

Y12 - Usage complet du projet Yocto

Objectifs

- Utilisation et personnalisation de Yocto
- Créer des plateformes Linux embarquées basées sur Yocto
- Utiliser Yocto pour développer des applications
- Personnalisation du BSP
- Construction de modules
- Configuration du cache source

Les travaux pratiques sont effectués sur une carte ARM QEMU

Nous utilisons une version récente de Yocto

Pré-requis

- Bonnes connaissances en programmation C (voir notre cours [L2 - C language for Embedded MCUs](#))
- Connaissance des systèmes embarqués Linux (voir notre cours [D1 - Linux embarqué avec Buildroot et Yocto](#))
- De préférence, connaissance de la programmation utilisateur Linux (voir notre cours [D0 - Programmation en mode utilisateur Linux](#))

Environnement du cours

- Cours théorique
 - Support de cours imprimé et au format PDF (en anglais)
 - Le formateur répond aux questions des stagiaires en direct pendant la formation et fournit une assistance technique et pédagogique
- Activités pratiques
 - Les activités pratiques représentent de 40% à 50% de la durée du cours
 - Elles permettent de valider ou compléter les connaissances acquises pendant le cours théorique.
 - Un PC pour deux stagiaires pour les activités pratiques
 - Une plateforme cible pour deux stagiaires (sauf en cas d'utilisation de qemu)
 - Accès à un serveur cloud privé
 - Exemples de code, exercices et solutions
 - Le formateur assiste les stagiaires pendant les exercices
- Au début de chaque demi-journée une période est réservée à une interaction avec les stagiaires pour s'assurer que le cours répond à leurs attentes et l'adapter si nécessaire

Audience visée

- Tout ingénieur ou technicien en systèmes embarqués possédant les prérequis ci-dessus.

Plan du cours

Premier jour

Introduction to Yocto

- Overview of Yocto
 - History
 - Yocto, Open Embedded and Poky
 - Purpose of the Yocto project
 - The main projects
- Yocto architecture
 - Overview
 - Recipes and classes
 - Tasks

The Yocto build system

- Build system objectives
 - Building deployable images
 - Layers and layer priorities
 - Directory layout
 - Configuration files (local, machine and distribution)
 - The bitbake tool
- Using Yocto
 - Building a package
 - Building an image (root file system + u-boot + kernel)
- Miscellaneous tools around Yocto
 - Yocto SDK
 - Extensible SDK

Exercise : Building a root file system using Yocto

Exercise : Use bitbake commands to build package & images

Exercise : Building a root file system using Yocto

Exercise : Build an extensible SDK for the generated image

Exercise : Deploy the generated image

Yocto package recipes structure

- Recipe architecture
 - Tasks
 - Task dependencies
 - Recipe dependencies
- The bitbake language
 - Standard variables and functions
 - Classes and recipes
 - The base Yocto classes
 - Main bitbake commands
- Adding a new layer
 - Layer structure
 - Various kinds of layers

Exercise : Adding a new layer

Deuxième jour

Writing package recipes for Yocto

- Various kind of recipes and classes
 - Bare program
 - Makefile-based package
 - autotools-based package
 - u-boot
 - kernel
 - Out-of-tree module
- Recipe creation strategies
 - From scratch
 - Using devtool
 - Using recipetool
 - From an existing, similar, recipe
- Debugging recipes
 - Debugging recipe selection
 - Debugging dependencies
 - Debugging tasks
- Defining packaging
 - Package splitting
- Automatically starting a program

Exercise : Writing a recipe for a local user-maintained package

Exercise : Writing and debugging a package recipe for an autotools-based package

Exercise : Starting a program at boot (systemd)

Modifying recipes

- Customizing an existing package recipe (.bbappend)
- Recipe dependencies
- Creating and adding patches
 - Creating a patch for a community-provided component
 - Creating a patch for an user-maintained component
- Defining new tasks
 - Task declaration
 - Coding tasks

Exercise : Adding patches and dependencies to a community package

Exercise : Adding a rootfsinstall task to directly copy the output of a user package in the rootfs image

Troisième jour

Creating new kinds of recipes

- Creating classes
 - Creating new independent classes
 - Inheriting from an existing class

Exercise : Create a class to generalize the “rootfsinstall” task

Creating a root file system

- Building a root file system with Yocto
 - Creating a custom root file system
- Writing an image recipe
 - Selecting the packages to build
 - Selecting the file system types

- The various kinds of images
- Inheriting and customizing images
 - Customizing system configuration files (network, mount points, ...)
- Users and groups management
- Package management
 - rpm
 - opkg

Exercise : Writing and building an image recipe

Exercise : Add new users to the image

Exercise : Create an image with package support for OTA deployment

Exercise : Test OTA update on the generated image

Quatrième jour

Development process using the extensible SDK and devtool

- Using devtool to create a package and its recipe
- Using devtool to modify an existing package and recipe
- Using devtool to update a recipe to build a new version of a package

Exercise : Create, test and modify a recipe for an existing package using devtool

Develop and debug applications using SDK and eclipse

- Adding eclipse remote debug packages
- Configuring eclipse

Exercise : Create remote debugging session using eclipse

Writing tasks in python

- Introduction to python
- Using python in Yocto
 - The main bitbake classes
 - Defining variable values in Python
 - Writing tasks in Python

Exercise : Writing a task and customizing a recipe in Python

Porting Yocto

- Porting Yocto to a new board
- BSP architecture
 - Selecting and configuring u-boot recipe
 - Selecting and configuring kernel recipe
- Adding a new BSP layer (yocto-bsp create)

Exercise : Creating a new BSP layer

Cinquième jour

BSP Development

- Adding a custom u-boot to Yocto
- Customizing the Yocto kernel recipe
 - Setting the default configuration
 - Adding patches
 - Specifying the kernel sources
- Configuring Linux Kernel
 - Using menuconfig
 - Using patches

- Creating Configuration Fragments
- Validating Configuration
- Kernel device tree

Exercise : Create u-boot and kernel recipes to use custom versions, test the result

Exercise : Patch kernel and activate new options using a fragment

Exercise : Create and use a new device tree

Out-of-Tree Modules

- Adding modules to image
- Creating an out-of-tree module
- Kernel modules with eSDK

Exercise : Build and test modules

Tailoring the build system

- Setting up a Yocto source cache
 - Local, per system, cache setup
 - Setting up a global, network wide, cache
- Customizing the build system
 - Using a prebuilt toolchain
 - Using a pre-compiled kernel
- Optimizing Yocto build times
 - Using prebuilt, binary, packages
 - Using shared compilation caches

Exercise : Setting up a global source cache

Exercise : Setting up an optimized build environment and rebuilding an image