
congatec x86 BSP (Yocto 2.1)

For Bay Trail and Braswell-Based congatec Modules

Installation Guide

Revision 1.1



Revision History

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1.0	2016.12.20	AEM	<ul style="list-style-type: none">• Official release
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Preface

This guide provides information on how to use Yocto project to build and develop images for congatec modules equipped with Intel Bay Trail and Braswell processors.

The list of congatec modules equipped with Intel Bay Trail and Braswell processors and their respective User's Guide can be found on the congatec AG website at www.congatec.com. For the list of sources of information, see section 7 "References".

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Cautions warn the user about how to prevent damage to hardware or loss of data.



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Terminology

Term	Description
CGOS	congatec Operating System
SSH	Secure Shell
VNC	Virtual Network Computing
API	Application Programming Interface
BSP	Board Support Package
CGEB	congatec Embedded BIOS

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1 Getting Started

This guide provides information on how to build and develop Yocto project 2.1 (Krogoth) image that runs on congatec Bay Trail and Braswell-based modules. The target device is the conga-QA3 in combination with a Qseven baseboard (for example, the conga-QEV2 baseboard).

1.1 Hardware Requirements

- Development build machine
- 100 GB disk space
- 4 GB RAM or more
- 2 CPU cores or more

1.2 Software Requirements

- 64 bit Ubuntu Desktop 14.04 (minimal installation).
 - Download the minimal installation image "mini.iso" from the link below:
<http://archive.ubuntu.com/ubuntu/dists/trusty/main/installer-amd64/current/images/netboot/>
- Swap Partition:
 - Because the Yocto build is memory intensive, we highly recommend that you create a swap partition. The size of the swap partition should be at least equal to the RAM size of the build machine.
- Packages:
 - Install required Ubuntu 14.04 packages

```
$ sudo apt-get update  
$ sudo apt-get upgrade  
$ sudo apt-get install screen gawk wget git-core diffstat unzip texinfo gcc-multilib build-essential chrpath socat libssl-dev
```



We recommend a headless Ubuntu installation to save system resources, increase build speed and simplify system maintenance.

1.3 Fetch the Source Code

```
$ cd ~
$ git clone git://git.yoctoproject.org/poky.git poky -b krogoth
$ cd ~/poky
$ git clone git://git.yoctoproject.org/meta-intel.git -b krogoth
$ git clone https://git.congatec.com/x86/meta-congatec-x86.git -b krogoth
$ git clone git://github.com/meta-qt5/meta-qt5 meta-qt5 -b krogoth
$ git clone git://git.openembedded.org/meta-openembedded -b krogoth
```

1.4 Configure the Build Machine

- Set up the build environment variables and build directory:

```
$ cd ~/poky
$ source oe-init-build-env ~/poky/build
```

- Edit *conf/bblayers.conf* file to append layers:

```
$ nano conf/bblayers.conf
```

- Find the line:

```
/home/<YOUR_USER_NAME>/poky/meta-yocto-bsp
```

- Add the following lines :

```
/home/<YOUR_USER_NAME>/poky/meta-intel \  
/home/<YOUR_USER_NAME>/poky/meta-intel/meta-isg/meta-valleyisland \  
/home/<YOUR_USER_NAME>/poky/meta-intel/meta-tlk \  
/home/<YOUR_USER_NAME>/poky/meta-congatec-x86 \  
\  
/home/<YOUR_USER_NAME>/poky/meta-qt5 \  
/home/<YOUR_USER_NAME>/poky/meta-openembedded/meta-ruby \  
/home/<YOUR_USER_NAME>/poky/meta-openembedded/meta-oe \  
"
```

- Edit `conf/local.conf` file to modify layers:
 - For Bay Trail-based platforms, change the target platform to:

```
MACHINE ?= "congatec-qa3-64"
```

The resulting configuration should look like this:

```
#MACHINE ?= "edgerouter"  
MACHINE ?= "congatec-qa3-64"  
# This sets the default machine to be qemux86 if no other machine is selected:  
MACHINE ??= "qemux86"
```

- For Braswell-based platforms, change the target platform to:

```
MACHINE ?= "congatec-tca4-64"
```

The resulting configuration should look like this:

```
#MACHINE ?= "edgerouter"  
MACHINE ?= "congatec-tca4-64"  
# This sets the default machine to be qemux86 if no other machine is selected:  
MACHINE ??= "qemux86"
```

- For a parallel build, add the following lines at the end of the file if the build machine has a CPU with 4 cores:

```
BB_NUMBER_THREADS ?= "8"  
PARALLEL_MAKE ?= "-j 8"
```



Note
Ensure that your build machine has a CPU with 4 cores or modify the code.

- The `cg-approval` recipe requires `systemd` enabled in your image. Please enable `systemd` in your `conf/local.conf` file:

```
DISTRO_FEATURES_append = "systemd"  
VIRTUAL-RUNTIME_init_manager = "systemd"  
DISTRO_FEATURES_BACKFILL_CONSIDERED = "sysvinit"  
VIRTUAL-RUNTIME_initscripts = ""
```

- Include the "cgos" tools in the image:

```
IMAGE_INSTALL_append = "cgos"
```

- Accept commercial licenses for video encoding/decoding support and check license files:

```
LICENSE_FLAGS_WHITELIST = "commercial"
```

2 Building and Deploying Image

2.1 Building Image

This section shows how to build a minimal headless image. For more information about the application sets in Yocto project, see the Yocto Project Reference Manual.

- Initialize the build environment and build a minimal image:

```
# This step assumes the build environment has been set up.  
$ cd ~\poky  
$ source ~/poky/oe-init-build-env ~/build  
$ bitbake <image-name>
```

The build may take several hours to complete. You can find the generated binary image in the following directory:

```
~/poky/build/tmp/deploy/images/congatec-qa3-64/core-image-minimal-congatec-qa3-64.hddimg
```

If you get the following error: "ERROR: openssh-7.1p2-r0@corei7_64 conflicts with dropbear-2015.71-r0@corei7_64 "

Solution:

- append the following line to conf/local.conf:
TASK_BASIC_SSHDAEMON = "openssh openssh-sftp openssh-sftp-server"
- remove the tmp/ folder and run the build:
\$ bitbake <image-name>.



Optionally, you can build a sato or sato-sdk image.

2.2 Sample Image

congatec AG provides sample images in the software section of the conga-QA3 product page at:

www.congatec.com/products/qseven/conga-qa3.html

You can download and run the sample images on your device or use the images for test purposes. You can find the sample images for other congatec Bay Trail-based products in the software section of the respective product.

- Download sample image and checksum file
Download : `core-image-minimal-congatec-qa3-64.hddimg.sha256`
Download : `core-image-minimal-congatec-qa3-64.hddimg.7z`

– Optionally, you can also download the sato or sato SDK sample image and checksum file:

```
core-image-sato-congatec-qa3-64.hddimg.7z
core-image-sato-congatec-qa3-64.hddimg.sha256
core-image-sato-sdk-congatec-qa3-64.hddimg.7z
core-image-sato-sdk-congatec-qa3-64.hddimg.sha256
```

- Unpack the sample image file
`7z x core-image-minimal-congatec-qa3-64.hddimg.7z`
- Compare the file's hash
`sha256sum core-image-minimal-congatec-qa3-64.hddimg`
`=> SHA_CODE`
`cat core-image-minimal-congatec-qa3-64.hddimg.sha256`
`=> SHA_CODE`



The 7z (7zip) software for windows is not compatible with Linux. Therefore, use only the linux version of 7zip software for file extraction.

2.3 USB Deployment

1. Check if your USB drive is recognized as `/dev/sd?`

```
$ lsblk
```

2. Define the device node as a system variable:

```
$ SD=/dev/sd?
```

3. Enter the following commands to deploy the image on the USB drive:

- For Bay Trail-based platforms

```
$ cd ~/build/tmp/deploy/images/congatec-qa3-64
$ IMAGE=core-image-sato-congatec-qa3-64.hddimg
$ sudo ~/poky/scripts/contrib/mkefidisk.sh "$SD" "$IMAGE" /dev/sda
$ sync
```

- For Braswell-based platforms

```
$ cd ~/build/tmp/deploy/images/congatec-tca4-64
$ IMAGE=core-image-sato-congatec-tca4-64.hddimg
$ sudo ~/poky/scripts/contrib/mkefidisk.sh "$SD" "$IMAGE" /dev/sda
$ sync
```

- For downloaded sample image

```
$ IMAGE=core-image-minimal-congatec-qa3-64.hddimg
$ sudo ~/poky/scripts/contrib/mkefidisk.sh "$SD" "$IMAGE" /dev/sda
$ sync
```



If the target device does not recognize the USB drive, try the following command:

```
$ sudo dd if=/dev/zero of=/dev/sd? bs=1M count=512
$ sync
```

2.4 eMMC Deployment

1. Check if your USB drive is recognized as `/dev/sd?`:

```
$ lsblk
```

2. Define the device node as a system variable:

```
$ SD=/dev/sd?
```

3. Enter the directory of the image and define the image name as a system variable:

- For Bay Trail-based platforms

```
$ cd ~/build/tmp/deploy/images/congatec-qa3-64
```

```
$ IMAGE=core-image-sato-congatec-qa3-64.hddimg
```

- For Braswell-based platforms

```
$ cd ~/build/tmp/deploy/images/congatec-tca4-64
```

```
$ IMAGE=core-image-sato-congatec-tca4-64.hddimg
```

- For downloaded sample image

```
$ IMAGE=core-image-minimal-congatec-qa3-64.hddimg
```

4. Deploy the image on the USB drive:

```
$ sudo dd if=$IMAGE of=$SD bs=2048
```

```
$ sync
```

5. Deploy the image on the eMMC:

- Insert the USB drive into the target system and press F11 key immediately after you turn on the system
- Select the USB device in the BIOS Boot Menu
- Boot from the USB device and wait for the GRUB bootloader options screen
- Select the "install" option and confirm the deployment to `mmcblk0`



Note

1. If `mmcblk` deployment fails, review the installer messages .
2. In case of a boot table issue, overwrite the eMMC's first sector:

```
$ sudo dd if=/dev/zero of=/dev/sd? bs=1M count=512
```

```
$ sync
```

2.5 BIOS Settings

Follow the steps below to set the right BIOS settings for Yocto Project:

1. Insert the USB drive into your target system
2. Enter the BIOS Setup
3. Press F9 to load BIOS defaults
4. Select "Yes" to accept
5. Enter the "Main" tab
6. Check the BIOS version to ensure it is up to date.
7. Enter the "Advanced" tab
8. Select "CSM Configuration"
9. Set "Boot Option filter" to "[UEFI only]"
10. Enter the "Boot" tab
11. Set "Boot Priority Selection" to "[Device Based]"
12. Ensure the USB drive is detected as item "Boot Option #1"
13. Press F10 to save the BIOS changes

3 Testing and Connecting

3.1 Approval Test

All platforms supported by this BSP passed congatec approval test. The approval test recipe is available in the BSP file "cg-approval.bb". This recipe can be used for example to demonstrate how to include hardware support in your custom image.

Modify the conf/local.conf file:

- Enable systemd:

```
DISTRO_FEATURES_append = "systemd"
VIRTUAL-RUNTIME_init_manager = "systemd"
DISTRO_FEATURES_BACKFILL_CONSIDERED = "sysvinit"
VIRTUAL-RUNTIME_initscripts = ""
```
- Include the cg-approval recipe:

```
IMAGE_INSTALL_append = "cg-approval"
```

3.2 SSH Connection

The ssh service runs on the target device by default (started by init scripts) so you can connect to the target device as soon as the boot procedure completes. The device requires a DHCP server on the local network for dynamic IP configuration. You also need to know the target's IP address before you can connect a new ssh session. There are several methods to find out the target's IP address:

- Connect a display to the target and run ifconfig command (write down the MAC and IP address of the target device).
- Open serial port console session and run the ifconfig on the target.
- Use nmap tool or other tools to find out the target device if the target device is connected to a local network and you know its MAC address.

```
sudo nmap -sP <YOUR-LOCAL-NET>.1-254
```

3.3 Serial Console

Serial console is enabled by default with the following settings: 115200 bps, 8 bit, 1 stop bit, no parity.



Serial port wiring is baseboard dependent. Therefore, consult the datasheet/user's guide of your baseboard for serial port wiring, pin-out description and suitable connector. Check also the BIOS setup menu for proper serial port configuration.

3.4 VNC Remote Access

Sato and sato-sdk images provide VNC server (x11vnc – a vnc server). The server is included by default but not started after boot. For security reasons, start the x11vnc manually from a console or create a simple init script.

4 BSP Features and Examples

The congatec BSP contains additional features such as congatec Operating System API (CGOS) and several demo applications. These features are included in the sato and sato sdk sample images provided on congatec website. .

4.1 congatec CGUTIL Recipe

The latest Yocto BSPs support congatec system utility tool (CGUTIL). With this tool, you can:

- update the congatec BIOS firmware
- update the congatec board controller firmware
- configure the local flat panel
- add OEM boot logo, code, add-on module, CMOS default or backup map
- Read out certain BIOS and hardware information
- modify the standard BIOS setup menu (supported only on products with AMIBIOS)



Note

Before you modify the BIOS, use the congatec evaluation baseboard to save a copy of the original system BIOS to an external flash memory chip.



Caution

Do not reset or shutdown the system during modification to avoid possible boot failure

4.2 congatec OS API (CGOS)

CGOS API is a C library that provides access to hardware features such as watchdog, sensors, system buses, memories, board controller etc. The library was primarily designed to support embedded hardware.

With CGOS API, customers benefit from a generic, hardware independent and easy-to-use interface that can be integrated with ease into their applications, to gain access to the onboard functionality without deep knowledge of the hardware details.

The following are some of the CGOS API functions:

- VGA (display control configuration)
- I2C bus
- Storage area access
- Watchdog
- Hardware monitoring (sensors, voltage, fan)

The main component of the CGOS API is an embedded code which is part of the BIOS firmware. It is located in the congatec embedded BIOS (CGEB). The module `cgosdrv.ko` acts as an interface between the kernel and the CGEB firmware. The `libcgos` library provides CGOS support for applications.

The interface between OS and CGEB firmware is provided by the `cgosdrv.ko` kernel module, a dynamic library (`/usr/lib/libcgos.so`) which acts as a `cgosdrv` application interface.

The BSP has two command line demo applications:

- `cgosdump` - displays hardware configuration details.
- `cgosmon` - provides information about the different voltage and temperature sensors on the CPU module.

The CGOS, `cgosdump` and `cgosmon` tools are included in the minimal, `sato` and `sato-sdk` images by default. To include the CGOS API and tools in your project's `local.conf` directory, add the line below:

```
IMAGE_INSTALL_append = "cgos"
```



Note

You can also include the CGOS API in your custom image recipe.

4.3 CGOS I2C Scan Demo Application

The `CGOSDemo I2C` tool is similar to the `i2cdetect` application (from `i2c-tools` package). The tool identifies all available I2C buses and displays the found devices in a per-bus table.

To include the I2C example application in your project's configuration file `local.conf`, add the line below:

```
IMAGE_INSTALL_append = "CGOSDemo-I2C"
```



Note

You can also include the `CGOSDemo-I2C` in your custom image recipe.

CGOSDemo-I2C output :

```
$ CGOSDemo-I2C
Congatec CG0S I2C Example
Bus 0: Primary I2C
 0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
80: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
90: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
a0: a0 -- a2 -- a4 -- a6 -- a8 -- aa -- ac -- ae --
b0: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
c0: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
d0: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
e0: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
f0: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

4.4 Qt5 Demo

The sample image includes a Qt5 demo application. This application is an example of Qt5 application build and integration in a Yocto image provided by the meta-qt5 layer. The demo binary is build automatically and included in sato and sato-sdk sample images.

The qsis recipe can be found at :

```
~/poky/meta-qt5/recipes-qt/qsiv/qsiv_1.1.bb
```

Follow the steps below to test the application:

1. Build and deploy a sato or sato-sdk sample image
2. Boot the image and use a green arrow pointer in the top left corner to switch to a previous desktop screen.
3. Open a terminal console.
4. Start the application with the command:

```
$ qsis -d <jpg-png-gallery-path>
```



Note

The system icons folder can be used as test gallery: `/usr/share/icons/Sato/64x64/apps`.

5 References

- Yocto Project Reference Manual
 - <http://www.yoctoproject.org/docs/current/ref-manual/ref-manual.html>
- List of Available Yocto Layers at:
 - <http://layers.openembedded.org/layerindex/branch/master/layers/>
- Congatec Website
 - <http://www.congatec.com>
- Ubuntu minimal installation website at:
 - <https://help.ubuntu.com/community/Installation/MinimalCD>