



# INTEL EMBEDDED SYSTEMS COMPETITION 2016

More info about software and hardware compatible with Intel® Galileo Gen 2

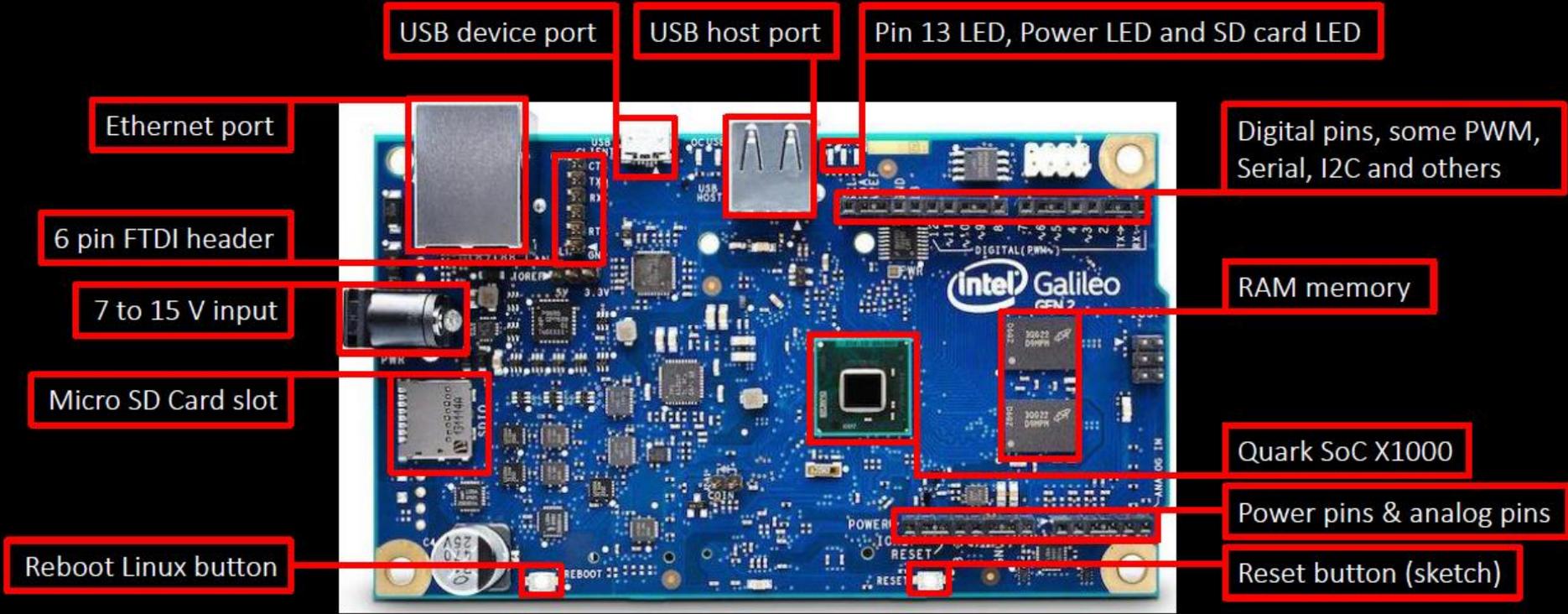
# In this webinar

- Getting started
  - Hardware revision
  - Communicating to the board
  - Firmware update
- Operating Systems Highlights
  - Yocto project based image
  - Debian
  - FreeRTOS
  - Zephyr
  - Wind River\* Rocket\* / Linux
  - Ostro

# In this webinar

- Building a custom kernel
  - Yocto Project
  - Ostro
- Software Highlights
  - Intel XDK IoT Edition
  - Intel System Studio IoT Edition
- General Information
- Q&A

# Intel® Galileo Gen 2 – Hardware Revision



# Communicating to the board

- USB – through Arduino IDE
  - Compile sketches and run Linux commands using the exclusive `system()` function (e.g. `system("ifconfig > /dev/ttyGSO");`)
- SSH – through Ethernet cable or WiFi connection and PuTTY
  - Full access to terminal
  - Require SSH enabled
- SERIAL – through FTDI/USB cable
  - Full access to terminal
  - Great for testing and debugging an image
  - Do not require ssh connection

# System( ) – why you should be careful

- Since sketch task is initiated at boot is important to notice the outcome of shell command parsed as a string on System( ) function
- One **really bad** use is System(“shutdown –h now”); Please don't do it 😊
- In case you did this or something similar, in which you can not rewrite /sketch/sketch.elf file with a new sketch, follow these instructions.
  - Remove the sdcard and plug it in to a Linux host (VM is ok)
  - Find the sketch folder and remove sketch.elf file
  - Eject sd card and insert back in Galileo
  - You now should be able to boot properly

# Firmware Update – option 1

- Update from 1.0.2 to 1.0.4 using the provided tool by Intel
- Download software and tutorial  
<https://downloadcenter.intel.com/download/24748/Intel-Galileo-Firmware-and-Drivers-1-0-4>
- Useful tips:
  - Don't run the program with the sdCard connected
  - Run as administrator (sudo for Linux users)
  - Wait for the board fully boot and be recognized before running the software
  - Make sure you selected the right port

# Firmware Update – option 2

- Update from 1.0.2 to 1.0.4 using a **specific** version of Arduino IDE
- Download software  
<https://downloadcenter.intel.com/download/24782/Intel-Arduino-1-5-3>
- Open IDE and go to Help -> Galileo Firmware Update
- Useful tips:
  - Unzip into **C:/** directory using 7-zip tool
  - Don't run the program with the sdCard connected
  - Wait for the board fully boot and be recognized
  - Make sure you selected the right board and port
  - If Arduino IDE does not open please consider the following solution  
<http://forum.arduino.cc/index.php?topic=234307.0>

# Yocto Project – prebuilt image

- Download EGLIBC image

<https://software.intel.com/en-us/iot/hardware/galileo/downloads>

<http://downloadmirror.intel.com/25384/eng/iot-devkit-201510010757-mmcb1kp0-galileo.direct.xz>

- Unzip with 7zip
- Burn .img or .direct file to micro sdCard (Win32DiskImager or using dd command)

Login: root \*\*no password required\*\*

## Resources:

- Arduino\* IDE support
- Development tools C/C++, Python\*, Node.js\* and OpenJDK 1.8

# Debian

- Download image  
<https://sourceforge.net/projects/galileodebian/files/SD%20card%20Image/>
- Unzip with 7zip
- Burn .img file to micro sdCard

Login: root Password: root

## Resources:

- Familiar Linux environment
- Access to Debian package repository and software updates
- Access to preconfigure Debian packages (e.g. Nano)

# Ostro

- Getting started guide

[https://ostroproject.org/documentation/quick\\_start/quick\\_start.html](https://ostroproject.org/documentation/quick_start/quick_start.html)

- Pre-built images

<https://download.ostroproject.org/>

## Resources:

- OS tailored for IoT smart devices and built with security in mind
- Base OS image can be used as-is or rebuilt (similar structure to Yocto Project)
- Support for Node.js\* , Python\* 2.7, C/C++ and Java\* (preconfigured in ostro-image-swupd-dev-intel-quark)

# FreeRTOS

- Download image and full tutorial  
[http://www.freertos.org/RTOS\\_Intel\\_Quark\\_Galileo\\_GCC.html](http://www.freertos.org/RTOS_Intel_Quark_Galileo_GCC.html)
- Prebuilt examples

Login: root Password: intel

## Resources:

- Provides a predictable (deterministic) execution pattern
- Allows user to assign a priority to each thread of execution (task)
- Provides the core real time scheduling functionality, inter-task communication and timing

# Zephyr

- Getting started and building demo for Galileo
- ❖ Getting started [https://www.zephyrproject.org/doc/getting\\_started/getting\\_started.html#getting-started](https://www.zephyrproject.org/doc/getting_started/getting_started.html#getting-started)
- ❖ Linux install [https://www.zephyrproject.org/doc/getting\\_started/installation\\_linux.html](https://www.zephyrproject.org/doc/getting_started/installation_linux.html)
- ❖ Galileo + Zephyr <https://www.zephyrproject.org/doc/board/galileo.html>
- ❖ Application Development [https://www.zephyrproject.org/doc/application/apps\\_dev\\_process.html](https://www.zephyrproject.org/doc/application/apps_dev_process.html)
- Prebuilt examples

## Resources:

- Real-Time Operating System (RTOS) for IoT
- Small, scalable and modular
- Developed with security in mind
- Offers a microkernel and a nanokernel

# Wind River\* Rocket\*

- Getting started guide  
[https://software.intel.com/sites/default/files/managed/b0/51/Wind\\_River\\_Rocket\\_GETTING\\_STARTED\\_GUIDE.pdf](https://software.intel.com/sites/default/files/managed/b0/51/Wind_River_Rocket_GETTING_STARTED_GUIDE.pdf)
- Free embedded RTOS for IoT

## Resources:

- Kernel based on Zephyr microkernel
- Code and debug applications from any browser
- Cloud-based development environment
- Development in C
- Arduino\* API
- Require serial connection (FTDI cable)

# Wind River\* Linux\*

- Initial setup  
[https://software.intel.com/sites/default/files/managed/b0/51/Wind\\_River\\_Rocket\\_GETTING\\_STARTED\\_GUIDE.pdf](https://software.intel.com/sites/default/files/managed/b0/51/Wind_River_Rocket_GETTING_STARTED_GUIDE.pdf)
- Access your account on Wind River® Helix™ App Cloud, select New Device -> Create a new device from the supported SDK -> follow the provided instructions

## Resources:

- Code and debug applications from any browser
- Cloud-based development environment
- Development in C/C++ and Node.js\*
- Require internet access and be on the same network with cloud workspace

# Building a custom kernel

*Why one might want to compile a custom kernel?*

- ✓ Gain more control over the embedded application
- ✓ Performance – compile only what's necessary
- ✓ Better use of resources – reduce overhead
- ✓ Knowledge - Learn more about the kernel

# Building a custom kernel – Yocto Project (1)

- BSP 1.2.1
- Tutorial and needed files  
<https://downloadcenter.intel.com/download/23197/Intel-Quark-BSP?product=79084>
- Offers:
  - Prebuilt Python\* 2.7
  - Easy connection to wireless networks with connmanctl
  - Kernel version 3.14.28
  - Opkg package manager
- Built and validated on Debian 7 and 8

# Building a custom kernel – Yocto Project (2)

- Devkit Daisy 1.6.1
- Tutorial <http://www.embarcados.com.br/galileo-yocto/>
- Offers:
  - Support to Python\* 2.7, Node.js\* and Arduino\* IDE
  - MRAA and UPM libraries
  - Easy connection to wireless networks with connmanctl
  - Kernel version 3.8.7
- Built and validated on Ubuntu 12.04 and Debian 7 and 8

# Building a custom kernel – Ostro

- Tutorial  
<https://ostroproject.org/documentation/howtos/building-images.html#building-images>
- Based on Yocto Project
- Offers:
  - Support to GCC, Python\* 2.7, Node.js\* and OpenJDK 1.8
  - Easy connection to wireless networks with connmanctl
  - Kernel version 4.4.9
- Built and validated on Debian 7 and 8

*“We should forget about small efficiencies, say about 97% of the time: premature optimization is the root of all evil.”*

—Donald Knuth

Making Embedded Systems by Elecia White – O’Reilly, 2011

# Intel® System Studio IoT Edition

- Plugin for Eclipse\* that allows to connect to, update, and program IoT projects on a compatible board
- C/C++ and Java

## Tips:

- For Windows\* users it may help have installed MinGW (with all basic tools)
- Requires Java\* JDK 1.8+, if Eclipse\* does not automatically find it, please consider the following: Window -> Preferences -> Java -> Installed JREs -> Add -> Standard VM -> JRE Home (set path to jdk1.8\_x) -> Finish -> unselect jre8 -> Ok

# Intel® XDK IoT Edition

- IDE for JavaScript\* and Node.js\* programming
- User guide  
<https://software.intel.com/en-us/getting-started-with-the-intel-xdk-iot-edition>

## Resources:

- Enables easy on-board app development and deployment
- Deploy, run and debug in the same place
- Provides quick start templates and samples
- Integrates with cloud, web services, and sensors through JavaScript APIs
- HTML5 app creation

# Intel® Galileo (Gen 2) – Network Connectivity

- While the Galileo board doesn't come with Wi-Fi connectivity, you can add to it.
- Any Linux-supported Wi-Fi card should work.
- Both wired and wireless connectivity settings can also be managed through the `connmanctl` tool.
- Link for Intel Centrino drivers  
<https://wireless.wiki.kernel.org/en/users/Drivers/iwlwifi>



# Configuring Package Repository – Intel Galileo

- OPKG is the package manager of Yocto images (usage e.g. `opkg install nodejs-npm`)
- To update the paths, please consider the following guide:

In **/etc/opkg** we are going to edit *iotdk.conf* and *mraa-upm.conf*

## For **iotdk.conf**:

```
src iotdk-i586 http://iotdk.intel.com/repos/3.0/iotdk/i586/  
src iotdk-intel-core-2-32 http://iotdk.intel.com/repos/3.0/iotdk/intel\_core2\_32/  
src iotdk-quark http://iotdk.intel.com/repos/3.0/iotdk/quark/  
src iotdk-x86 http://iotdk.intel.com/repos/3.0/iotdk/x86/  
src iotdk-core-2-32 http://iotdk.intel.com/repos/3.0/iotdk/core2-32/
```

## For **mraa-upm.conf**:

```
src mraa-upm http://iotdk.intel.com/repos/3.0/intelgalactic/opkg/i586/
```

# Intel® Galileo and Embedded Systems– Useful books

- Embedded Linux Development with Yocto Project by Otavio Salvador; Daiane Angolini – Packt, 2014
- Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers by Manoel Carlos Ramon – Apress, 2015
- Internet of Things with Intel Galileo by Miguel de Sousa – Packt, 2015
- Node.js for Embedded Systems by Patrick Mulder; Kelsey Breseman – O'Reilly, 2016 (early release)

# Intel® Galileo – Useful links

- Galileo downloads:  
<https://software.intel.com/en-us/iot/hardware/galileo/downloads>
- Galileo IDE downloads: <https://software.intel.com/en-us/iot/software/ide>
- Yocto Project Development Manual:  
<http://www.yoctoproject.org/docs/current/dev-manual/dev-manual.html>
- Videos Competition - Intel Embedded Systems 2015:  
[https://www.youtube.com/playlist?list=PLdv8QZ\\_rwBOdwKX-LVTrv62MQfYiJ2XTk](https://www.youtube.com/playlist?list=PLdv8QZ_rwBOdwKX-LVTrv62MQfYiJ2XTk)
- Our website:  
<http://sbesc.lisha.ufsc.br/sbesc2016/Intel+Embedded+Systems+Competition>

# Don't forget...

- Keep your schedule up-to-date weekly
- Got a question? Ask us!

[submissaocompeticaointel@gmail.com](mailto:submissaocompeticaointel@gmail.com)

## Next Webinar...

- August 23 – 15h00
- August 24 – 10h30

## Next Deadline...

- September 20 – Partial Report Submission  
(through JEMS)

