and here you check the build environment where to execute the Build Task.

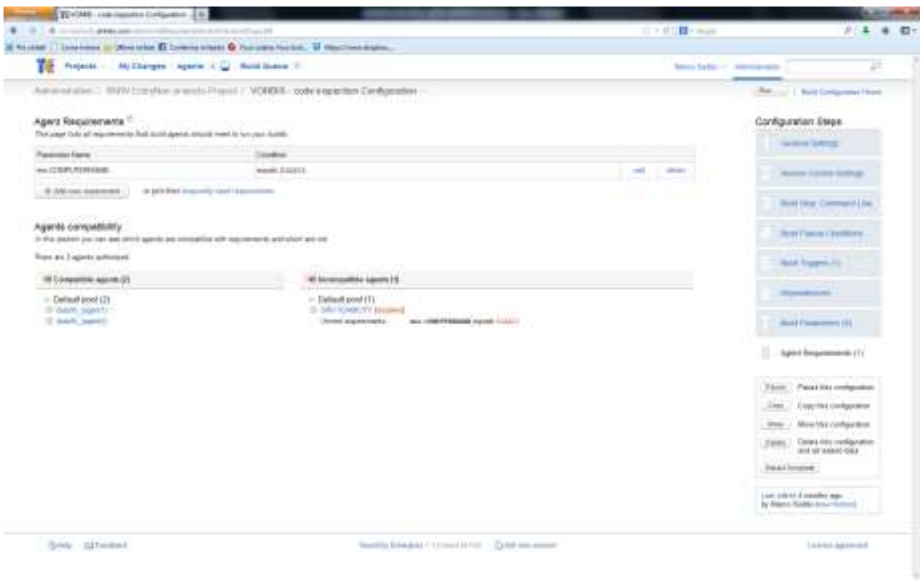


Figure 49: Agent setup

3.3.4.5.13 Task Run

The build can start when the Build Condition set are verified or you can force the start on demand just clicking on the **Run** button associated.

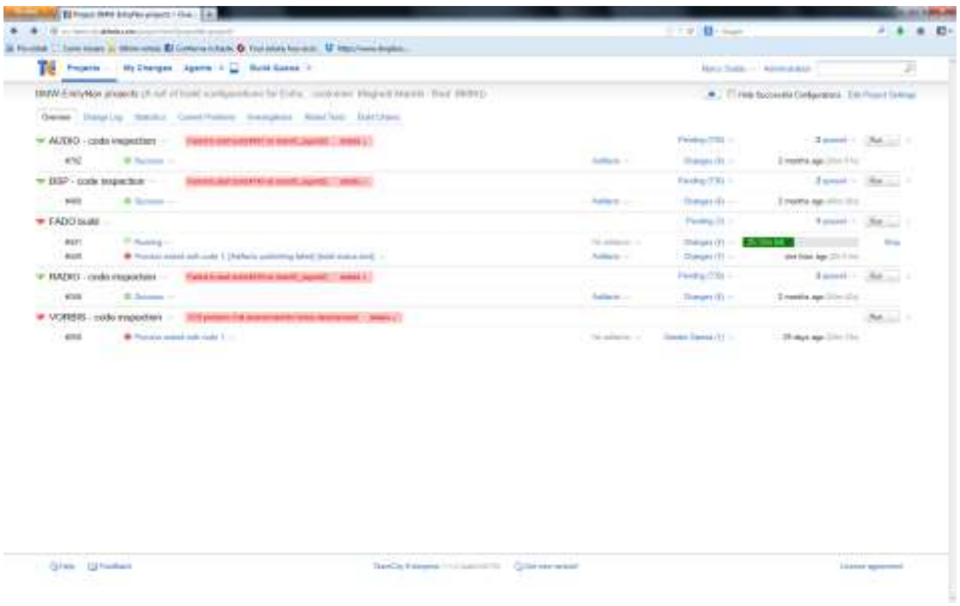
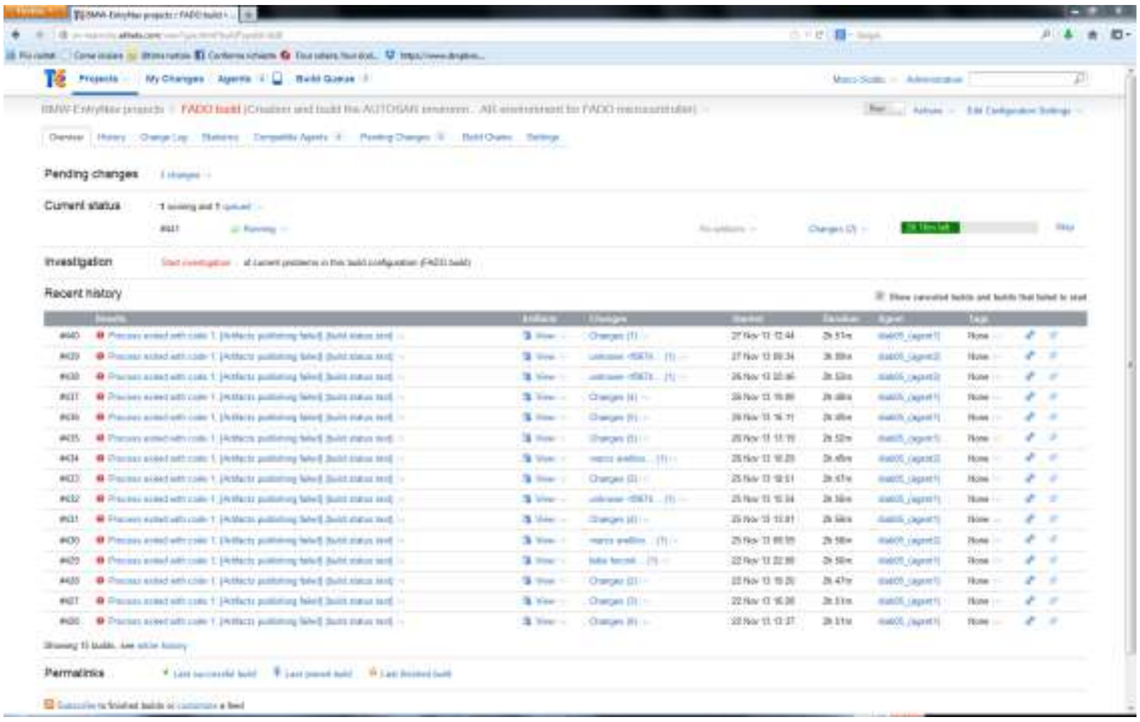


Figure 50: Build status display

3.3.4.5.14 Build Tasks history table

For each Build Task, an historical legend is available where additional information can be retrieved.



Projects | My Changes | Agents | Build Queue

FADO build

Overview | History | Change Log | Statistics | Compatible Agents | Pending Changes | Build Chains | Settings

Pending changes

Current status: 1 running and 1 queued

#441 Running

Investigation: Start investigation of current problems in this build configuration (FADO build)

Recent history

	Results	Artifacts	Changes	Started	Duration	Agent	Tags
#440	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#439	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#438	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#437	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#436	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#435	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#434	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#433	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#432	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#431	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#430	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#429	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#428	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#427	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None
#426	Process exited with code 1. [Artifacts publishing failed] [build status text]	View	[illegible]	[illegible]	[illegible]	[illegible]	None

Showing 15 builds. See whole history

Permalinks: Last successful build | Last pinned build | Last finished build

Subscribe to finished builds or customize a feed

Figure 51: Build History Log display

3.3. Translators And Code Generators

3.3.1. Installation of DEMANES XML generator for MetaEdit+

The DEMANES XML generator produces an XML file with an intermediate, persistent representation of a DEMANES model entered in the MetaEdit+ modeller software. The generator is written in the proprietary language MERL, offered by the MetaEdit+ environment. The complete set of files composing the generator is presented in Table 1.

Table 1 : The list of files beloning DEMANES XML generator

Create_XMI.rep _dl_xmi_systemProperties.rep _dl_ID.rep _dl_label.rep _dl_translators.rep _dl_version.rep _dl_xmi_acceptorHandles.rep _dl_xmi_algoInterfaceAssociations.rep _dl_xmi_algorithm.rep _dl_xmi_algorithmModel.rep _dl_xmi_attr.rep	_dl_xmi_model.rep _dl_xmi_node.rep _dl_xmi_nodeComponent_battery.rep _dl_xmi_nodeComponent_clock.rep _dl_xmi_nodeComponent_commHw.rep _dl_xmi_nodeComponent_genericHwComponent.rep _dl_xmi_nodeComponent_memory.rep _dl_xmi_nodeComponent_powerSupply.rep _dl_xmi_nodeComponent_processor.rep

_dl_xmi_attr_href.rep	_dl_xmi_nodeDefinition.rep
_dl_xmi_attr_id.rep	_dl_xmi_nodeReference.rep
_dl_xmi_attr_label.rep	_dl_xmi_openIDTag.rep
_dl_xmi_behaInterfaceAssociations.rep	_dl_xmi_outputDataPorts.rep
_dl_xmi_behaviouralModel.rep	_dl_xmi_physicalModel.rep
_dl_xmi_behaviouralStates.rep	_dl_xmi_portMappingAssociation.rep
_dl_xmi_channel.rep	_dl_xmi_properties.rep
_dl_xmi_channelAssociation.rep	_dl_xmi_property.rep
_dl_xmi_channelAssociations.rep	_dl_xmi_reconfigurationReq.rep
_dl_xmi_closeIDTag.rep	_dl_xmi_replicator.rep
_dl_xmi_commAssociations.rep	_dl_xmi_replicatorAssociation.rep
_dl_xmi_comment.rep	_dl_xmi_replicatorAssociations.rep
_dl_xmi_comments.rep	_dl_xmi_replicators.rep
_dl_xmi_Configurations.rep	_dl_xmi_reqResources.rep
_dl_xmi_dataFlows.rep	_dl_xmi_root.rep
_dl_xmi_flowAcceptorHandles.rep	_dl_xmi_task.rep
_dl_xmi_HREFTag.rep	_dl_xmi_taskGroup.rep
_dl_xmi_IDTag.rep	_dl_xmi_taskGroupReference.rep
_dl_xmi_initialState.rep	_dl_xmi_taskMappingAssociation.rep
_dl_xmi_inputDataPorts.rep	_dl_xmi_taskModel.rep
_dl_xmi_interfaceAssociations.rep	_dl_xmi_taskReference.rep
_dl_xmi_issuerHandles.rep	_dl_xmi_termState.rep
_dl_xmi_mappingModel.rep	_dl_xmi_transitions.rep

For installing the generator files in a new instance of MetaEdit+ do the following steps:

1. Copy the generator files listed above to a temporary folder in the computer where MetaEdit++ is installed.
2. Start MetaEdit++ and login to the repository where you want to import the code generator. It is important to notice that the DEMANES metamodeling language should be available as one individual project in this repository.
3. Start the generator editor MERL by clicking the appropriate button as depicted in Figure 52. Alternatively, use the menu **Metamodel – Generator editor;**

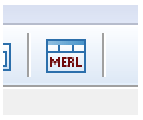
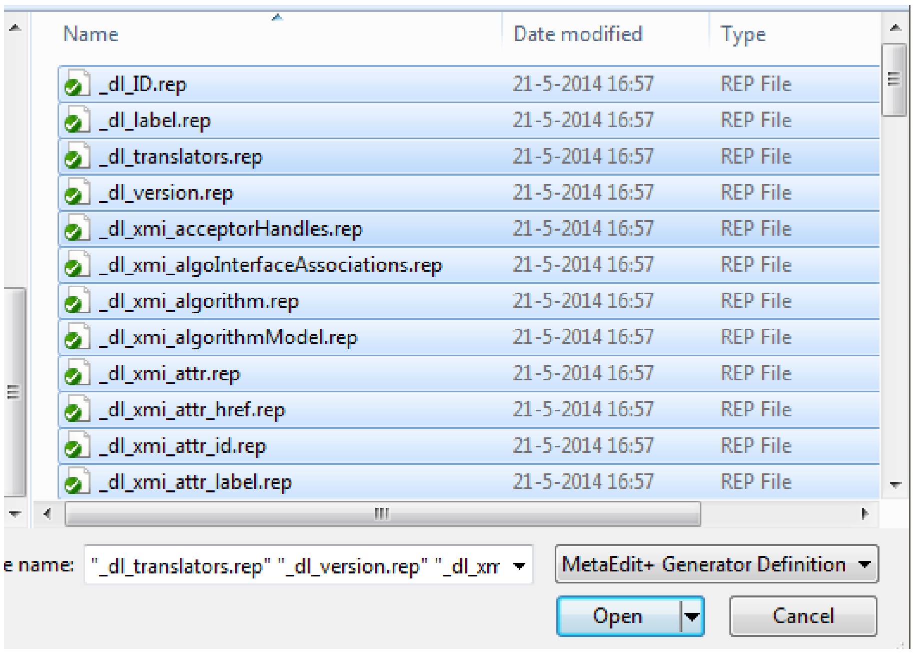


Figure 52: Button to start the generator editor MERL in MetaEdit++

4. In the generator editor window, select the menu Generator – Read from file;
5. In the browser window that appears, go to the folder where the generator files are and select all, as depicted in Figure 53. Click open.

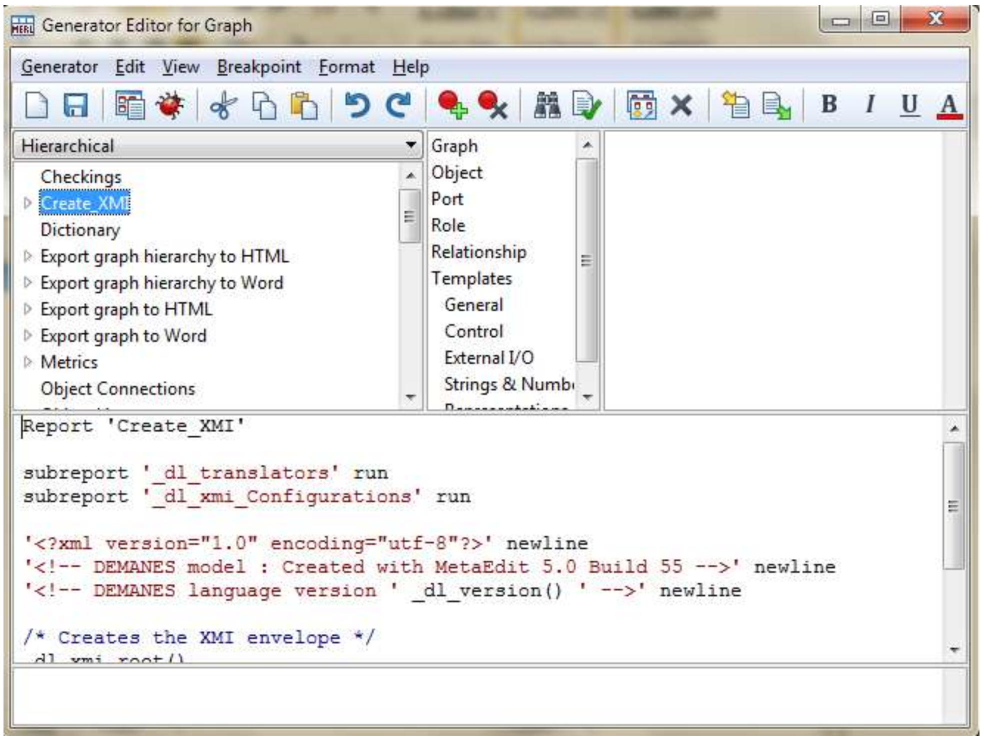


Name	Date modified	Type
_dl_ID.rep	21-5-2014 16:57	REP File
_dl_label.rep	21-5-2014 16:57	REP File
_dl_translators.rep	21-5-2014 16:57	REP File
_dl_version.rep	21-5-2014 16:57	REP File
_dl_xmi_acceptorHandles.rep	21-5-2014 16:57	REP File
_dl_xmi_algoInterfaceAssociations.rep	21-5-2014 16:57	REP File
_dl_xmi_algorithm.rep	21-5-2014 16:57	REP File
_dl_xmi_algorithmModel.rep	21-5-2014 16:57	REP File
_dl_xmi_attr.rep	21-5-2014 16:57	REP File
_dl_xmi_attr_href.rep	21-5-2014 16:57	REP File
_dl_xmi_attr_id.rep	21-5-2014 16:57	REP File
_dl_xmi_attr_label.rep	21-5-2014 16:57	REP File

e name: "_dl_translators.rep" "_dl_version.rep" "_dl_xm

Figure 53: Select all the generator files and click Open.

6. The import of the files is complete. The new generator is available at the Generator Editor window, as depicted in Figure 54.



```
Report 'Create_XMI'

subreport '_dl_translators' run
subreport '_dl_xmi_Configurations' run

'<?xml version="1.0" encoding="utf-8"?>' newline
'<!-- DEMANES model : Created with MetaEdit 5.0 Build 55 -->' newline
'<!-- DEMANES language version ' _dl_version() ' -->' newline

/* Creates the XMI envelope */
```

Figure 54: The newly imported generator is available and accessible from the Generator Editor for Graph window.

3.3.2. Installation of DEMANES XML generator for MetaEdit+

The DEMANES Matlab code generator reads the intermediate representation of a DEMANES model (XML file) and produces Matlab code for the simulation and analysis tool DynAA. The generator is written in the Matlab native language and uses the Mathworks software Matlab™ for execution. Therefore for installing and running the generator, the user needs the Matlab tool with at least version 2012b.

The Matlab code generator is composed by a set of files and folders delivered as a package (toolbox) for Matlab. The installation procedure is as follows:

1. Copy the package of files and folders containing the generator to a local folder;
2. Start the Matlab tool;
3. Direct the working directory of the Matlab tool to the folder containing the generator;
4. Run the script called '**startup'**;
   After that, the generator is inserted in the working path of Matlab and is completely installed.

3.3.3. Installation of DEMANES Java code generator for MetaEdit+

The Java code generator was not available during the writing of this document, and therefore the installation instructions will follow in the future.

4. Creating Software Design Model

4.1. THE DEMANES MODELLING LANGUAGE

The DEMANES modelling is developed during the DEMANES project. The aim of the language is to give a strong support to the modelling adaptivity and reconfiguration functionality of DEMANES applications. The full definition of the language is available in DEMANES project deliverable D3.2 – modelling for architecture design: specification of the DEMANES modelling framework, which should be obtained as a handbook of a modelling language.

At first sight, the DEMANES modelling language is similar to other well knows system modelling languages such as UML, MARTE and SysML. Some significant differences exist, however. At first, the DEMANEs modelling languages describes a system using four different aspects whereas many more aspects and relations can be implemented into other languages. At second, the important features needed in DEMANES are lacking from other modelling language. These are implemented in the DEMANES Modelling language.

As the DEMANES modelling language is a graphical language designers used to UML or similar language can easily adopt the DEMANES modelling language. The look and feel of the DEMANES modelling language is very similar between MetaEdit+ and Papyrys modelling extension. See sample Papyrus screen shots in paragraph 3.3.2.7 - DEMANES system modelling using DEMANES UML Profile.

4.2. The Modelling Aspects

The DEMANES Modelling language supports four modelling aspects, which are a task model, a behavioural model, a physical model and a mapping model. The modelling language is graphical and a model comes into diagrams.

The task model describes an application as terms of functionalities, which communicates and synchronizes to each other. The task model is hierarchical. So, tasks can be grouped in a task groups. A task group can contain task groups or tasks. The task interface is modelled as ports. There are different types of ports, which are data ports and control ports. Ports have a direction property. The direction is input ports or output. The tasks are connected together using links between the ports. The link can carry a data flow or an event flow respectively to the port type.

The Behavioural Model describes, as the name suggests, the behaviour of a task. The task is described in terms states and sequential state transitions. The concurrency is not implemented in the Behavioural Model. Each state can have an action associated. The possible actions are predefined and are as follows: processing action, data communication action, event handling action and the delay action. The data communication and the event handling actions can specify a direction: send, receive, handle an event and emit and event.

The Physical Model describes the hardware devices of a system. The model consists on devices and their resources, which include processing resources, communication resources, storage capacity, clock definition and power supply resources. In addition, the physical Model includes channels. The communication resources are connected together via channels.

The Mapping Model allocates tasks and other modelling elements in the physical devices and channels. As a result, the mapping model specifies how tasks are located in the real system.

4.3. Putting The Aspects Together

The full detailed description of the DEMANES Modelling language is out of the scope of this user manual. It is recommended to refer the DEMANES project deliverable D4.2 for the full description of the modelling language. In addition, the user guides of MetaEdit+ and Papyrus are documents to be read in order to dig deeper inside the modelling language.

It is recommended that the task model is created at first. The behavioural model of each task can be composed as soon as tasks are identified and added into the design. The physical model is created at the third phase. As the mapping model needs information on the task model and the physical model, the creation of the mapping model is the last phase in the modelling. Note however, a model can be developed step by step. So there is no need to get the task model fully complete before the mapping model can be started. As the model comes in the forms of the diagrams, diagrams can be edited later and thus the modelling can be composed using an iterative cyclic approach where a designer can fix e.g. the task model and then go to continue to work on the behaviour, the physical and the mapping models.

5. Simulating Software Model

The design of large embedded and distributed can be very complex and all sequences of the design decisions are not always seen beforehand. Even to DEMANES modelling helps to build a complex system, identify loopholes of the design and verify the design, simulating can still be needed to make sure that design works as planned.

To simulate SW model Mathlab and DynAA simulation tool are needed. DynAA is an in-house simulation tool of TNO. Simulation can be used to analyse sensor and communication networks by using terms such as a number of CPU cores, a clock speed, a bandwidth, a power consumption and a memory requirements.

6. Application Distribution Services

Google Play is an online store for purchasing and downloading applications, music, books, movies and similar content for use on Android smartphones, tablets and other Android devices.

For enabling Google Play distribution service Google provides Google Play Library. By integrating this library into Android project in application compiling phase Google Play can be used as a service for applications distributing when applications are developed with Eclipse. Google Play allows the automatic updates of new Android application versions to end-users android devices when new applications are uploaded to Google Play service. More information about Google Play implementation can be found on the website of Google Play Services.

7. Conclusions

The ANES tool chain User Manual audience are people, who are interested in applying DEMANES design process, technical support people and software designers.

The ANES tool chain consists on a number of tools which are supporting modelling, simulation, application implementing, system delivery and application development process management. A tool in a tool chain co-operates the adjacent tool of the tools chain by using DEMANES XML files to exchange design data. Special code generators and XML translators are included for making these DEMANES XML files. Refer Figure 1 at page 10 to see relationships between tools of the ANES tool chain.

Some of the tools are available on the open source basis and some are commercial tools. Papyrus and MetaEdit+ are tools used for modelling and simulating. In addition, to simulate the model, Mathlab is required. Programming languages supported by ANES tool chain are C and Java. These languages are available through GNU Compiler Collection and Android Development Kit. Those developers, who are using Android based devices, can deliver their applications by using Google Play. This document contains step by step instructions on how to install the tools of the ANES tool chain. In practice, all tools must be downloaded from the web sites of open source project and tool vendor. If a tool is a commercial one, a free evaluation period is offered very often. During this period, a user is expected to purchase the license if the tool is taken in use.

The DEMANES modelling is developed during the DEMANES project. The aim of the language is to give a strong support to the modelling adaptivity and reconfiguration functionality of DEMANES applications. The full definition of the language is available in DEMANES project deliverable D3.2 – modelling for architecture design: specification of the DEMANES modelling framework.

The DEMANES modelling language is used design systems having automatic reconfiguration and adaption to changes in application environment. The DEMANEs modelling languages describes a system using four different aspects, which are a task model, a behavioural model, a physical model and a mapping model. The modelling language is graphical and a model comes into diagrams. The DEMANES modelling language can be used to design a hierarchical system model. The Behavioural Model describes the behaviour of a task. The task is described in terms states and sequential state transitions. The Physical Model describes devices and their hardware resources such as a number of CPU cores, communication ports and storage capacity. The mapping model specifies how tasks are located in the real system.

References

[1] https://github.com/g-oikonomou/contiki-sensinode

[2] http://sourceforge.net/projects/contiki/files/Instant%20Contiki/Instant%20Contiki%202.5/

[3] http://sdcc.sourceforge.net/snap.php

[4] http://www.ti.com/tool/flas-programmer

[5] http://www.ti.com/tool/packet-sniffer

[6] https://www.eclipse.org/downloads/

[7] http://www.ibm.com/developerworks/java/jdk/

[8] http://openjdk.java.net/

[9] http://www.oracle.com/technetwork/java/javase/downloads/

[10] https://www.eclipse.org/downloads/index-developer.php?release=kepler

[11] *https://dl-ssl.google.com/android/eclipse/*

[12] http://wireshark.org/

[13] http://www.iar.com

[14] www.java.com

[15] https://www.eclipse.org/downloads/

[16] http://metacase.com

[17] http://www.jetbrains.com/teamcity/download/

Appendix A System Reliability

1. Introduction

A system is a set of interacting or interdependent components forming an integrated whole. This implicates that two components together already form a system. When the number of components and their interactions hugely increase, so-called large or complex systems are formed. The types of components, their quantities, their qualities and the manner in which they are arranged within the system have a direct effect on the system's reliability. The commonly used description for system reliability is given as:

> *The probability that a system, including all hardware, firm-ware, and software, will satisfactorily perform the task for which it was designed or intended, for a specified time and in a specified environment.*

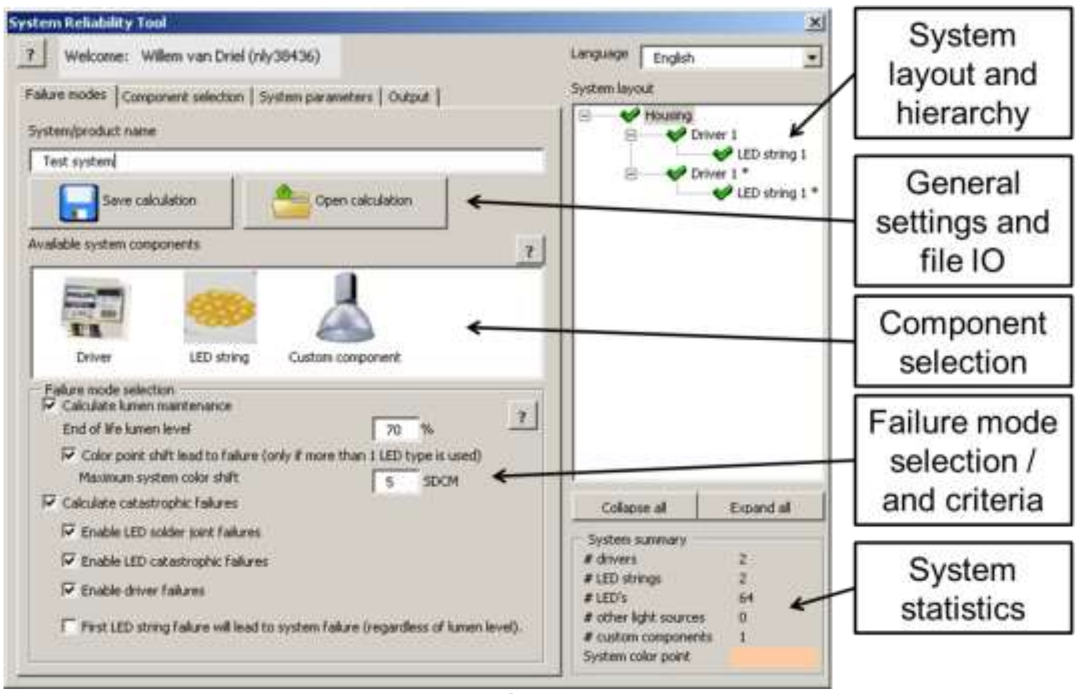
From a system reliability point of the view, the challenge is to master the reliability of all these components. Figure A.1 shows different possible lighting applications, ranging from lighting in offices, around living houses to streetlight and a total city that needs to be lighted.

Figure A.1: Lighting applications, with from left to right, an office with bulbs, outdoor luminaries at living house environments, street lighting in Dubai and lighting the city of Shanghai with LED-based products.

Within DEMANES, Philips Lighting has developed the so-called System Reliability Tool (SRT). It can be seen as a sort of a middle ware that connects between the actual product architecture and the behaviour of the system. The purpose of the SRT is to:

- Automate the manual combination of reliability models
- Prevent errors by rigorous data checking
- Lower the entry barrier for doing a reliability calculation
- Integrate the estimation of reliability figures into an NPI project during the DFSS Design and Optimize phase.

Figure A.2 shows the GUI of the tool. The next paragraph demonstrates the use of the tool for the smart Lighting Outdoor pilot. It is an example, any other pilot can be assessed in the same manner.


System Reliability Tool

Welcome: Willem van Driel (nly38436)

Language: English

System/product name: Test system

Available system components: Driver, LED string, Custom component

Failure mode selection

- ☑ Calculate lumen maintenance
  - End of life lumen level: 70 %
  - ☑ Color point shift lead to failure (only if more than 1 LED type is used)
  - Maximum system color shift: 5 SDCM
- ☑ Calculate catastrophic failures
  - ☑ Enable LED solder joint failures
  - ☑ Enable LED catastrophic failures
  - ☑ Enable driver failures
  - ☐ First LED string failure will lead to system failure (regardless of lumen level).

System layout

- Housing
  - Driver 1
    - LED string 1
  - Driver 1 *
    - LED string 1 *

System summary

# drivers	2
# LED strings	2
# LED's	64
# other light sources	0
# custom components	1
System color point	🟧

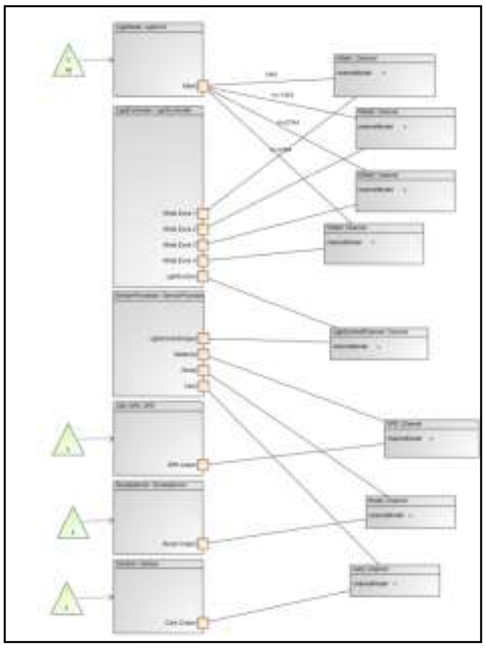
Figure A.2: SRT V2 GUI.

2. SYSTEM RELIABILITY ANALYSIS FOR THE SMART OUTDOOR LIGHTING

The system layout as defined in the MetaEdit –Physical model is first transferred to a reliability Fault Tree. Below picture on the left side shows the physical model, on the right side a schematic presentation that can be used for setting up the Fault Tree. The following is assumed:

1. Only if 2 light sources next to each other fail simultaneously, this will be considered as a system failures (read no availability of the function). This means that 4 zones with only 2 light sources need to be considered in the system reliability model when it concerns system availability.
2. As the controller is key for all 40 light sources, failure of this device is crucial for the availability of the function. For time being the FIT for the controller is set to 600.
3. On estimate, there will be about 50-100 fire calls per year in the city. Assuming that the components in the system would run for 60 seconds per fire, the total amount of use hours per year is equal to. 15-20 seconds/day**. For reasons of simplicity we have truncated this number to 5 minutes per day.**
4. Each pole will be modelled by 40 blue LEDs of type Luxeon Rebel mounted on FR4, a piece of electronics with a FIT of 1200 at a $T_{case,max}$ of 85degC. The pole electronics is running on 65degC. The router is considered as a controller with a FIT of 300. IF the router fails, the system is not available anymore.
5. We do not consider Lumen Maintenance degradation a failure item for the system.
6. The average ambient temperature is set according to the climate maps available on the internet. For the Netherlands the registered average minimal yearly temperature is 6degC, the maximum yearly temperature is 14degC. This yields an average daily temperature of 10degC.
7. The lifetime target is set as:

a. 1 failure in 10 year service.
b. 10 year service is equal to 1000 fire calls
c. That is approximately 100hrs burning hours



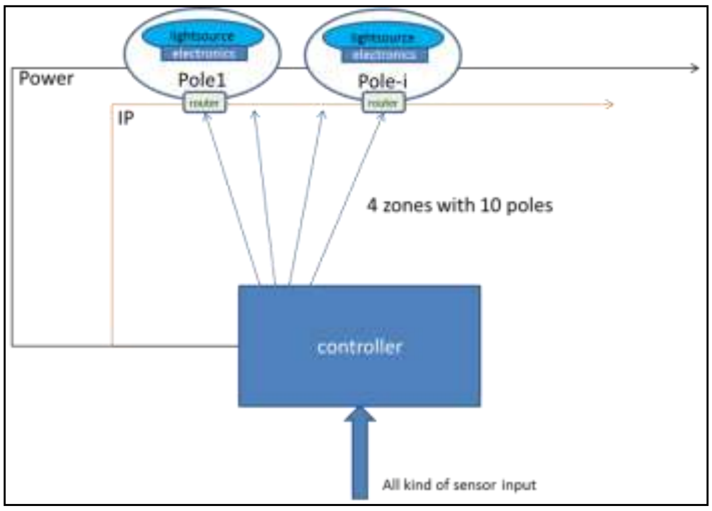
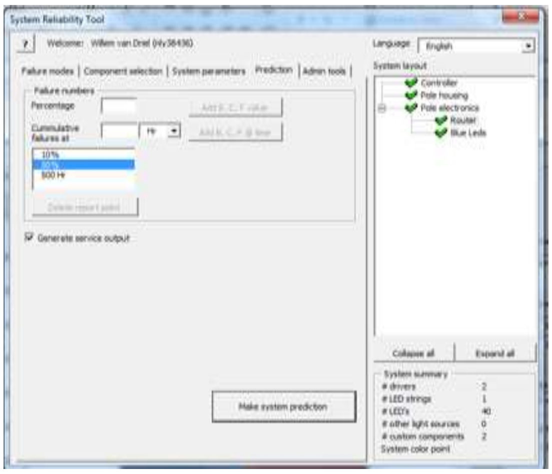


Figure A.3: Left side shows the physical model, he right side a schematic presenation for setting up the Fault Tree.

The developed System Reliability Tool is used to model the Smart Outdoor Pilot case. The model is build step by step, being:

1. 1 Pole only

The screen shot on the left shows the system model with one pole only. The 500hr cumulative field call rate is 0.05% and only dominated by the failure of the electronic parts (router, pole electronics and controller). The 1% point will only appear after 16khrs, which is equal to 32 years of service. The 10 yrs performance is listed in the table.



System summary

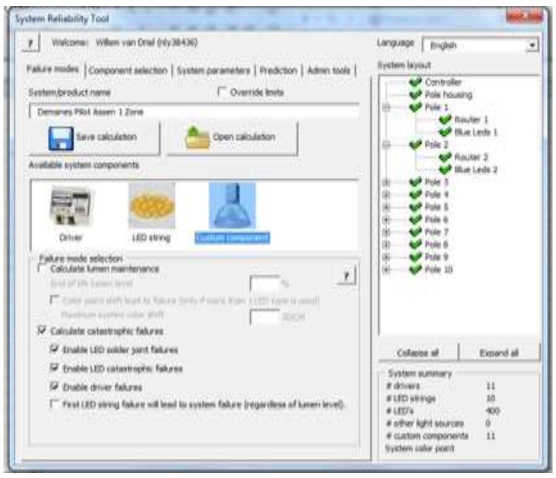
# drivers	2
# LED strings	1
# LED's	40
# other light sources	0
# custom components	2
System color point	

Reliability	99.98%
Availability	99.98%

Figure A.4: Screen shot of the system model with only 1 pole

2. 1 Zone of 10 Poles

Note that in this case the restriction of ‘*Only if 2 light sources next to each other fail simultaneously, this will be considered as a system failures (read no availability of the function)*’ comes into play. This means that the system reliability will not be the same as the system availability. The system reliability is calculated assuming that each component can fail, the system availability only on the given restriction. The screenshot on the left is the model. The 10 yrs performance is listed in the table. Pareto plots are shown below.


System Reliability Tool
Welcome: Willem van Driel (nly38436)
Language English
Failure modes | Component selection | System parameters | Prediction | Admin tools
Save calculation
Open calculation
Available system components
Driver
LED string
Custom component
Collapse all
Expand all

System/product name: Demanes Pilot Assen 1 Zone
Override limits: ☐
Failure mode selection
☐ Calculate lumen maintenance
☑ Calculate catastrophic failures
☑ Enable LED solder joint failures
☑ Enable LED catastrophic failures
☑ Enable driver failures
☐ First LED string failure will lead to system failure (regardless of lumen level).

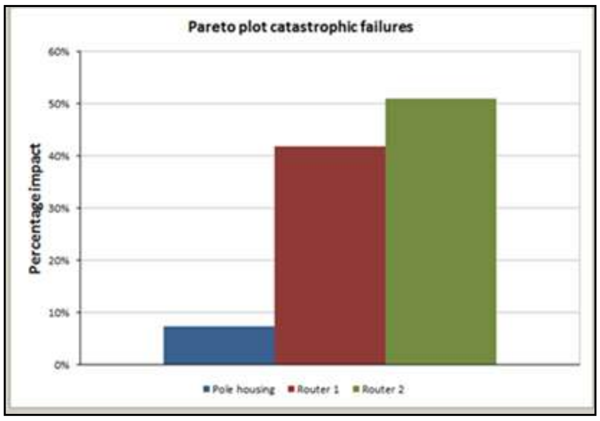
System layout: Controller; Pole housing; Pole 1 (Router 1, Blue Leds 1); Pole 2 (Router 2, Blue Leds 2); Pole 3; Pole 4; Pole 5; Pole 6; Pole 7; Pole 8; Pole 9; Pole 10

System summary

# drivers	11
# LED strings	10
# LED's	400
# other light sources	0
# custom components	11
System color point	

Reliability	99.7%
Availability	99.9%

Figure A.5: Screen shot of the system model with only 1 zone.



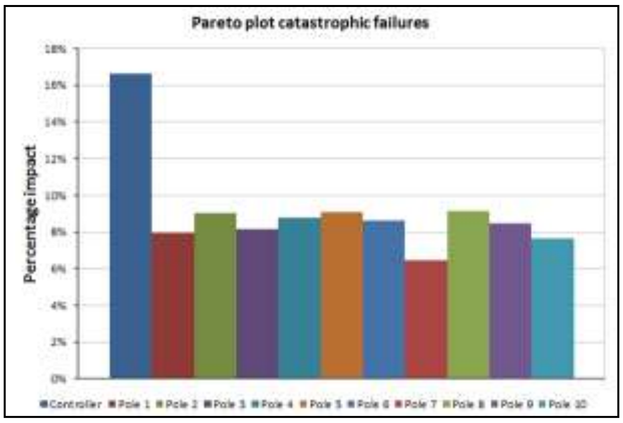
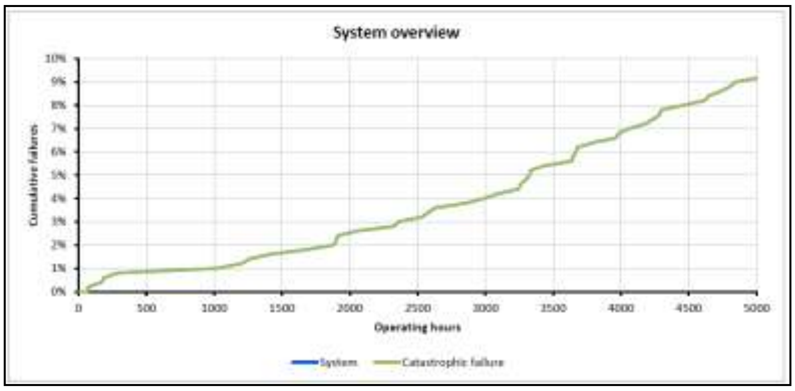


Figure A.6: Left side shows the pareto plot for system catastrophic failure contribution, with on right side the details for the poles.

3. 2 Zones with 10 Poles Each

Following op on 1 Zone, the 10 poles are extended to another zone with 10 poles. The same principle repeats and the 10yr results are listed in the below table. The reliability curve is also plotted, no up till a time scale of 5000hrs (note: this is the reliability curve and not the availability curve).



Reliability	99.0%
Availability	99.8%

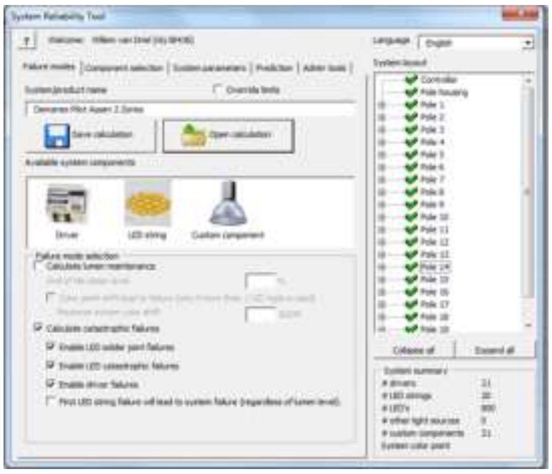
Figure A.7: Reliability curve (failure rate versus time) for the situation with 2 zones.

4. 4 Zones with 10 Poles Each

Duplicating to 4 zones of 10 poles each enlarges the system model extensively. The model is depicted in the picture on the left. The algorithm works like this: 100k monte carlos drawings are taken from the failure distribution, then the software will sort 100 times a list of 10000 numbers. The CPU time for this particular case is several seconds. The 10yr results are listed in the table below.

Reliability	98.0%
Availability	99.6%

In the system reliability tool it is possible to appoint a component to be crucial for the reliability or not. The way this works is depected in the right figure below (by the arrow). In this way, the tool can handle the difference between reliability and availability.



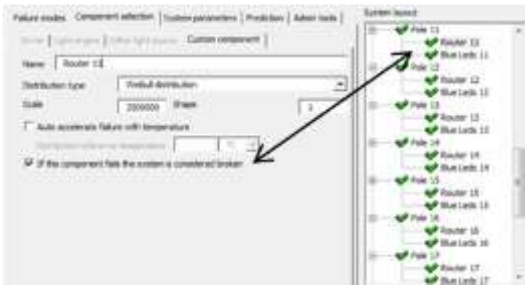
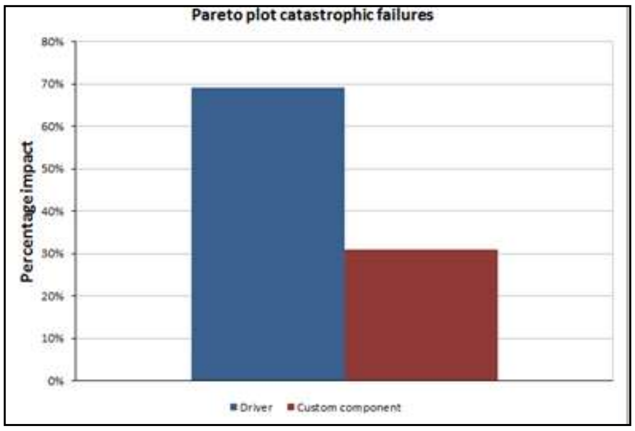


Figure A.8 : On the left screen shot of the system model with only 4 zones, on the right demonstrating the ability of the tool to hand reliability vs availability.

The table shows that the availability of the system is 99.6% over a service period of 10yrs. This means the with a confidence level of 90% that in this period 4 out of anticipated 1000 fire calls may not work properly. This could be due to a catastrophic failure of a component or due to an improper transfer of a signal. The pareto plot on the left below indicated that in 70% of these cases the controller is the root cause for such failure. In 30% of the cases one of the routers did not work properly (not signal transferred or catastrophic failure). The pareto plot on the right below demonstrates the statistical behaviour of our calculations. Actually one would expect that for each 8 routers (remind that 2 in a row should fail) the failure probability should be almost equal (1/8 = 12.5%). Due to the Monte Carlo drawings this it is not the case. Actually, if same calculation is repeated, the answer will be slightly different.



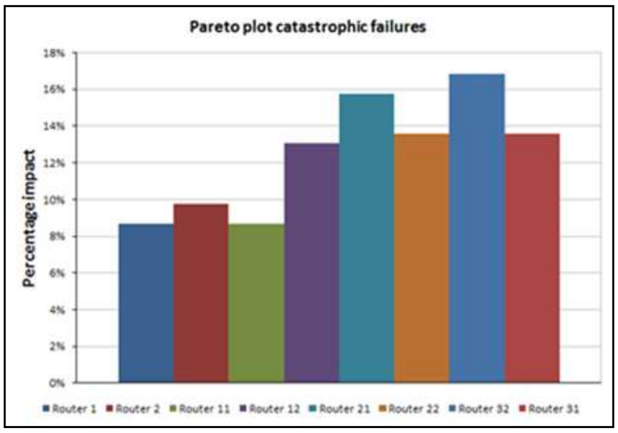


Figure A.9: Left side shows the pareto plot for system catastrophic failure contribution, with on right side the details for the routers.

3.3.4.5.14.1 Discussion & Conclusions

We have demonstrated the use of the developed System Reliability Tool for large and complex services. For the outdoor pilot it means that in a period of 10 years and with a confidence level of 90% out of the anticipated 1000 fire calls may not work properly. This is seen as acceptable.
Further field testing is needed to verify our predictions. In 1 year of service, with 100 fire calls we expect a lower and upper bound of 0 failures. The first failure is not expected in a period of 3 years. It means that we have to track the system for quite some time.

References

[1] 1. H. Pham, System Software Reliability, in Springer series in Reliability Engineering, vol. 79, London, Springer, March, 2006, pp. 45-52.
[2] W.D. van Driel, X.J. Fan, Solid State Lighting Reliability: Components to Systems, ISBN 978-1-4614-3066-7, 31 August 2012, Springer, 617 pages.
[3] W.D. van Driel, M. Schuld, R. Wijgers, W.E.J. van Kooten, Software Reliability and Its Interaction with Hardware Reliability, Proceeding of the EuroSimE conference, Gent, 2014.