SHIFTING LEFT TOGETHER
ENABLING THE ECOSYSTEM WITH VIRTUAL PLATFORMS

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“SHIFT LEFT”
Software development, integration, and testing move earlier = shift left
BENEFITS OF SHIFT LEFT

**Shorten time to market** (by overlapping software and hardware design)

**Improve quality** (by finding bugs earlier)

**Decouple** hardware and software schedules for reduced project risk

**More predictable** hardware bring-up
DOING SHIFT LEFT: FAST VIRTUAL PLATFORMS

Full-system platform:
- Run the same software as the (eventual) physical system
- Run the complete software stack

Important properties:
- Fast – to be able to run real workloads
- Functional – software cannot tell the difference
- Scalable – IP block, system-on-chip (SoC), board, cabinet, network, ...

Runs on a standard server, desktop, laptop:
- Software for specific target, running on general-purpose host

Virtual platform tool

Any OS: Linux, Windows, Macos

Any PC

User-level application code
Middleware and libraries
Target operating system (s)
Virtual platform (VP)
Firmware
IP Block
Apps
OS
VP
Network
SILICON-VENDOR-INTERNAL SHIFT LEFT

SILICON-VENDOR INTERNAL USE

- IP-BLOCK FIRMWARE
- BOOT CODE BIOS UEFI
- OPERATING SYSTEM KERNEL SUPPORT AND DRIVERS
- LIBRARIES AND SOFTWARE DEVELOPMENT KITS (SDK)
- APPLICATION SOFTWARE PORTING AND OPTIMIZATION
- COMPILER AND TOOL SUPPORT

= SOFTWARE READY AT LAUNCH

...Software for the silicon chip or platform...
The Silicon Platform is not a product in its own right.

SILICON VENDOR CHIPS

CUSTOM BOARD

PRODUCT

Board design
Firmware dev UEFI customization Device drivers
Realizing Si features
Custom hardware integration

Start early using virtual platform models – even at custom board level (we'll get there soon)
DEVELOPING WITHOUT A VIRTUAL PLATFORM

WAIT FOR (PROTOTYPE) HARDWARE

"CODE IN THE DARK"

USE PREVIOUS GENERATION COMPUTERS
BENEFITS*

**SHORTER TIME TO MARKET**
- Hardware bringup can go from months to days or hours

**HIGHER QUALITY AND MORE ATTRACTIVE PRODUCTS**
- More time to integrate and use new silicon features
- Testing scales up without hardware limitations

**PRE-SILICON INTEGRATION**
- Silicon vendor platform + other chips
- New boards + older boards
- Software features

**JOIN THE FUTURE**
- Find bugs early - fix in final hardware
- Provide feedback to silicon vendor on new features, get what you need

* In addition to the general virtual platform benefits
PRACTICAL NOTES ON SHIFT LEFT
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VP VARIANTS

Just SoC

Reference board

SoC

RAM

FLASH

Disk

I2C

PHY

Used inside silicon vendor, and as initial OEM platform

Operating system

Applications

Libraries

Boot code

Standard drivers

Firmware

Firmware

Custom board

3rd

Custom

RAM

FLASH

Disk

I2C

PHY

3rd

Full OEM model

Custom board

Product

Applications

Fault tolerance

Management

Middleware

Main silicon vendor

SoC

RAM

Generic model

Additional chips from 3rd-party vendors

OEM in-house chips and FPGA designs

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HOW TO [ACTUALLY] DO IT

WHO DOES THE MODELING?

- Main platform silicon vendor *(Given starting point)*
- In-house modeling team *(good for custom hardware) (might already exist)*
- Modeling consultants *(in lieu of an in-house team)*
- Addition silicon vendors *(if they have appropriate models)*

THINK ABOUT SUPPORT!

- More players = more friction
- Avoid long chains of suppliers
- One point integrate contributions and models from multiple sources
- Goal: fix bugs & add model features in a week or less
There will be many iterations.

- Design revision
- Virtual platform deliveries
- Hardware deliveries
- Customer

<table>
<thead>
<tr>
<th>Time</th>
<th>Design Revision</th>
<th>Virtual Platform Deliveries</th>
<th>Hardware Deliveries</th>
<th>Customer</th>
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<tbody>
<tr>
<td></td>
<td>0.1</td>
<td>Initial VP</td>
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<td></td>
<td>0.4</td>
<td>First Customer-Quality VP</td>
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<td>0.9</td>
<td>Revised VP</td>
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<td>1.1</td>
<td>Revised VP</td>
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First executable system, if using hardware:
- Design Version 0.5
- Design Version 0.9
- Design Version 1.0
- Design Version 1.1

Internal bring-up systems
Customer-stable HW

First executable system, if using hardware.
RESOURCE SCHEDULING

OLD PROJECT SCHEDULES

MANPOWER

TIME

Project A  Project B  Project C

NAIVE SHIFT-LEFT OF PROJECT B

MANPOWER

TIME

Project A  Project B  Project C
Digital Twin

- System mechanics
- Surrounding world
  - Network model
  - Real-world connection

Environment model

Custom board
- RAM
- FLASH
- Disk
- I2C
- PHY
- 3rd
- Custom

Product

Just SoC

SoC

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QUESTIONS?
SHIFTING LEFT TOGETHER