IDF2013
INTEL DEVELOPER FORUM

Using Wind River Simics* Virtual Platforms to Accelerate Firmware Development

Steven Shi, Senior Firmware Engineer, Intel
Chunrong Lai, Software Engineer, Intel
Alexander Y. Belousov, Engineer Manager, Intel

PTAS003

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Agenda

- Problems for Today's Firmware Developer
- Benefits of a Virtual Platform
- Using Wind River Simics* for Firmware Development
- Integrating Debug Tools with Wind River Simics
- Summary / Next Steps / Q&A

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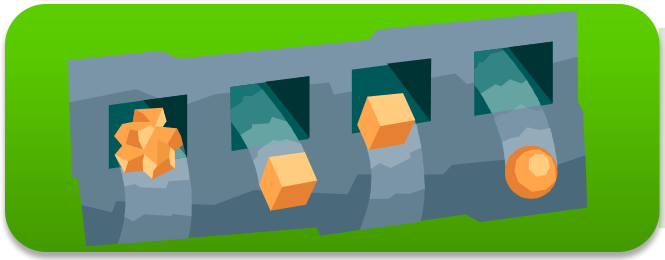
URL is on top of Session Agenda Pages in Pocket Guide

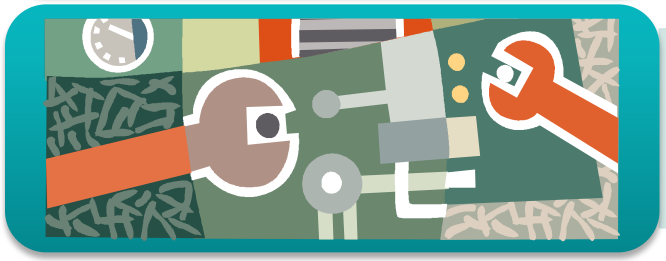

Problems for
Today's Firmware
Developer

Problems for Today's Firmware Developer

Need to work on firmware earlier, especially if hardware is delayed



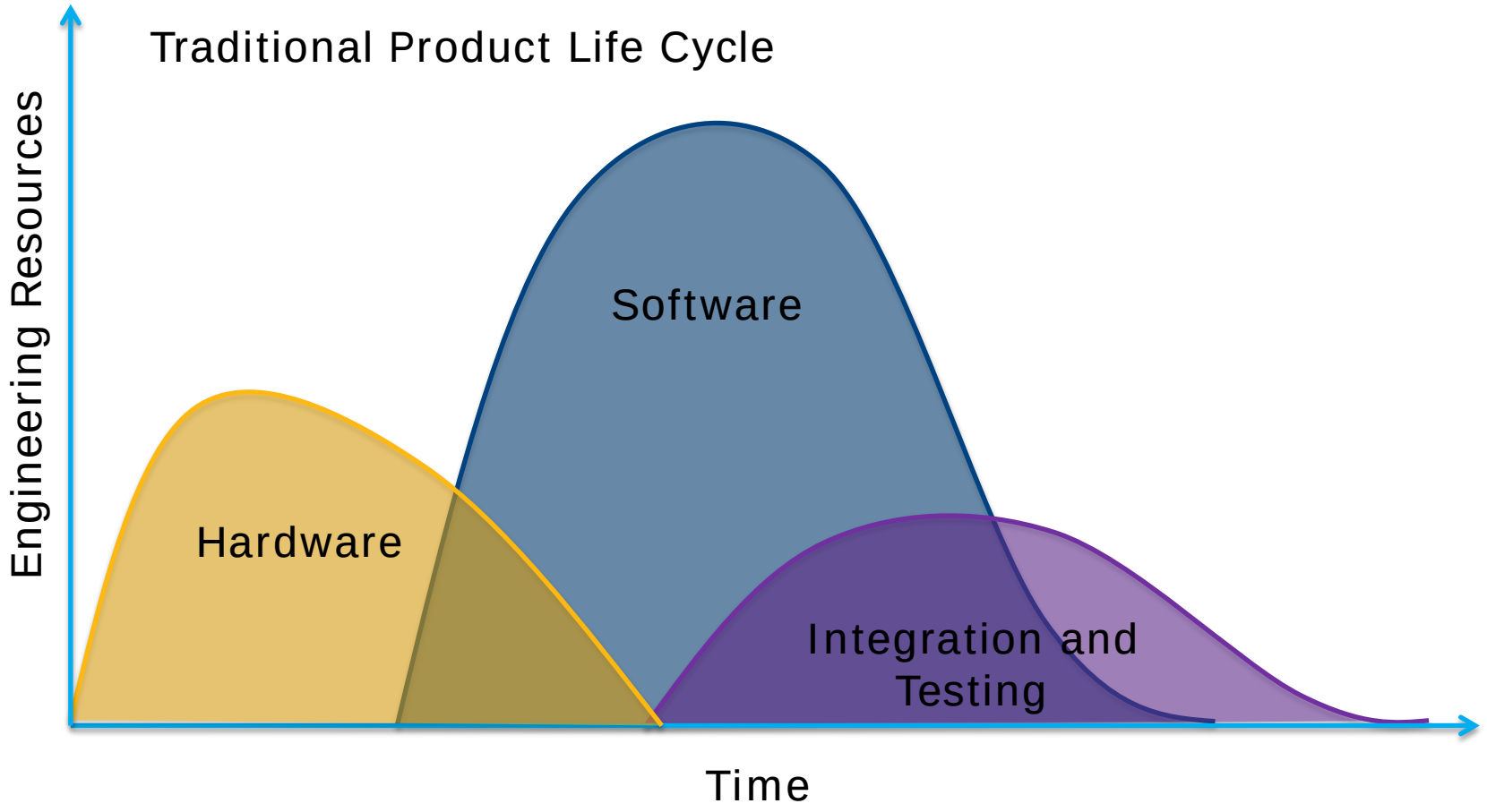
Early boards are missing key features and cannot be tested



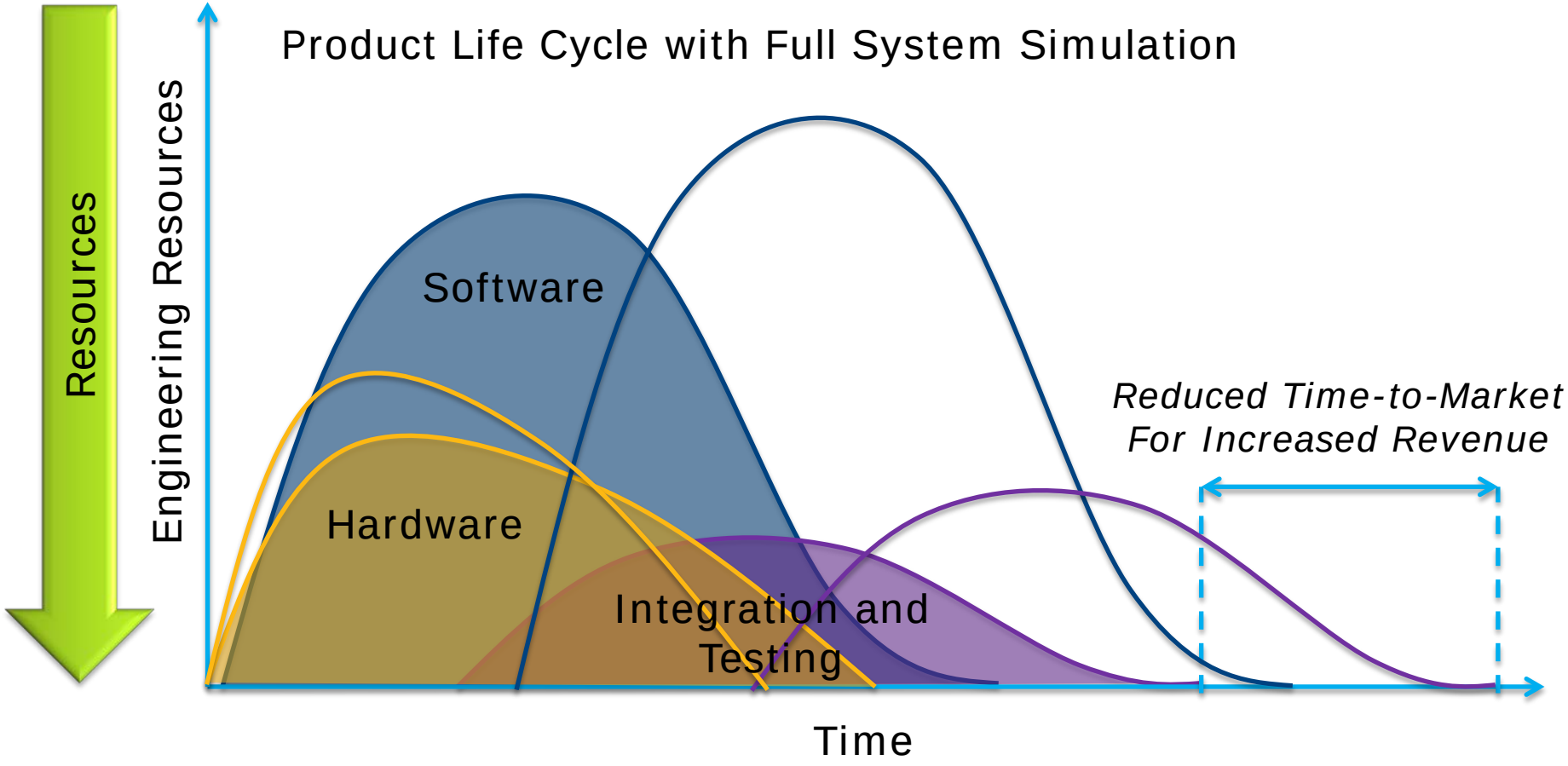
Different configurations cannot be tested using the reference board

Customers need firmware before the board is working

Shift Left: Shorter Time to Market



Shift Left: Shorter Time to Market



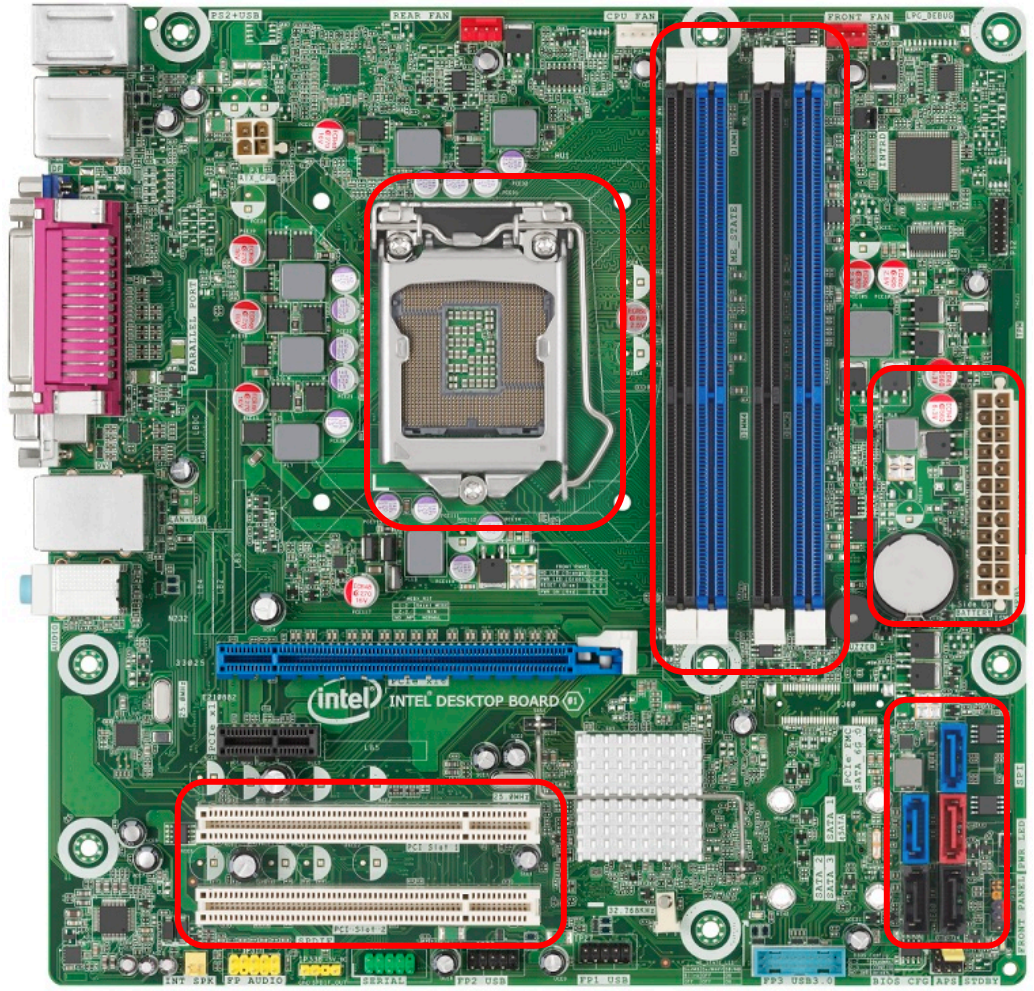
Bringing Up The First Board…

Are all of the ports wired properly?

Can you test against different processor models?

Does the board support the maximum amount of memory?

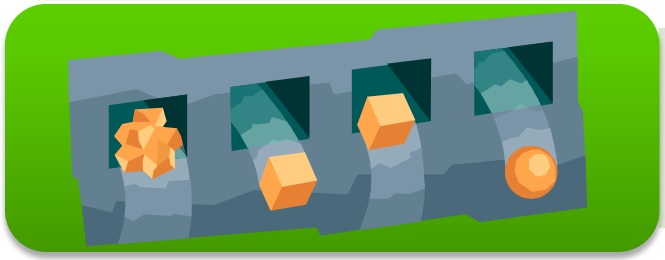
Is the board electrically stable (power, ground, …)?



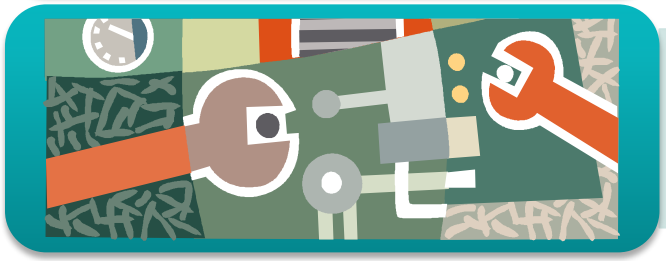
Hardware issues delay firmware delivery

What a Firmware Developer Needs…

- Earlier platform access



- Exercise all platform features



- Quickly try different platform configurations

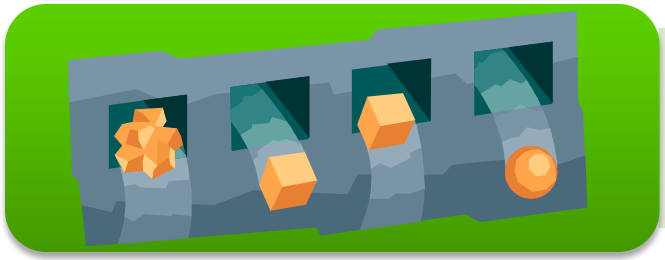
- Work when hardware is unstable or unavailable

Modern firmware needs to go beyond the "reference board"

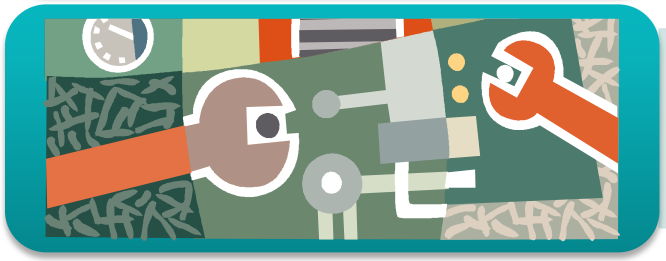
Benefits of a Virtual Platform

Benefits of a Virtual Platform

Available before hardware ships



Models all platform features



Easily reconfigured for testing various platform configurations

Virtual platforms models work even if hardware is unstable

Solving “Classic” Firmware Problems

Virtual platforms address “classic” challenges…

- Customers want boot firmware before the platform is ready
- The first board is always missing key features
- The first board can be unstable and hard to test
- Firmware developers don’t get as many boards as they need

Virtual platform models for Intel® Silicon are available before the reference board

Validate features on a virtual platform before hardware is functional

You don’t “run out” of virtual platforms

Solving “New” Firmware Problems

Reconfigure virtual platforms to include features not found on the reference board

Starting work early on the virtual platform gets the firmware ahead of schedule

People still think this way. We don’t know why. Sorry. ☹

Virtual platforms address other challenges…

- Not every silicon feature can be exercised on the “reference board”
- Customers want to use hardware combinations that can’t be tested on the “reference board”
- Schedules are tighter
- Firmware is “magic” so it will fix everything ☺

Challenges for Virtual Development

Accuracy

- Simulation must model hardware behavior

Performance

- Speed cannot adversely affect development

Debugging

- Similar toolset as used on real hardware

Virtual platforms can benefit firmware development

Using Wind River Simics* for Firmware Development

What Is Wind River Simics*?

Wind River Simics* is a full system simulator used by software developers to simulate the hardware of large and complex electronic systems.

Target system

- Simulate any size of target system
- Run unmodified target binaries

Simics allows you to **break the rules** of product development.

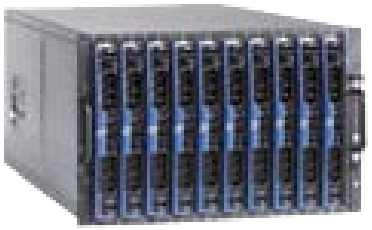
Simulate Electronic System

- Simulate any level of complexity…every engineer ALWAYS has access to the complete system

…or Multiple Boards:
Connected via Ethernet or other communication buses

Simulate A Single Board:
Your own custom board or a standard reference/production board, including CPU and all devices on the board

…or a Rack of Boards:
Connected via VME or other backplane

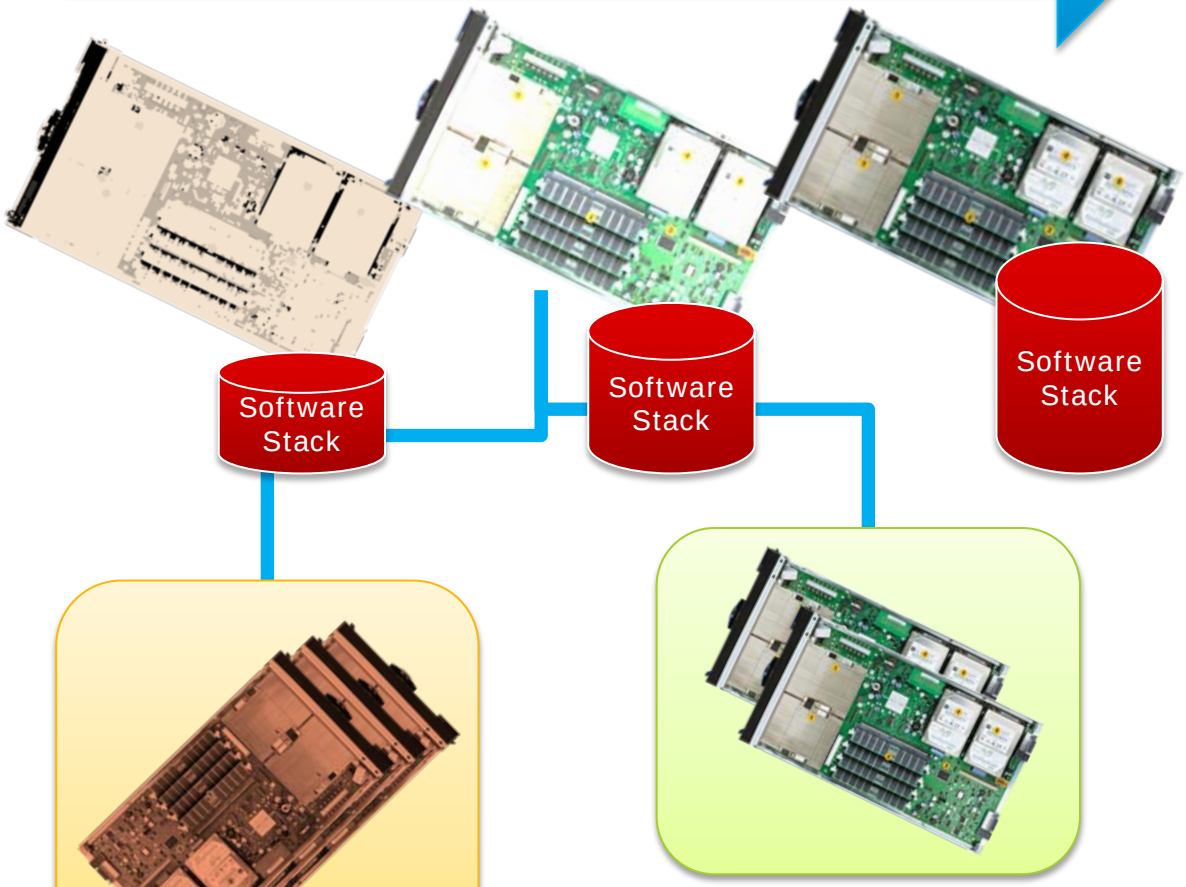


…or your complete customized digital system:
Containing 100's of CPU's and devices




Continuous Integration

No need to delay software development until an SoC or board is fully functional…begin early

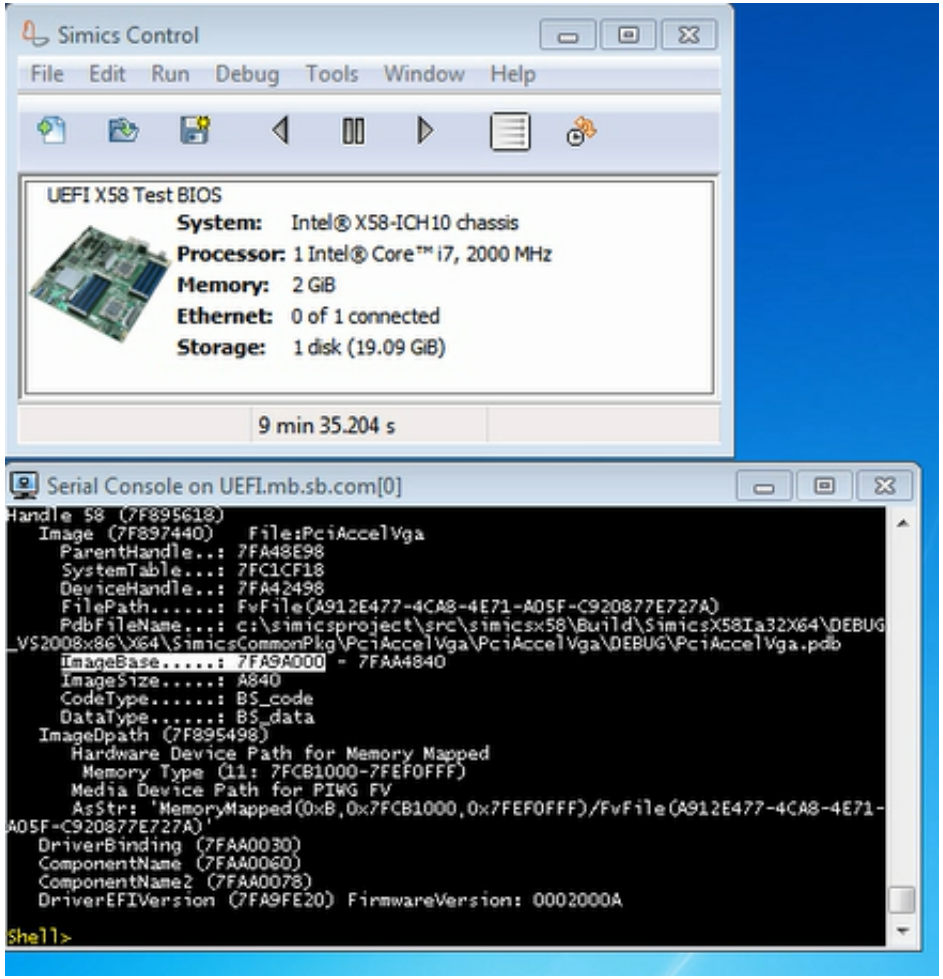


- Integrate throughout the project, don't wait until all hardware is available
- Reduces:
  - Risks
  - Costs
  - Errors
  - Time to market

Begin system integration even before physical components are available

Hardware Accuracy in Simics*

- The accuracy of the Simics* model can be demonstrated with the platform's UEFI BIOS
- *Binary is unmodified between hardware and Simics*
- Code can run without any awareness of the virtual environment



Managing Performance in Simics*

Microsoft* Windows* 7 boots[1] in about **1 minute** on Simics*

Some customer systems take almost 30 minutes to boot (on real hardware)

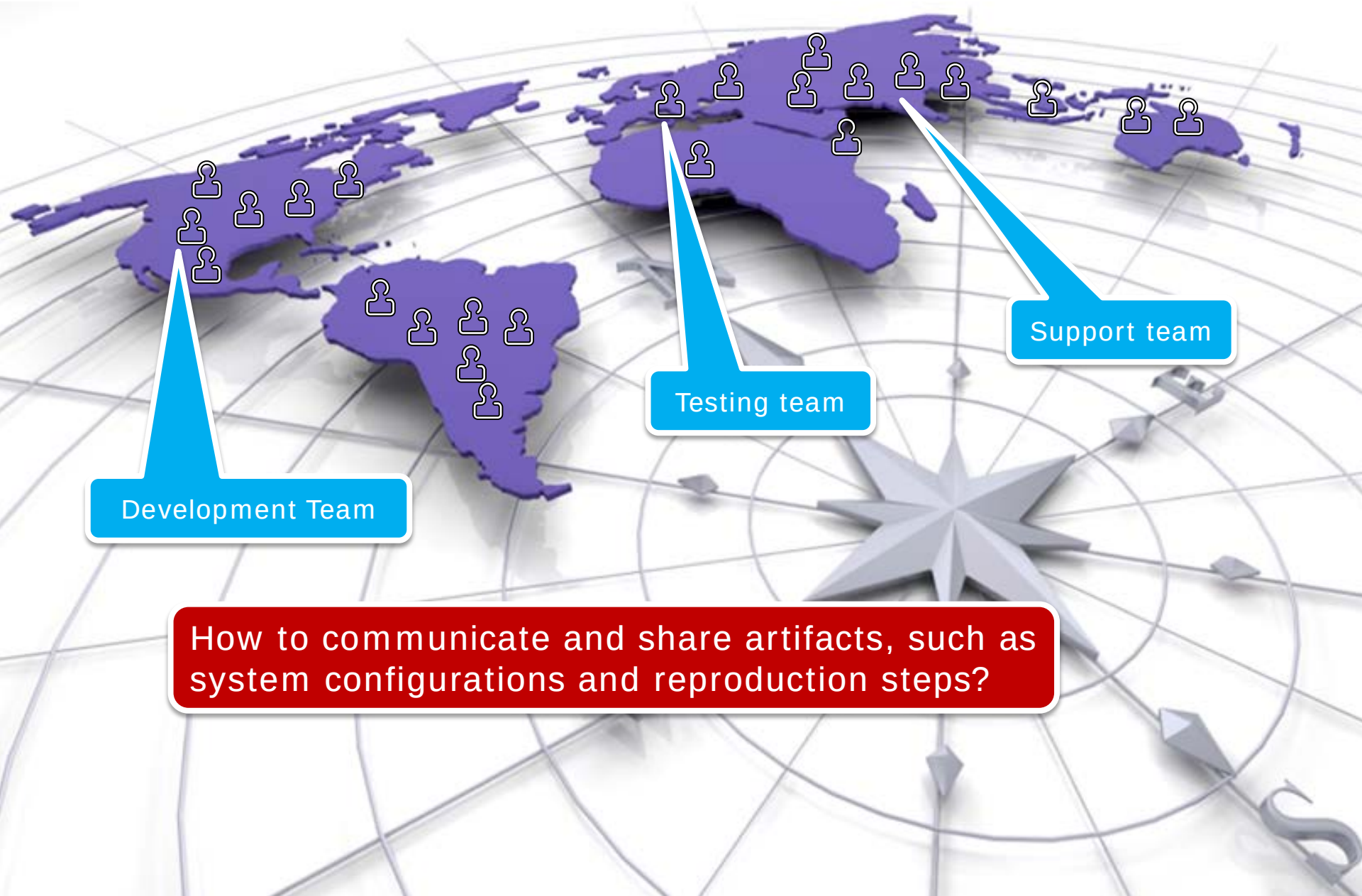
Add to this time for loading applications, running to interesting points, etc.

Microsoft Windows 7 can be restored from a checkpoint in about **1 second**[1]

Loading from checkpoints is even faster than the traditional boot process

[1] Actual boot time will depend on host and target configuration. Results may vary.

Today's Reality: Worldwide Development



How to communicate and share artifacts, such as system configurations and reproduction steps?

Checkpoint Collaboration

Simics* Virtual Platform
Exact configuration of the target system where the bug was found

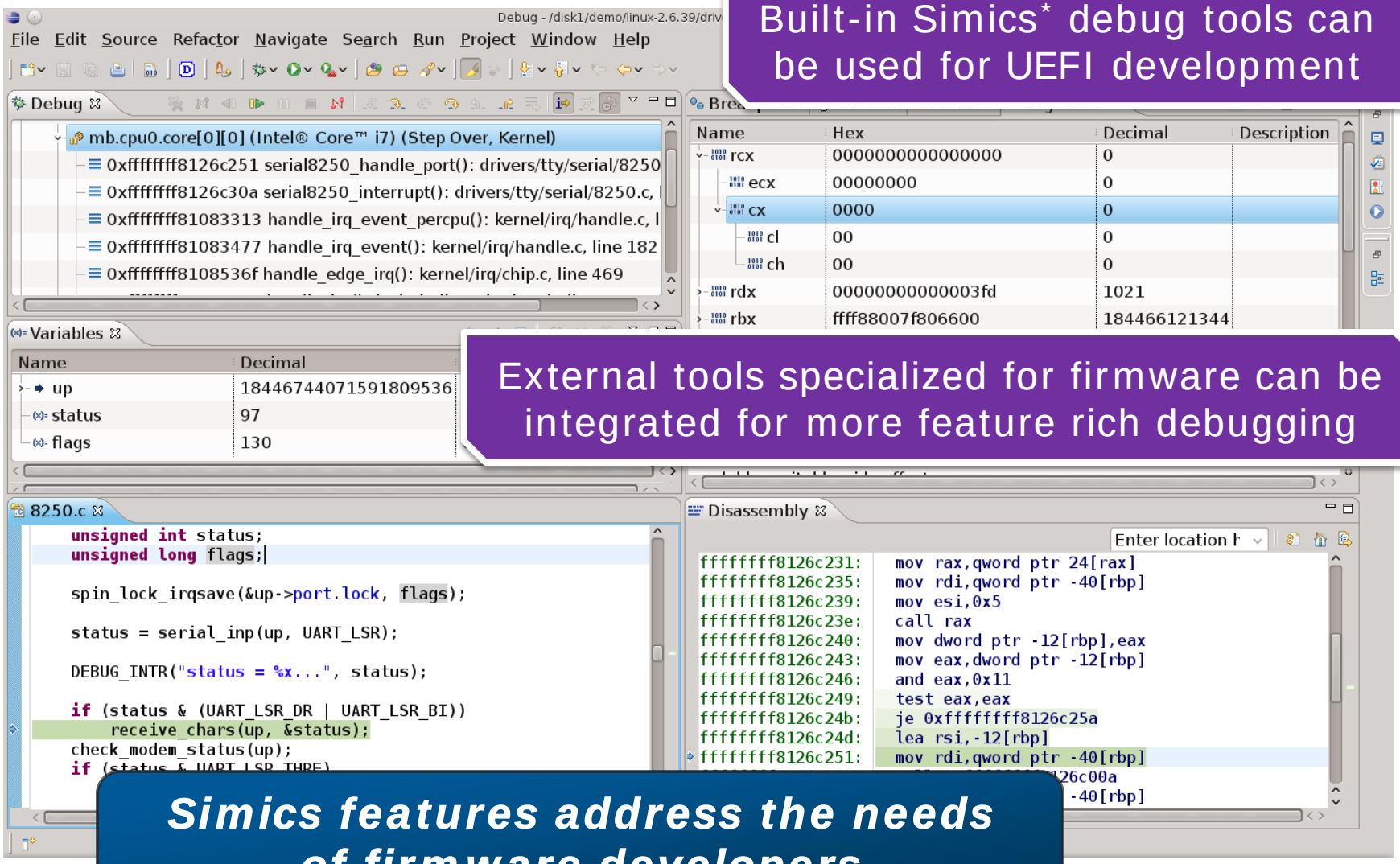
Simics Script
Automate the actions that led to a bug

Simics Checkpoint
A snapshot of the full system that can be restarted on any machine anywhere

Testing Team
Finds a bug

Development Team
Loads checkpoint and resumes execution to find the source of the bug

Software Debugging in Simics*



Feedback from Internal Users:

- Simics* was used for UEFI BIOS development:
  - *"…Various BIOS issues eliminated 3 months before first silicon, only 1 minor BIOS defect caught during hardware bring up"*
  - *"…I would like to say that Simics is a very powerful tool that allows you to do almost any kinds of things/tweaks/hacks/workarounds on the model which I think other simulators not able to offer."*
  - *"…A lot of BIOS bugs being caught during the early stage while using Simics, including the scary ACPI issue. In the end, we still able to get successfully PO with the BIOS with almost no ACPI issue."*


Integrating Debug Tools with Wind River Simics*

Integrating Intel® ITP Software with Wind River Simics*

One example of debug tool integration is using Intel® In-Target Probe (Intel® ITP) software with Simics*

- Same toolset used on physical hardware
- Simple integration with Simics
  (does not rely on Extended Debug Port –XDP interface)

Working Example:

- Boot to UEFI Shell
- Add breakpoint to video driver
- Trace driver through BLT function

Demo Video

UEFI Debug Capacities Integrated in Wind River Simics* Eclipse* Frontend

Video demo:

- Based on Simics* server model of next generation Intel® Microarchitecture codename Haswell
- Set breakpoints proactively, keep them between runs
- Execution control of: step into/over, step out, reverse step into/over, un-call
- Direct source file editing within debugger
- Inspecting of variables, registers and UEFI modules
- Provide access to all generic UEFI commands

Summary

- Modern firmware needs to go beyond the “reference board”
- Virtual platforms can benefit firmware development
- Simics* features address the needs of firmware developers
- Simics offers seamless firmware debugging

Get More Information

UEFI

- UEFI Forum Learning Center
  - http://www.uefi.org/learning_center/
- Intel UEFI Community
  - http://intel.com/udk
- Use the TianoCore edk2-devel mailing list for support from other UEFI developers

Wind River Simics*

- http://www.windriver.com/products/simics/
- http://www.intel.com/p/en_US/embedded/hwsw/software/simics

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Using Wind River Simics* Virtual Platforms to Accelerate Firmware Development

Backup Materials

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Problems for Today's Firmware Developer

The "classic" challenges haven't changed…

- Customers want boot firmware before the platform is ready
- The first board is always missing key features
- The first board can be unstable and hard to test
- Firmware developers don't get as many boards as they need

Over time, we have more interesting challenges…

- Not every silicon feature can be exercised on the "reference board"
- Customers want to use hardware combinations that can't be tested on the "reference board"
- Schedules are tighter
- Firmware is "magic" so it will fix everything ☺

Benefits Going Virtual

Hardware

- Actual behavior
- Speed

Simulator

- Non-intrusive debugging
- Checkpointing
- Determinism
- Reverse execution
- Scripting
- Hardware replication
- Speed!

Speed? Really?

- Embedded processors slower than server ones
- Almost reach host speed for x86 on x86 (VMP)
- Complex systems often boot slowly
  - Waiting for slow hardware, mandatory timeouts
  - Clearing memory
  - Hardware self-tests
  - Lots of idle time in parallel systems
- Simics can fast forward when system is waiting!
- Loading software on real system:
  - Program flash memory, load over network or USB
- Loading software on Simics*:
  - Load binary directly into target memory in no time
- Checkpointing
  - No need to reboot every time