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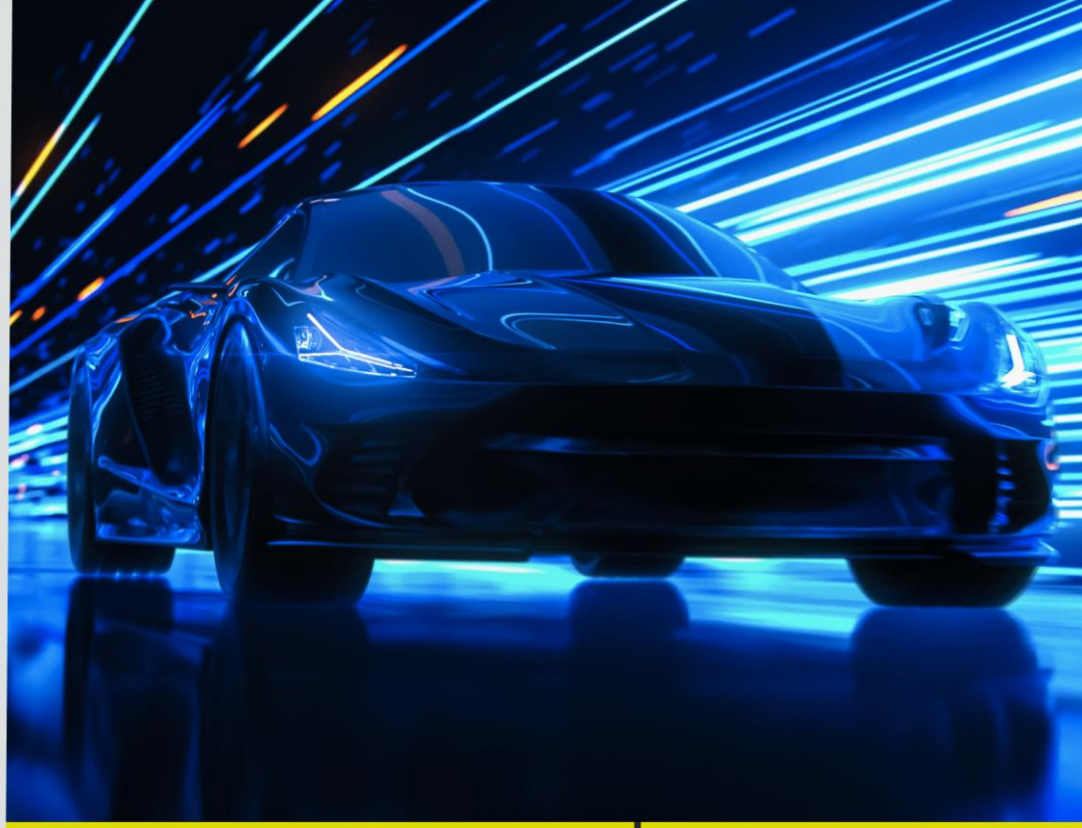


Virtual Platform for “Chip to Factory”

Benefits and Challenges of VP

Hyugjin Kwon, Head of SoC SW Team, Hyundai
May 15th, SOAFEE Seminar 2025

HYUNDAI

Agenda

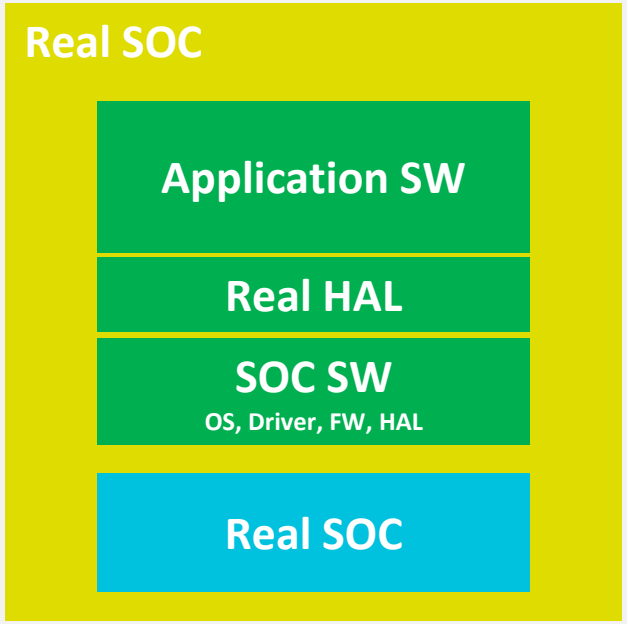
- Introduction: Why Virtual Platform?
- Recap: Approach of Virtual Platforms
- Comparison Traditional vs VP approach
- Benefits of Virtual Platform
- Challenges for Virtual Platform
- Conclusion

Introduction: Why Virtual Platform?

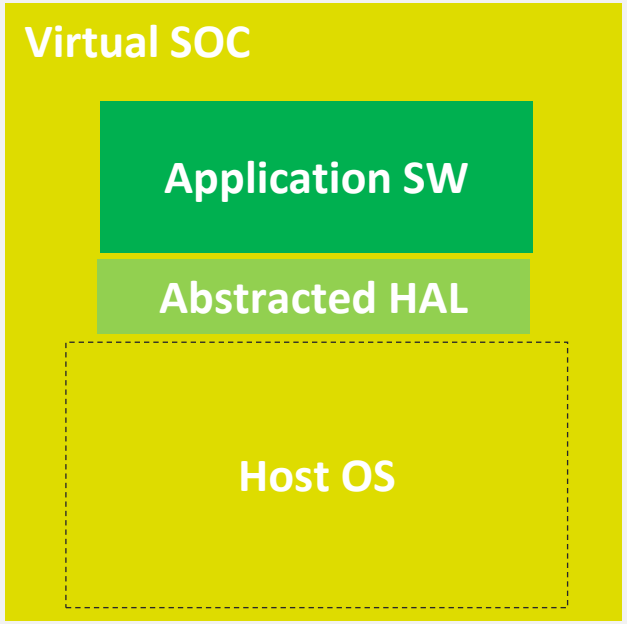
- Software-defined vehicles require earlier and faster development cycles
- Virtual platforms enable CI/CD, early prototyping, and hardware decoupling
- SOAFEE enables scalable architecture across cloud and edge

Recap: Approach of Virtual Platforms

- Called as Digital Twin, generally Simulator also

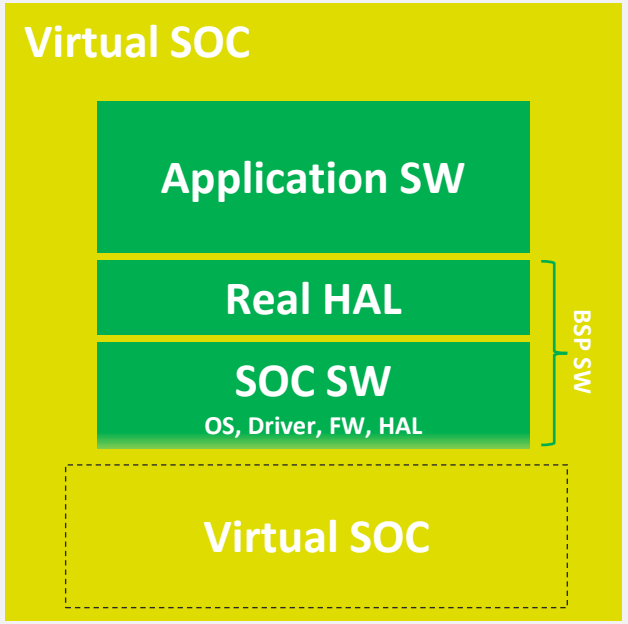


Real Product



Focus on Application Development

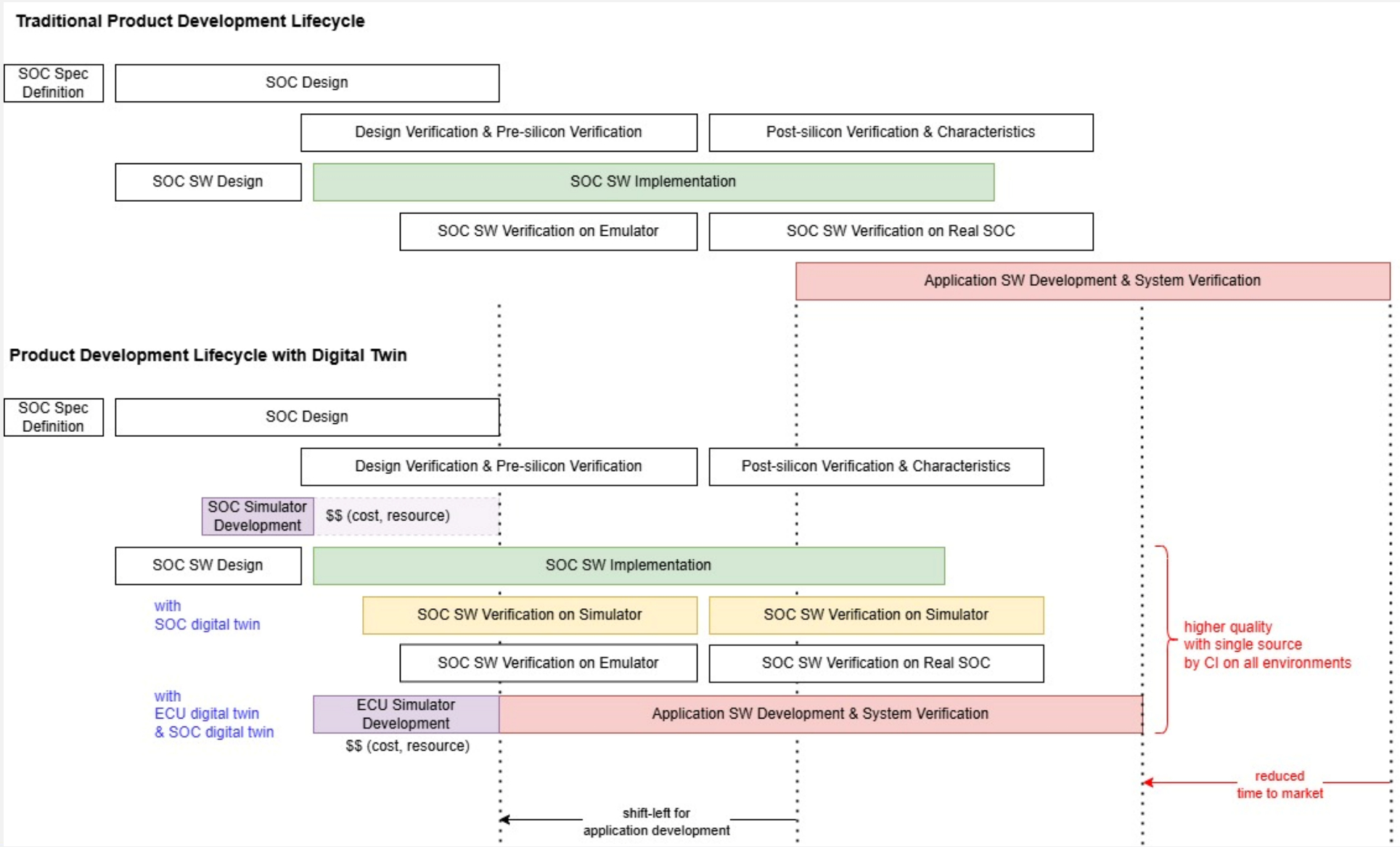
- Functional Behavior only
- Bit Accuracy for Application SW



Focus on Product Development

- Functional and (additionally) Timing Behavior
- Bit Accuracy for Application & BSP SW
- Cycle Accuracy or Approximation for all SW

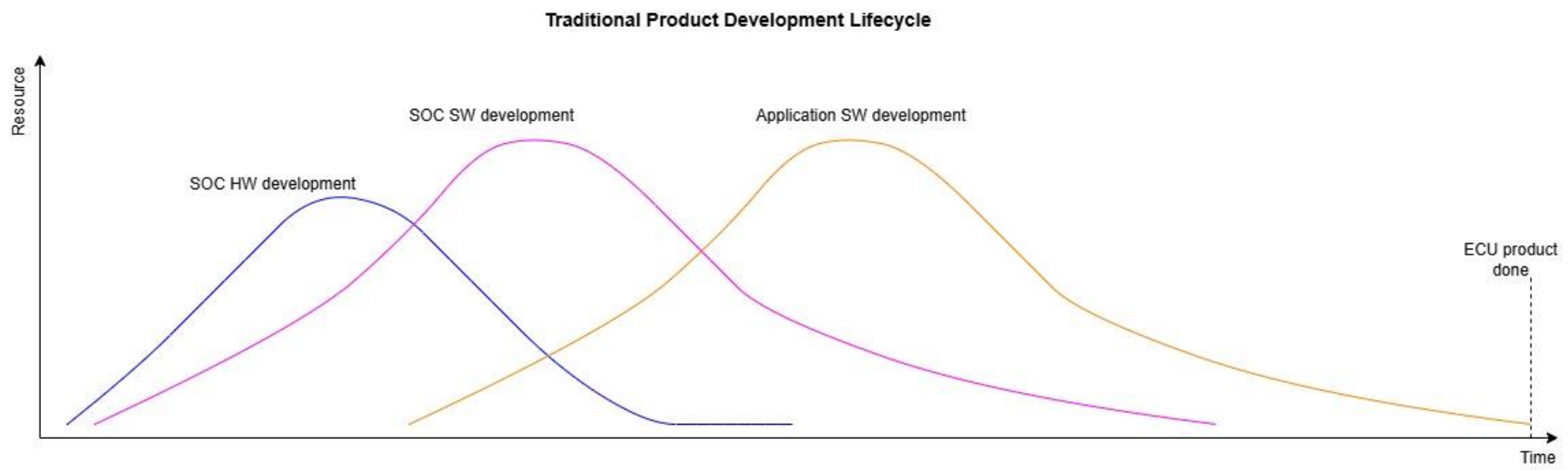
Comparison Traditional vs VP approach

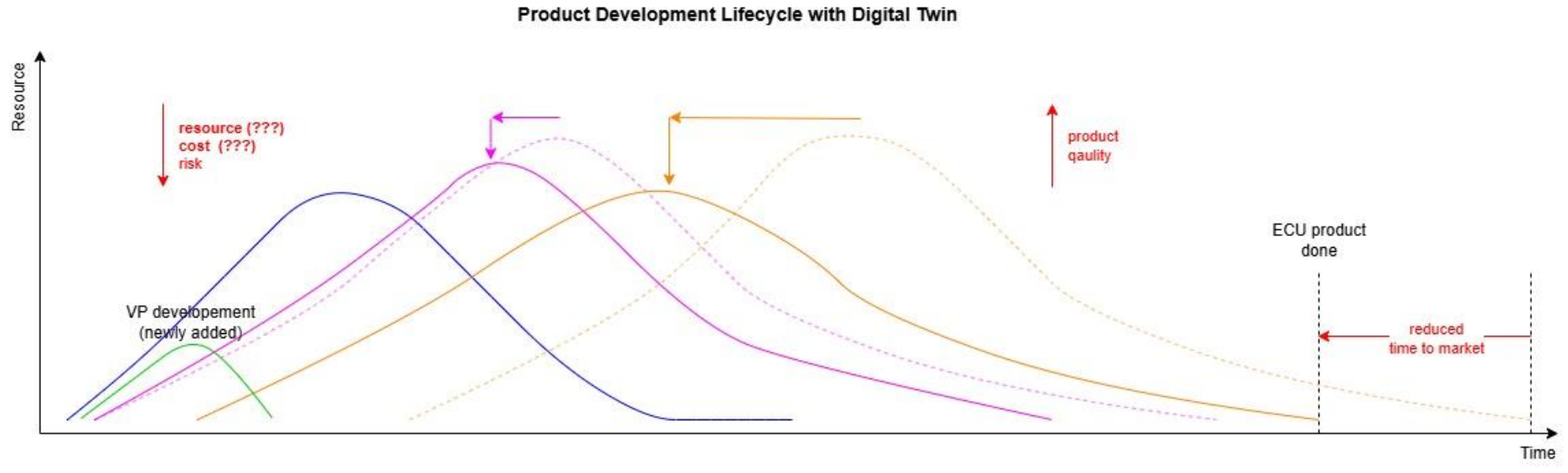


Benefits of Virtual Platform

- Accelerated early SW development
- Parallel development without waiting for HW
- Better integration with DevOps/CI-CD
- Case examples:
  - comprehensive architecture exploration
  - easier test coverage measurement
  - reduced testing time
  - earlier bug catching

Benefits of Virtual Platform





* reference: this diagram is inspired by Intel Simics Document (Link)

* note: the graph related to ECU HW development has been omitted.

Challenges for Virtual Platform

(Minor)

- Binary compatibility issues
- EL2/EL3 reservation conflicts in cloud-hosted SoCs
- Security Policy restrictions (public cloud use not allowed)

(Major)

- Cost of Simulator to run the Virtual Platform
- Limited I/O modeling and ECU completeness
- Functional vs. Timing discrepancies

Challenges for Virtual Platform

- Binary compatibility issues
  - SW needs to be identical for real and VP
- EL2/EL3 reservation conflicts in cloud-hosted SoCs
  - EL2 and EL3 also need to be simulated, even though cloud environment
- Security Policy restrictions (public cloud use not allowed)
  - Some companies don’t allow the use of public clouds due to security policies

Challenges for Virtual Platform

- Cost of Simulator to run the Virtual Platform
  - There is no free solution

  - To promote the use of VP, the cost of the simulator is also an important issue
    - SOC SW developer
    - CI for SOC SW
    - Application developer
    - CI for Application SW

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cadence Helium
Intel Simics
SYNOPSYS® Virtualizer
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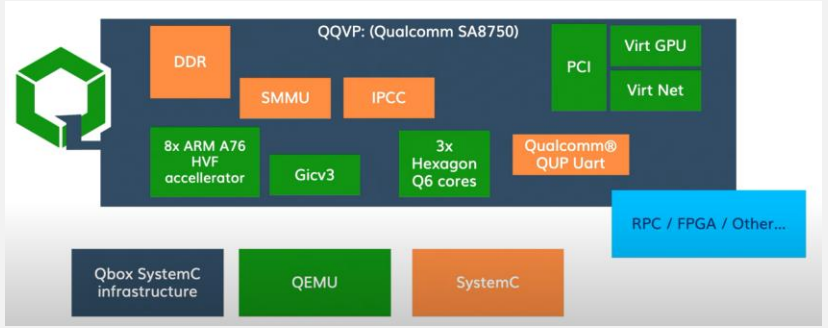
[Commercial Solutions]



* reference: Linaro Connect 2024, Qualcomm
MAD24 417 QQVP Qualcomm's SystemC and Qemu modelling solution

[Open-Source based Solution]

Challenges for Virtual Platform

- Limited I/O modeling and ECU completeness
  - There is no free solution
  - Modeling of HW also needs cost and resource
    - It could be over millions of dollars for AP SOC for IVI and AD
  - Maintenance of models also needs cost and resource
    - This could be the tip of the iceberg

Challenges for Virtual Platform

- Functional vs. Timing discrepancies
  - Only Functional
    - Many issues arise due to timing problems in real-time system
    - Multiple issues were identified during the reliability test
  - Trade-off between Simulation Time and Timing Accuracy
    - Sometimes, slower than real board
  - Timing Modeling Overhead for Timing Accuracy
    - Timing modeling needs resource to do
    - Validation of correlation between VP and real is required

Conclusion

- In SDV era, the complexity of SW is increasing quickly.
- Early SW development without HW coupling is key point of Time-To-Market.
- Virtual Platform for SOC/ECU can help this approach.
- But there is no silver bullet, because it also add more cost and resource.
  - Incremental Solution: In-house VP development capabilities
    - Iterative HW architecture exploration using VPs
    - VP/SW parallel development
      Unlike SOC HW, VP can evolve incrementally, aligning with SW development needs

- To enjoy the VP's benefit widely, the reduced cost by early TTM must be larger than the additional cost for VP.

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Thank You