## Course Overview:

RTOSs have become a critical component in IoT devices to manage the devices real-time behavior. Leveraging a connected RTOS framework can dramatically accelerate development by decreasing the time required to setup and secure a device but it can also cause delays and budget overruns if developers don't understand the frameworks architecture and how to build their application around it.

In this course, we will examine the Amazon FreeRTOS framework and learn how to build an extensible and reusable application architecture around it. We will examine how Amazon Web Services works and the steps necessary to configure microcontrollers to run it and handle bi-directional communication with the cloud. Attendees will also learn how about how to optimize their design for size, performance and energy. Each session includes a hands-on lab to help developers get experience with the concepts we discuss during the lectures and will also leverage Percepio Tracealyzer to peer into how the application and framework works.

## Who Should Attend?

Attendees are engineers and managers who are interested in developing IoT products that use Amazon Web Services and Amazon FreeRTOS. The course is appropriate for attendees who want to get up to speed on Amazon FreeRTOS quickly and avoid pitfalls that could cause major delays, costs or problems with developing an IoT product.

## Key Take-a-ways:

- Hands-on experience using Amazon FreeRTOS
- The Amazon FreeRTOS Architecture
- Setting up and developing Amazon FreeRTOS applications
- How to configure Amazon Web Services for IoT devices
- Understanding the subscriber/publisher model
- Over-The-Air Updates
- Best practices for using Amazon FreeRTOS

## Course Format:

This course is offered live online, as a self-paced course. Public and on-site courses are available on request.

## Cost:

Single Regular:     $750   USD
Group Rates: Contact jacob@beningo.com

## Contact Information:

Jacob Beningo
jacob@beningo.com
P.O. Box 400
Linden, Mi 48451

## Sessions Overview:

Session 1 – The Amazon FreeRTOS Architecture
- The IoT Architecture
- Amazon FreeRTOS hardware support
- Amazons IoT Console
- Downloading and Configuring Amazon FreeRTOS
- Introduction to Amazon FreeRTOS software architecture
- Measuring baseline behavior
- Configuration management
- Best Practices

Session 2 – All about AWS
- AWS Overview
- Creating Things
- Generating certificates and keys
- Writing user policies
- Device provisioning
- Connecting to the server
- Best Practices

Session 3 – Subscribing and Publishing
- Understanding the publish and subscribe model
- The demonstration code
- Issues and short comings
- Extending the subscription capabilities
- Developing application ready publishing functionality
- The MQTT console
- Best Practices

Session 4 – Command processing, performance and optimization
- RTOS receive mechanism
- How to process a MQTT message
- A reusable MQTT message parser
- Measuring application performance
- Concerns and potential issues
- Optimization recommendations
- Best Practices

Session 5 – OTA Updates
- Introduction to OTA
- AWS configuration
- AWS Jobs
- The Amazon FreeRTOS firmware update demonstration
- Examining the architecture
- Best Practices
- Next steps

Note: Each lecture has an associated lab.

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## Frequently Asked Questions (FAQ):

**How long do I have access to the course materials for?**

Attendees have access to the materials indefinitely. Attendees not only get to keep the materials and recordings but may also attend any online live runs of the class at any point in the future and will also get access to any updates to the course.

**What hardware and toolchain does the course use?**

Amazon FreeRTOS is supported by several different silicon vendors and the list is growing every day. The course is designed to work with any of these boards. You choose your board at:

https://aws.amazon.com/freertos/getting-started/

You can then order the board from your favorite electronics distributor.

**What format is the course offered in?**

The courses are offered in three different formats:
- Live Online w/ access to recording (self-paced materials)
- Self-paced online
- Public
- Company On-site courses

**Is there a discount for multiple people to attend?**

Yes. There is a discount for 3+ attendees. Please contact us for details.

**How are the online live sessions hosted?**

Live sessions are hosted through GoTo Webinar. After sign-up, you will receive the link to registered for the online sessions about a week before they start. If you miss an online session, the recording is usually posted to the course site within 24 hours.

**How do I access the course materials?**

Course materials are hosted at https://beningo.mykajabi.com/library. After ordering, you will receive a username and login to access the materials.

**If I attend a live course, do I still get access to the online course?**

Yes. If you attend a course live online or in person, you will get access to the self-paced recordings and materials that you can then reference and access at a later date.

# Lecturer Background

Jacob Beningo is a Certified Software Development Professional (CSDP), chair of the IEEE South Eastern Michigan Consultants Affinity Group, an independent consultant and lecturer who specializes in the design of embedded software for resource constrained and low energy mobile devices. He has successfully completed projects across a number of industries including automotive, defense, medical and space. He enjoys developing and teaching real-time and reusable software development techniques using the latest methods and tools. He blogs for EDN.com about embedded system design techniques and challenges. Jacob holds bachelor's degrees in Electrical Engineering, Physics and Mathematics from Central Michigan University and a Master's degree in Space Systems Engineering from the University of Michigan.

Additional resources, templates and Jacob's monthly embedded software newsletter can be found at www.beningo.com . Check out his other workshops at http://www.beningo.com/services/workshops/

Click the social media link below to follow Jacob and get more tips and tricks:

Blogs can be found at the following sites by clicking the image:

# Testimonials

"I would like to express my gratitude to Mr. Beningo for putting together this bootloader class. His excellent teaching skills made the training very enjoyable. The videos and material provided, including the laboratories, contributed to my success in understanding that topic.  It was also very comforting to know that whenever I had a question he was always available.  I cannot wait to put this knowledge into practice! I recommend this class to anyone serious about embedded system design and engineering."

-- Michel Bédard


"Thank you for the extra materials and the course – I now understand better some issues specific for embedded systems, I also learned few things I didn't know yet. It definitely influences my performance in daily work (IP and its driver prototyping in embedded system) and already allowed me to successfully debug some strange behavior"

-- Arek Golec


"In addition to having an extremely high level of expertise with regard to architecting and implementing embedded software and real-time embedded systems, Jacob has a rare talent for communication. His cheerful disposition, enthusiasm, and depth of knowledge make Jacob one of the most popular presenters at the Embedded Systems Conference (ESC). Jacob's sessions are always well-attended (often standing room only) and well-received by the attendees."

-- Clive "Max" Maxfield, Editorial Director, Embedded.com, and Technical Content Director, ESC


 "Jacob Beningo conducted a 5-session hands-on class on the fundamentals of microcontrollers for EETimes University, that was sponsored by STMicroelectronics. While the "fundamentals" approach was familiar, we added the unique hands-on wrinkle and Jacob proved to be an excellent instructor. He adapted seminar material we supplied and patiently walked the on-line class through lessons while contributed to their learning about the valuable features of the provided STM32 microcontroller and Discovery Kit. His success in leading the class was amply demonstrated in the outstanding participant engagement during the sessions and in their comments and feedback afterwards."

-- Michael Markowitz, Director Technical Media Relations, STMicroelectronics