

Automated Hierarchical Stock Inventory Management with IoT and cloud based solutions. A Risc V story.

A late breaking paper.

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Abstract:

We are entering a new era in automation, where AWS or Azure cloud based IoT solutions are being used to automate stock inventory management and retail. Inspired by Amazon's Go store franchise, the author has developed the Go-Pi box as a primary retail cache with a feed from a secondary warehouse cache with innovative IoT based inventory stock keeping. With the increased societal and academic pressure for an experimental approach, the author proposes an experimental methodology of data collection, using a network of pi-boxes on a pilot basis, using Amazon Go technology, in collaboration with Amazon, for a viability check, using predictive analytics, of the evolution of retail e-commerce to a multi tier cache based Pi-Box called "Just Walk Out". (["Just Walk Out"* n.d.](#))*

The pertinent research problems are:

1. Development of a flexible plastic system on chip, with passive power sources, to evolve an RFID based solution to an IoT and cloud/SaaS based solution using the things network with NFC/Lora/SigFox for connectivity.
2. Evolution of the humble vending machine to a smaller Amazon Go retail experience.

While Amazon franchises its deep learning based shopping experience, I would like to use that technology with the Go-Pi, a democratized vending machine, that logs peoples donations and gives credit for that while selling Amazon Go products as well as offering the donations for free to people with the app. While we develop better automated stock management for both the warehouse feed and the Pi box.

Keywords: SAP, AWS, Leonardo IoT, EBF, GreenGrass, FreeRTOS, Pi-Box, Just Go Out, Amazon Go, conversational CRM with Amazon Lex.

Introduction.

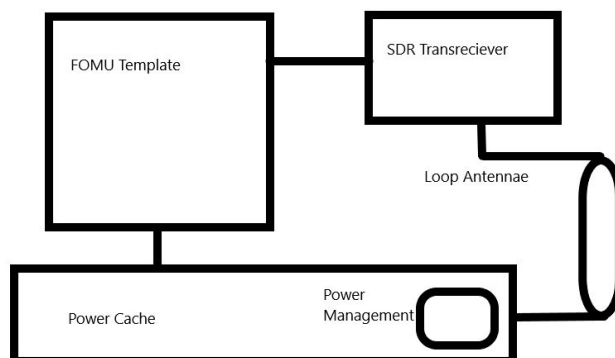
ARM Cortex based IoT architectures.

The Arm cortex M0 is the architecture PragmaticIC used to create inexpensive IoT solutions for automated stock auditing and inventory management. “The [PR1100](#) product series ([PR1101](#) and [PR1102](#)) facilitates rapid detection of objects when one or more low-cost custom readers are integrated into the system. Designed for proximity identification applications, these FlexICs are ideal for applications including hierarchical inventory management, item identification, and tracking, supply chain assurance and brand authentication. They are targeted at market segments such as food and beverage, personal and home care, pharmaceutical, and healthcare. They also support the introduction of digital interactivity into physical toys and games. [Click here to learn more about PR1100 Products.](#)”(“PragmatIC Introduces Ultra-Low Cost Flexible RFID ICs” n.d.)

While IoT replaces RFID, the PR1100 is just the beginning, the author intends developing, very low power architectures, of RISC V architectures, exclusively for the food industry for hierarchical inventory management solutions.

FreeRTOS and AWS with HANA on FOMU-Ex.

FOMU-Ex extends FOMU with a wireless antennae chip and integrated power management from ambient RF power, along with an RF Transceiver ASIC for a SDR implementation with a tape battery and power management asic.



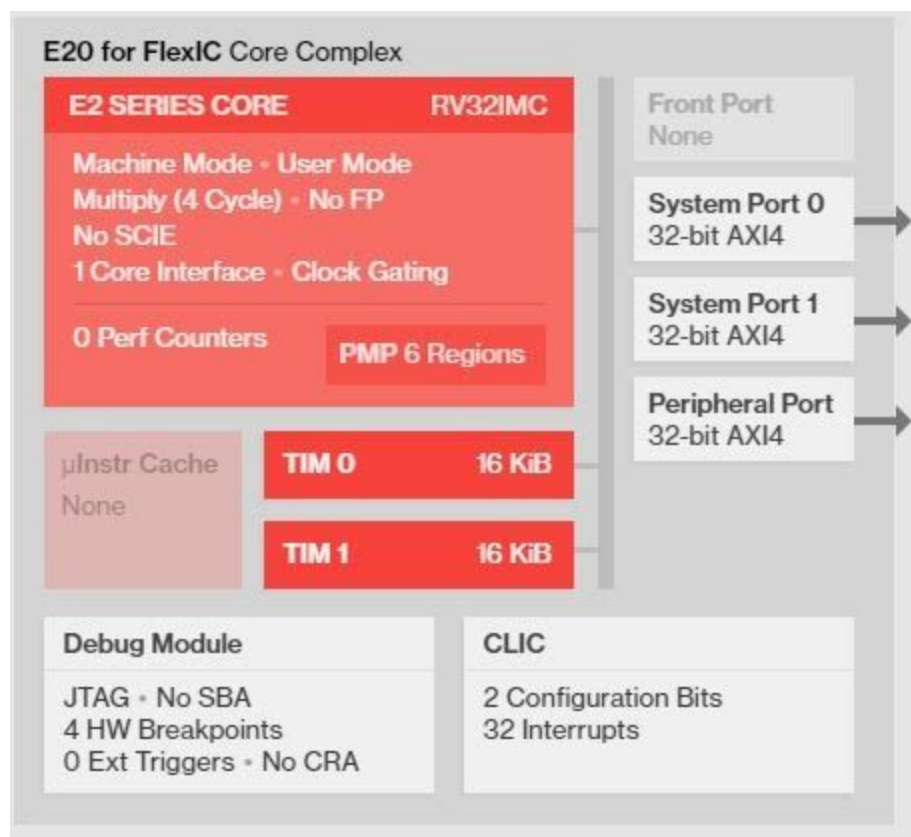
The E20 core is loaded on the FOMU with FreeRTOS compiled for the RISC V ISA, and I/O to the transceiver, to implement a sdr for IoT, both 4g and 5g LTE/ NFC for passive tagging for IoT, for the food industry.

We consider a @edge version of HANA and an AWS version of HANA, integrated with edge circuitry for IoT, using FreeRTOS and AWS.

The sifive E20 core.

Sifive is an innovator of micro core RISC V architectures, for IoT end uses, in this paper we explore the customization of the E20 core for IoT use using the FOMU-Ex as a Flex circuit, easily printed on a flex design.

The sifive portal, (“Core Designer - SiFive” n.d.) provides a user interface for the customization of the E20 core for IoT use. In this paper we describe design tradeoffs in the use of the E20 for food product inventory management , as a backup technology to Amazon's Just Walk out and Prime Hub based inventory management, based on multi sensor integration and deep learning.

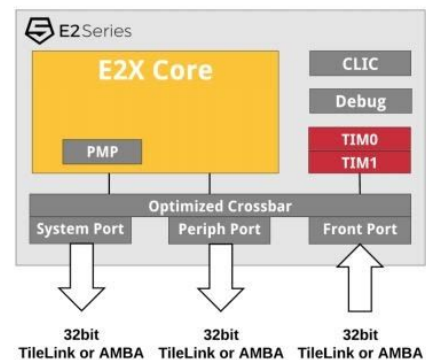


Comparison of E20 with ARM M0

E20 has 28% more performance vs Cortex-M0+ (“[No Title]” n.d.).

The Smallest, Most Efficient RISC-V MCU Family

- **E2 Series core architectural overview**
 - RV32IMACF capable core
 - 2-3 stage, optional, Harvard Pipeline
- **Configurable to meet application specific needs**
 - Ability to add multiple outbound Ports of different specifications
 - Optional Tightly Integrated Memory (TIM)
 - Flexible address map
 - Optional FPU, tunable Multiply performance, Memory Protection, and more...
- **First RISC-V core with support for the RISC-V Core Local Interrupt Controller (CLIC)**
 - Execute first instruction of a C handler in **6 cycles**
 - Hardware interrupt prioritization and nesting
- **Drop In Cortex-M0+ and Cortex-M3/M4 replacement**
 - E21 has 12% more performance vs Cortex-M4
 - **E20 has 28% more performance vs Cortex-M0+**



Tightly Coupled memory and unified Instruction and Data Caching.

The E20 features a 2 or 3 stage harvard pipeline, which greatly accelerates performance, even without an FP unit, which is unnecessary for IoT applications, like shelf life monitoring, data mining and cloud interface, through NFC and @edge computing.

The harvard pipeline has a prediction architecture, which contributes to much of the increased performance gains, compared to ARM M0.

Single private instruction caches per L1 core in the two cluster in E20 is proven more efficient, analogous to GPGPU architectures. (“[No Title]” n.d.) .

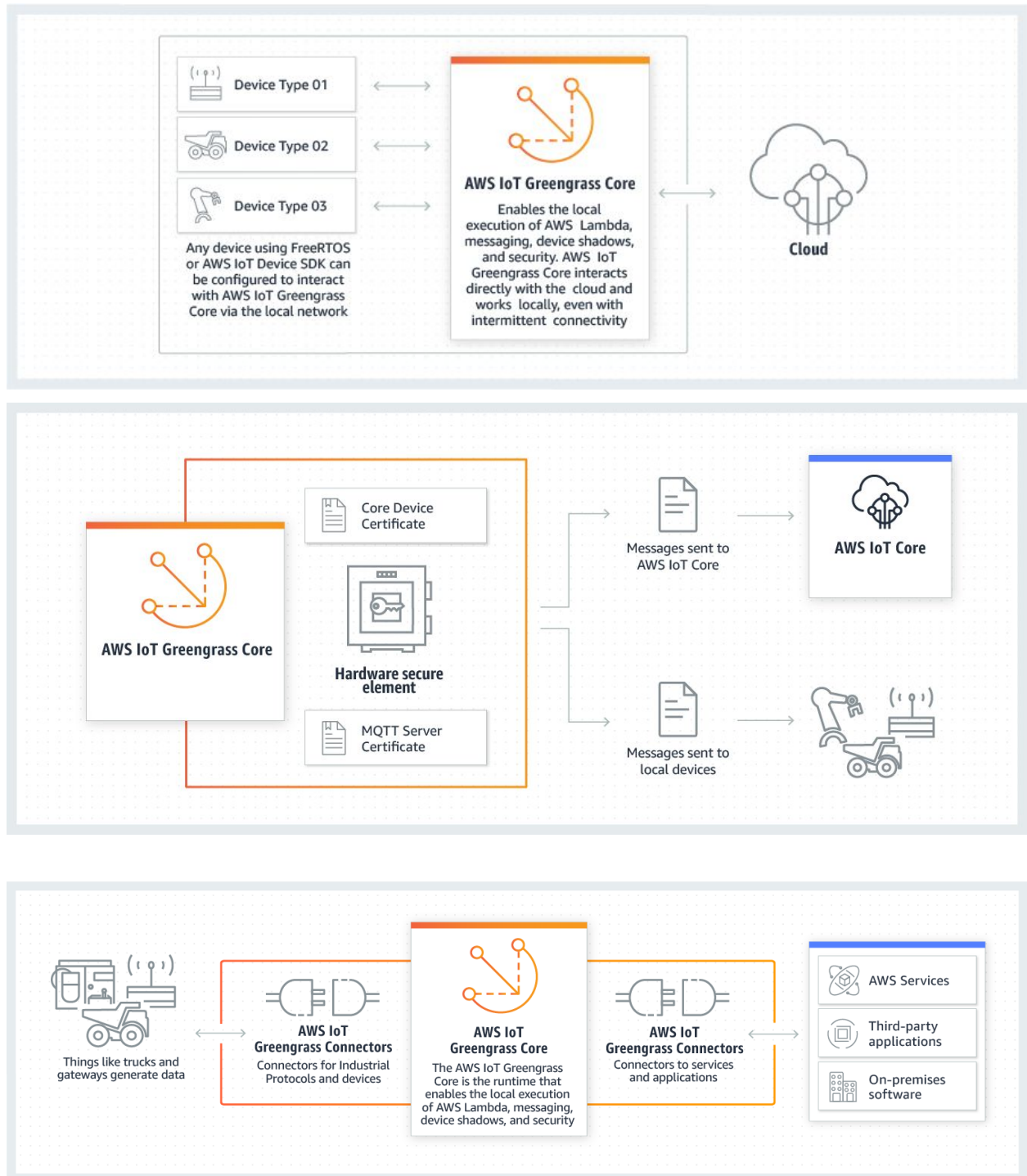
FreeRTOS on E20.

The FOMU-Ex is directly amenable to an FreeRTOS implementation on a E20 core, with NFC connectivity to @edge hardware with AWS integration. It has 128 Kb of RAM and 2048 Kb of Flash RAM, enough for the E20 core and an SDR core. (“Fomu - An FPGA Which Fits in Your USB Port” n.d.)

AWS Integration.

The FreeRTOS integration with AWS , uses an sdk for AWS upload.(aws n.d.) is a light weight on FOMU-Ex option, with GreenGrass providing the structure for edge gateway management.

GreenGrass IoT will support SAP EBF or enterprise business functions. (“AWS and SAP Announce IoT Interoperability Solution | Amazon Web Services” 2019a)



("AWS IoT Greengrass - Amazon Web Services" n.d.)

SAP Leonardo IoT and EBF on AWS for material management and multi cache models of Hierarchical Inventory Management.

Material management solutions for IoT with SAP Leonardo IoT on AWS.: EBFs and models.

S2 has a donor/consumer retail relationship, with the pi-box accepting and accrediting retail donations, with merit attributed to good samaritanism.

Thing Engineering, enables an object model of sensors with an accessibility model for assets and people, coupled with material management for physical good.

This leads to the use of IoT ML and a rule based system for (S1, [S2], [S3]).

Discussion and Future work.

The sensor integration, Things and Tenant model with the rule description for the people - things access rules for the (S1, [S2], [S3]) cache with an integration of an AWS based conversational CRM system and UI are the topics of a future publication.

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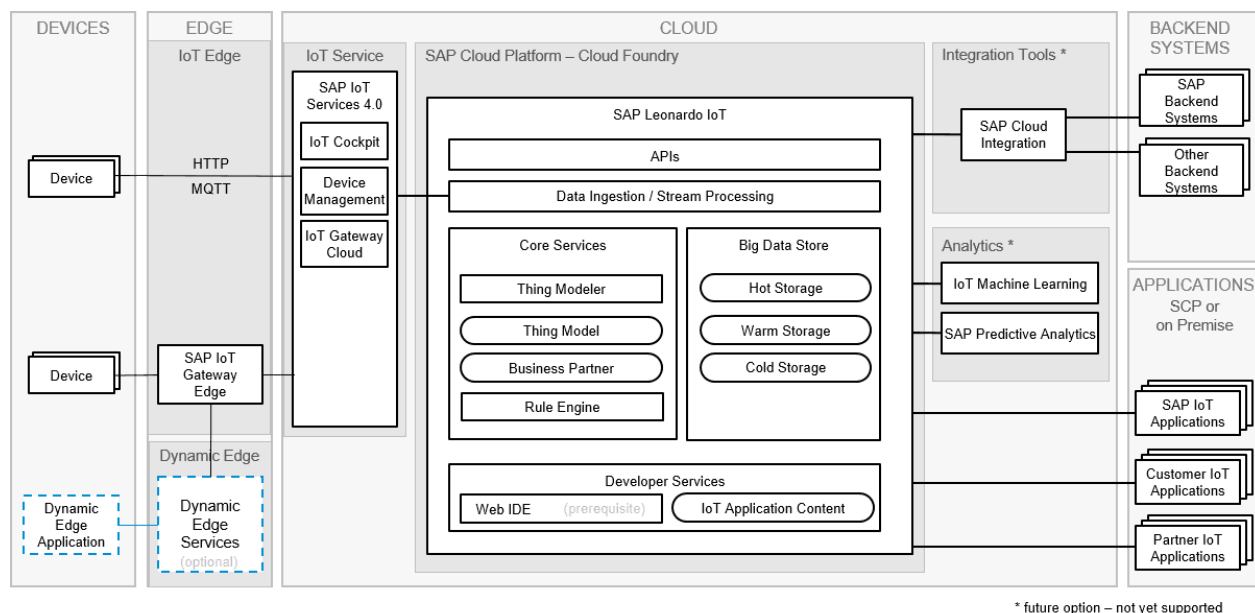
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