A Formal Modeling Framework for Dependable and Portable Embedded Operating Systems

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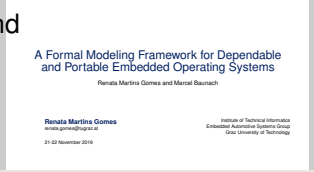
21-22 November 2019



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Long title for a 10-minute talk!
Let's go by parts.

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I guess you all know what OS means...

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Not talking about desktop Linux, Windows...
Focus on IoT:
devices embedded into our environment,
ranging from small and simple sensor devices to complex ECUs inside cars.

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The OS must be dependable:
safe, secure, available, reliable, etc...

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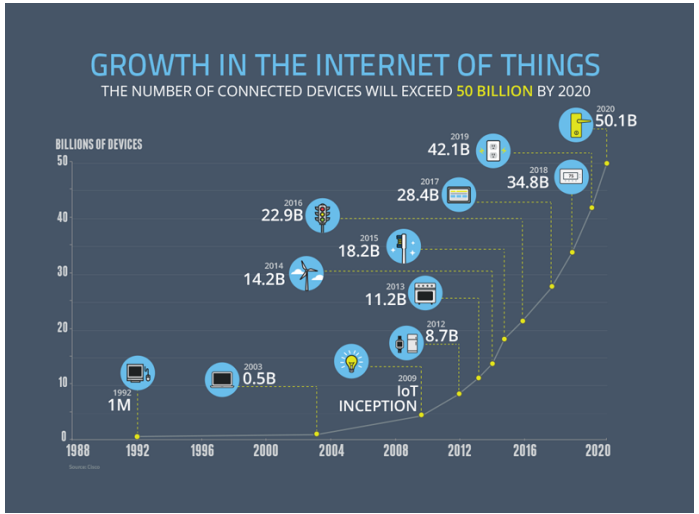
Isn't it solved yet?
you can separate code: compiled for all devices (**high-level**)
from code that must be rewritten or adapted (**low-level**)

To port low-level, you must be an expert on both sides: HW and SW

- How to test it? You know there are bugs hiding!
- Do you even know what you must implement? Is there any specification?
- And how can you assess the dependability of each port?
- Including functional and non-functional behavior? Do all ports behave as they should?

Ah but we only do this for a couple of devices! Is it really? Or the OSs only support a couple of devices because they are not that portable?
Much better if it can run anywhere (like Android?)



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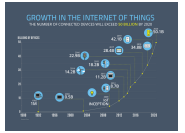

- Billions of devices
- Variety of devices
- dependability requirements
- specialized and reconfigurable HW

Finally, what is our plan to solve this?
Don't get scared, but... formal methods!

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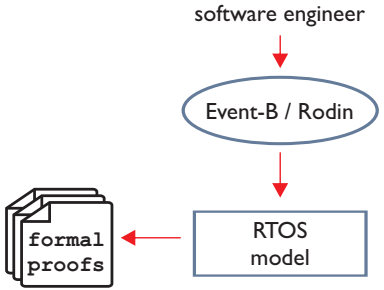
Model the OS's intended low-level functionality,
automatically generate low-level code for target devices.



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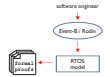
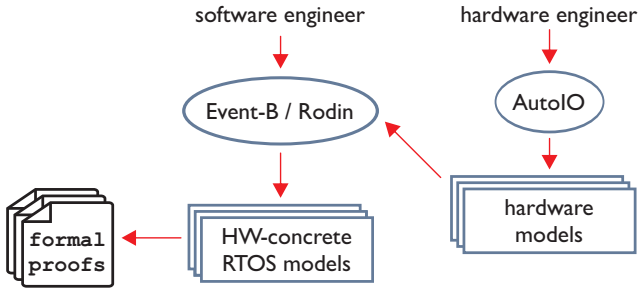


Formally model the RTOS considering generic HW
bonus: FM improve SW quality. We can verify the model for safety, correctness, non-functional properties...

Event-B: formal method based on set theory and state transitions.



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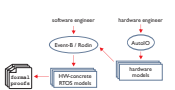
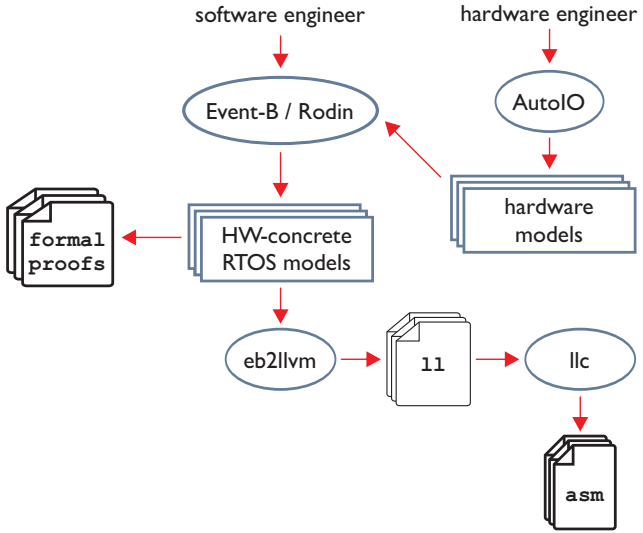
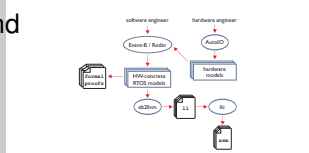


With generic model ready and verified, we instantiate it with HW models and verify again
(modeling part under review)





Code generation (work in progress)
inputs welcome!

convert math language (Event-B) into LLVM Intermediate Representation
can be compiled to target code.

can already generate some code, but some HW-specifics from the model must still be translated
(e.g. registers cannot always be selected by the compiler. Intrinsics?

Thank you!

Ideas, feedback, questions? Get in touch!
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