

The Use of Hardware Simulation in Smartphone Projects

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Background

- S60 smartphones are feature-rich mobile phones
- The S60 platform
 - An open mobile software platform by Nokia
 - Built on top of Symbian OS
 - Licensed by several mobile phone manufacturers
 - The leading smartphone platform in the world



Research Problem

- Time-to-market is too long
 - Smartphones are complex embedded systems
 - Hardware available relatively late
 - The risk of delays is comparatively high
- Virtual platforms
 - Could they speed up the overall process?
 - Could they reduce the risk of missing the intended market window?
 - What can be developed/tested on virtual platforms?
 - How reliable are the results?

Research Methods

- Investigating the feasibility of virtual platforms by
 - Creating an S60 environment on
 - Hardware (OMAP2420 Software Development Platform)
 - Virtual platform (Virtio VPOM-2420 Virtual Platform)
 - Defining and executing several use cases
 - Performance measurements
 - Boot up time
 - Disk/memory write and read
 - Functionality tests

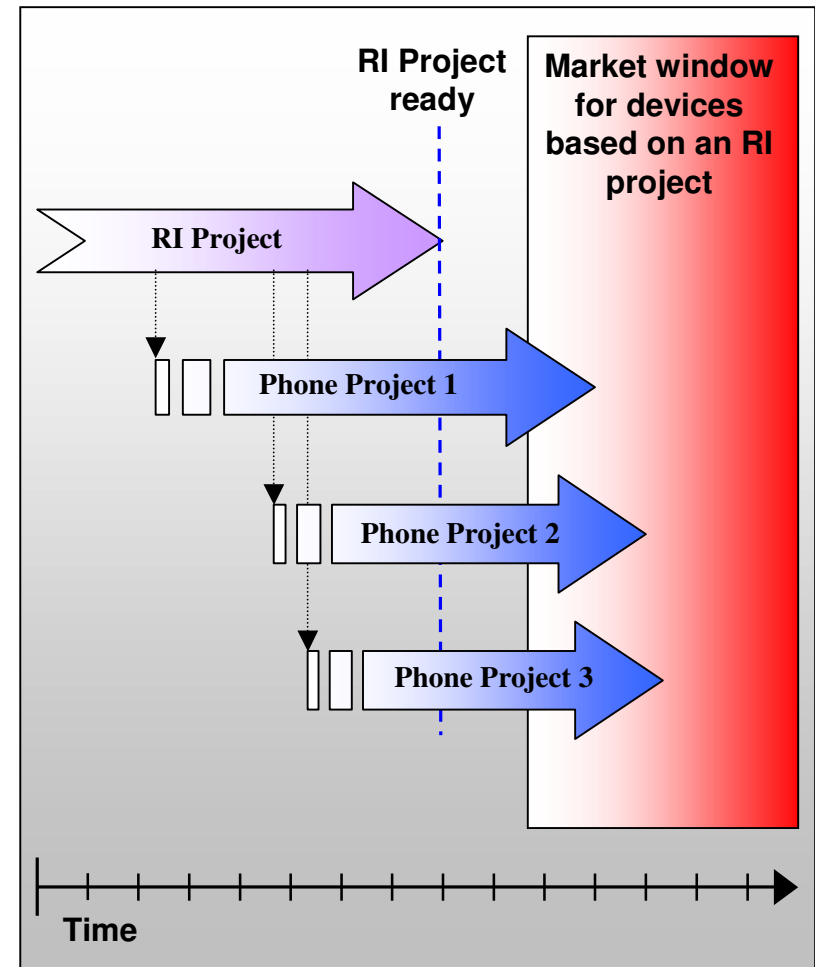


S60 Reference Implementations

- Model designs for developing S60 devices
- Pre-integrated products
- Roughly 50 – 80 % of the complete product

S60 Reference Implementations

- Opening up a possibility to
 - Reduce the development costs
 - Shorten the time-to-market
- Reducing the risk of missing the intended market window
- Increasing the competitiveness of the chipset vendor

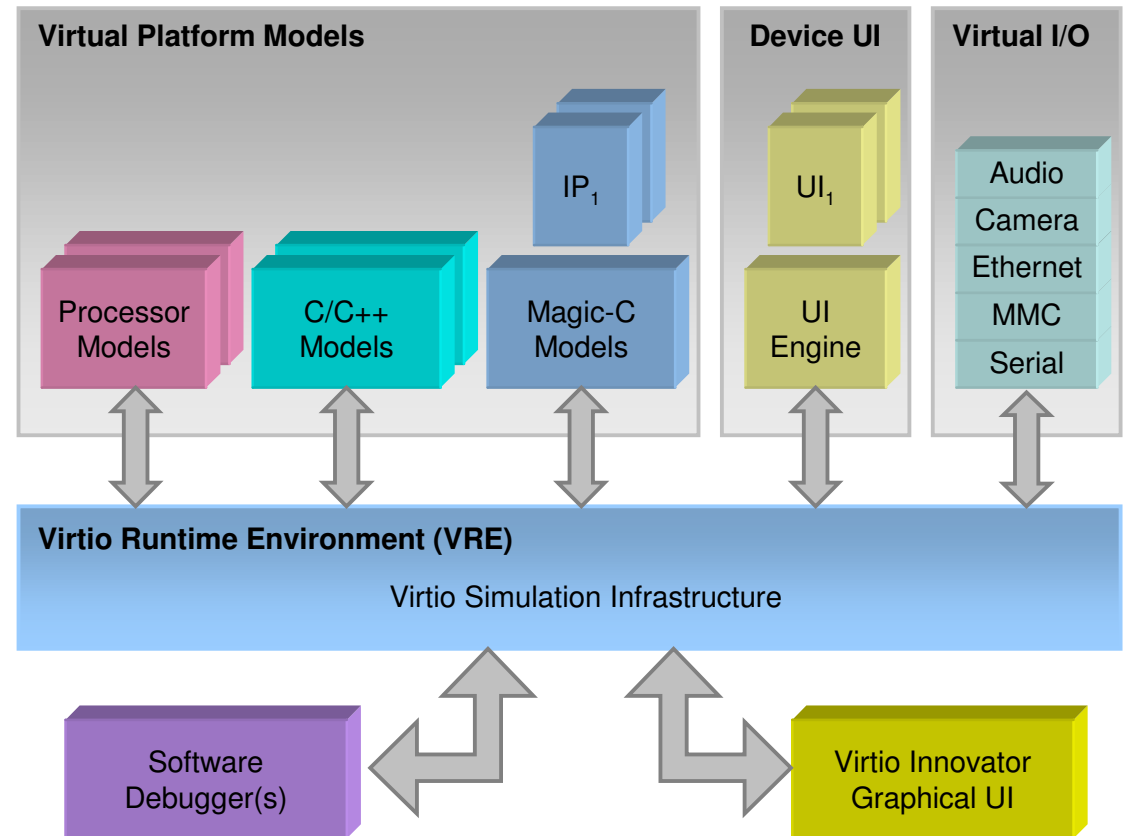


Virtual Platforms

- Emulator environments, emulating embedded development boards / devices on a PC
- Providing target binary compatible environments
 - Advantage over the *WINS* emulator
- Available before the actual hardware exists
 - SW development can be started in parallel with the hardware design


Virtio VPOM-2420 Virtual Platform

- Models OMAP2420 Software Development Platform
- Real world connectivity via the Windows OS
- Advanced debugging capabilities
- Online distribution of hardware models



Limitations of VPOM-2420

- Instruction accurate instead of cycle accurate
 - Clock cycle details not modeled
 - May cause problems in timing critical device driver development and performance optimization
- Only a subset of the hardware functionality and peripherals modeled
 - E.g. no modem, WLAN, Bluetooth or IrDA
 - Limited power management modeling



Results - General

- Relatively large number of bugs found from VPOM-2420 Virtual Platform
 - A lot of debugging was required
- Easy to debug
- Virtio support excellent

Results - Functionality

- Exactly the same S60 software booted up on both environments
- Tests did not reveal any significant differences in functionality
 - Corrections to the existing models needed to achieve this result
 - Problems with some hardware drivers on the virtual platform

Test case	Result VPOM-2420	Result OMAP2420	Comments
Phonebook	OK	OK	
Clock	OK	OK	VPOM-2420: The system time running about three times slower than real time
Camera	OK	OK	VPOM-2420: Camera application can be launched only once
RealOne Player	FAIL	FAIL	Similar error on both environments
Memory Card	OK	OK	VPOM-2420: Parameter tweaking required to get the memory card to work
Application Installer	OK	OK	VPOM-2420: Parameter tweaking required to get the memory card to work
Basic Call	FAIL	FAIL	Similar error on both environments

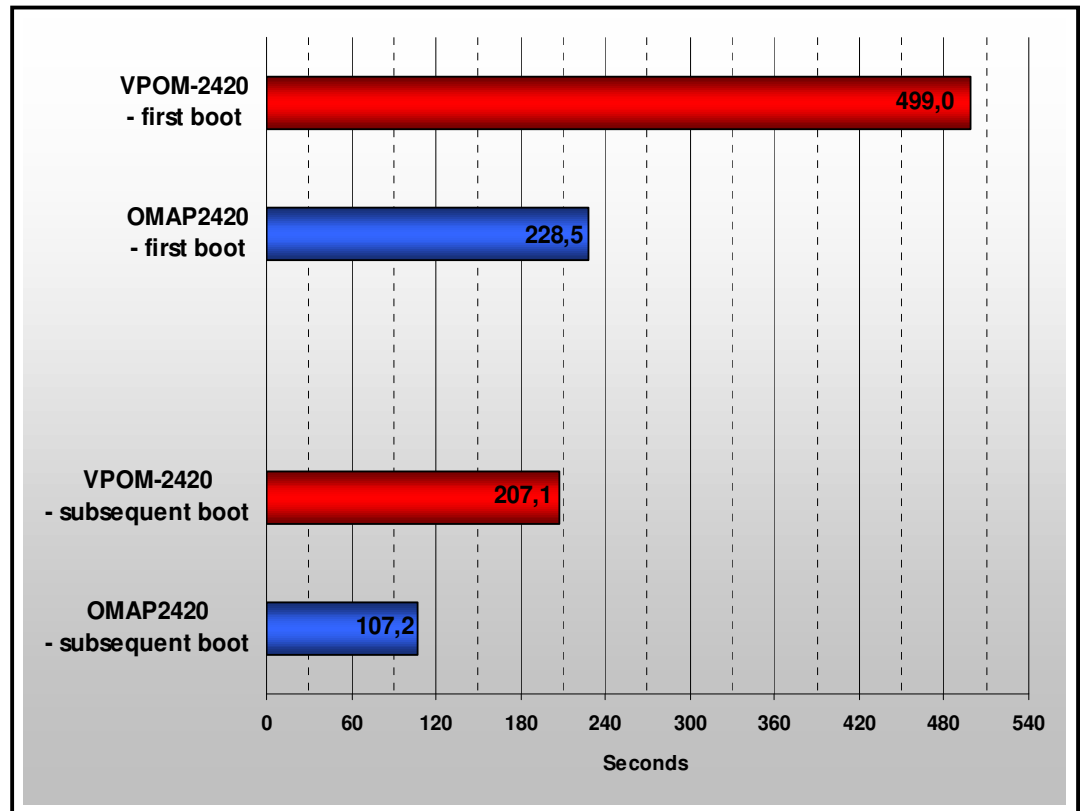
Results - Performance

- VPOM-2420 performance very poor with the default settings
- Performance could be brought up to a relatively good level with model updates and parameter tweaking
 - The virtual platform approximately two to three times slower than the actual hardware
 - In some functionality areas more significant differences were measured
- The state of the Windows OS affects the performance of the virtual platform

Performance Results Example

S60 Boot Up Time

Environment Full boot up	Average in seconds	Standard Deviation
VPOM-2420 - first boot	499,0	5,21
OMAP2420 - first boot	228,5	0,19
VPOM-2420 - subsequent boot	207,1	1,08
OMAP2420 - subsequent boot	107,2	0,37



Conclusions

- Advanced debugging capabilities
 - Improve efficiency especially in low-level software development
 - Possible to find hardware design faults
- If used in an actual smartphone project, the virtual platform has to be reliable
 - A close co-operation between the virtual platform provider and the hardware manufacturer is essential
 - Updates needed if the hardware is changed

Conclusions

- Suitable for smartphone development
 - Prior to silicon
 - When the actual hardware already exists
- The use of a virtual platform could be particularly beneficial in Reference Implementation projects



Questions?

Thank You!