# PNSQC

OCTOBER 10-12 2022

Kathy Iberle

# Agile Gets Physical

40TH ANNUAL PACIFIC NW SOFTWARE QUALITY CONFERENCE OCT. 10–12, 2022

# Agile Gets Physical: Slice-Based Integration

- Challenges of HW/FW integration
- Agile principles which help
- How to apply the principles
- Slice-based integration planning
- Questions
- How to Learn More

Kathy Iberle

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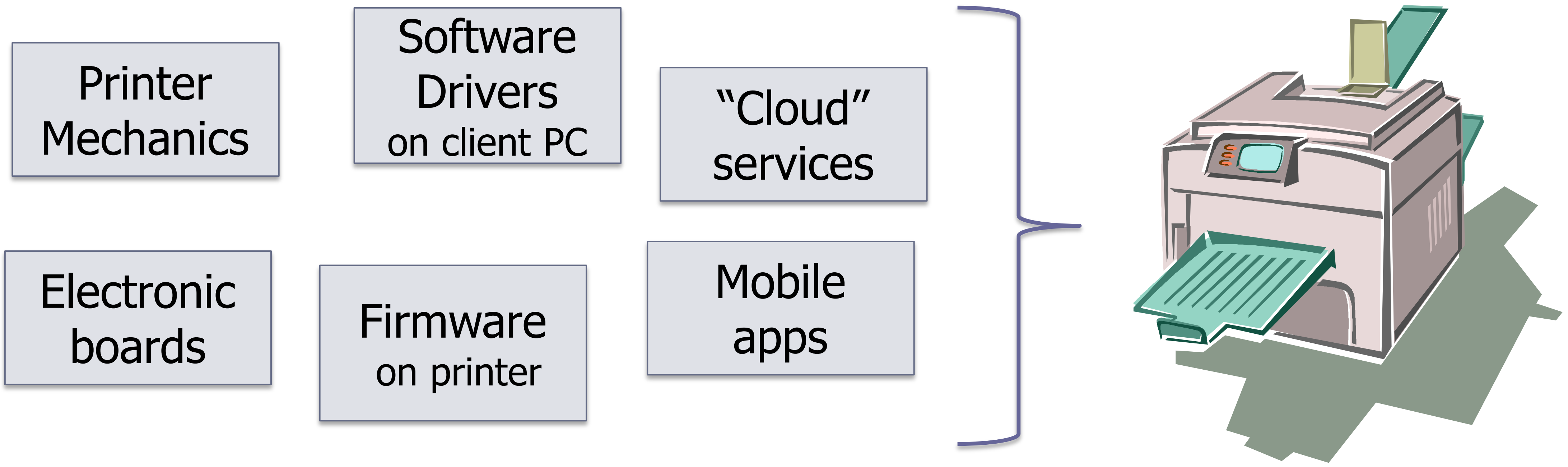
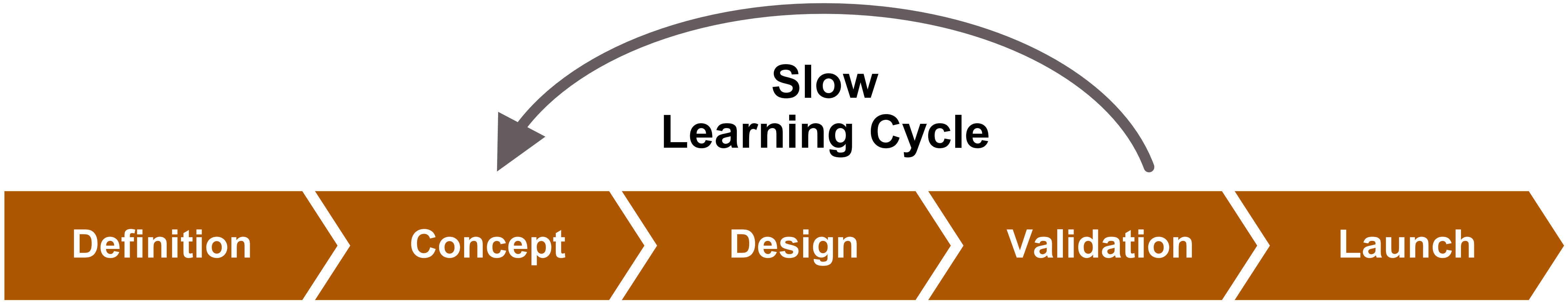
# Mixed HW/FW/SW Products

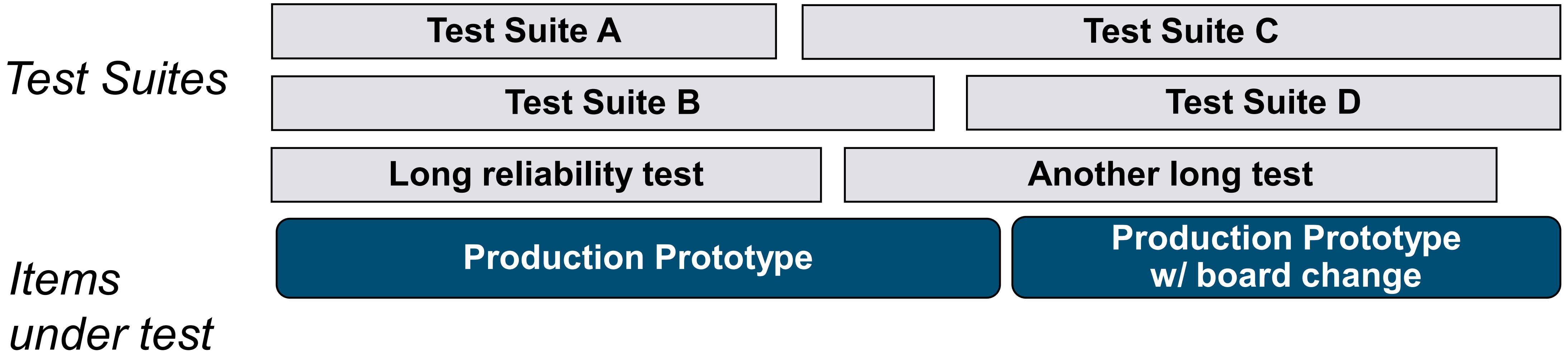
- Each discipline has its own team of engineers.
- Each discipline tends to optimize for itself.



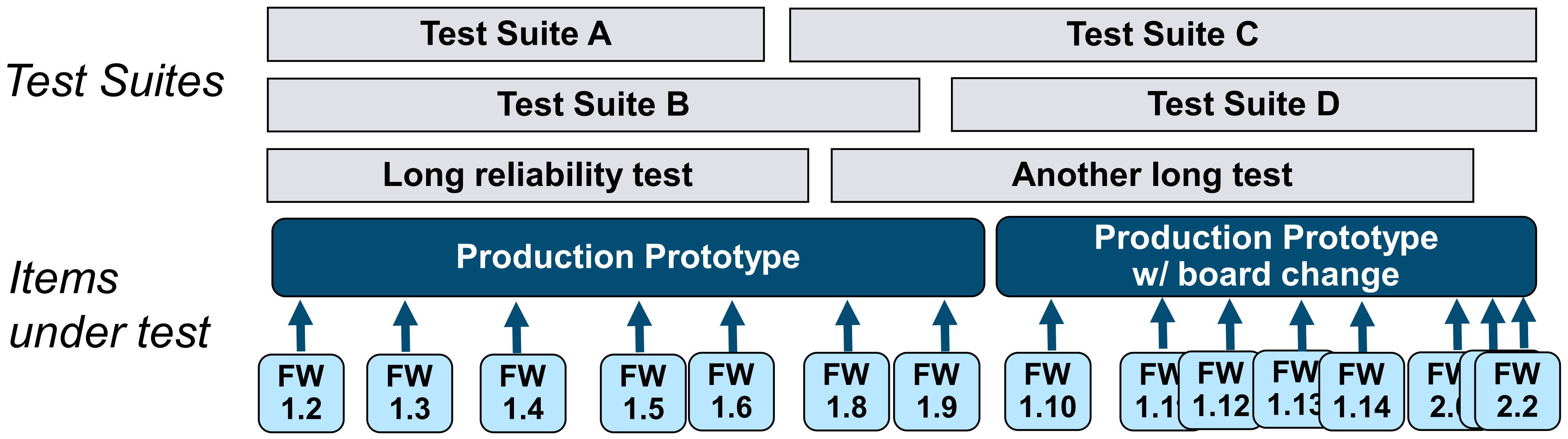
# Hardware Programs Are Often Rather Waterfall



# Traditional HW Project

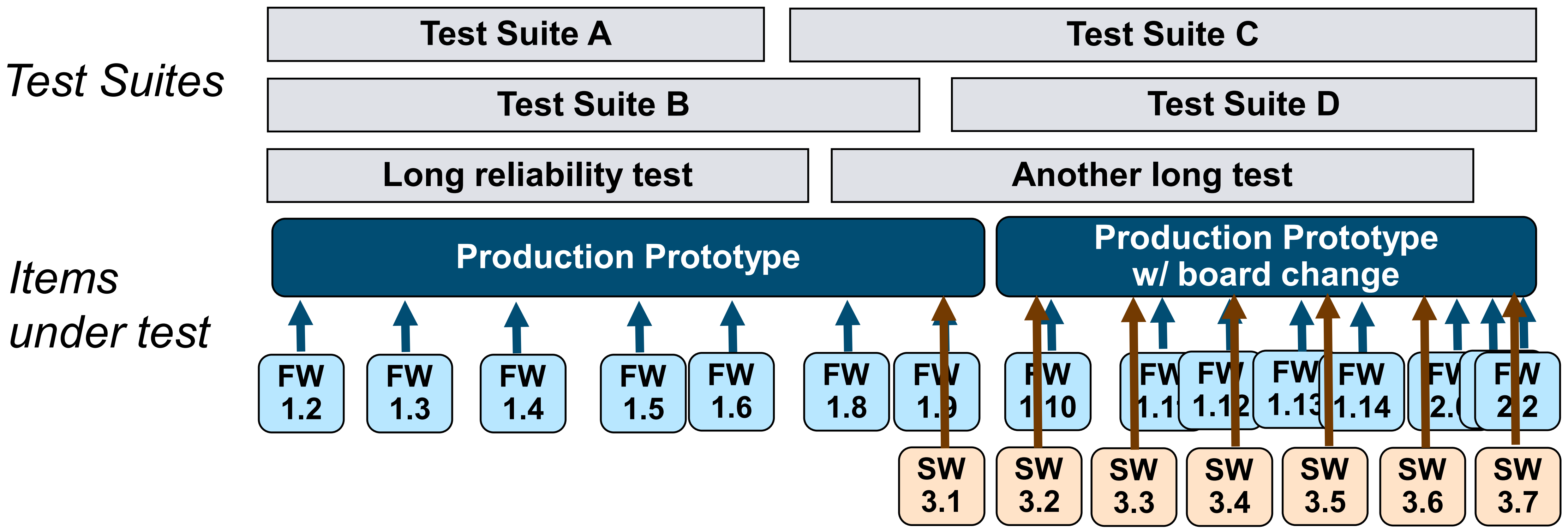


# A Mixed HW/FW/SW Project



# A Mixed HW/FW/SW Project

What is testable today?  Next week?



Implement your best guess→
Test the results →
Refactor if needed

**OR**

Experiment, prototype, investigate →
Then implement

**Low cost of change**

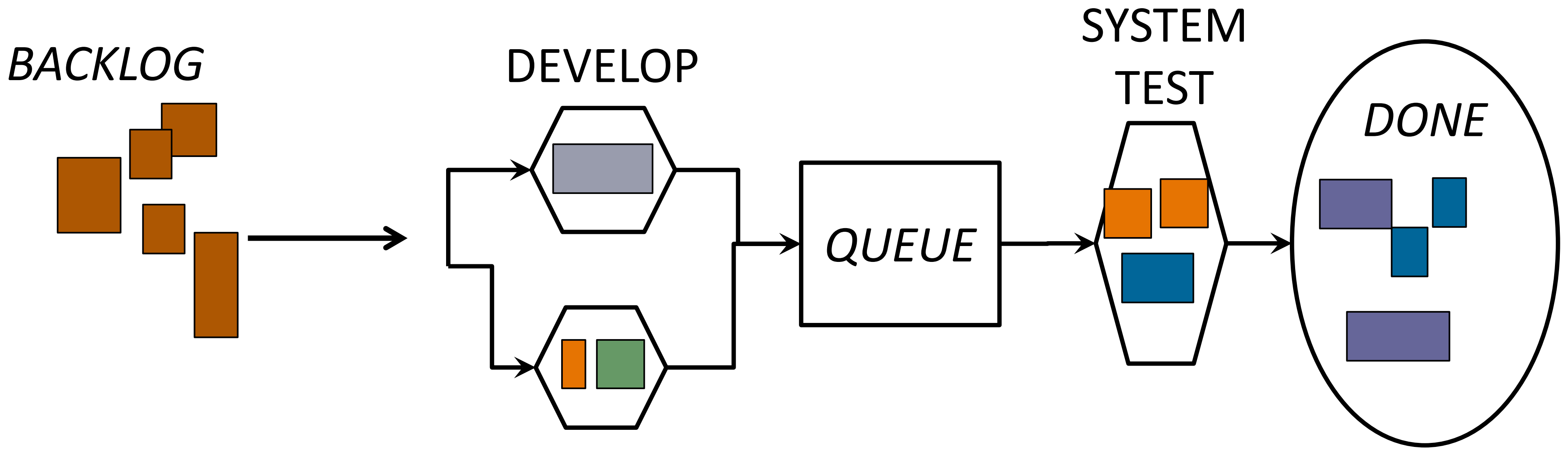
**High cost of change**

## Are we stuck with this situation?

No!

We can apply agile principles to improve the situation.

## Agile Principle: Small Batches

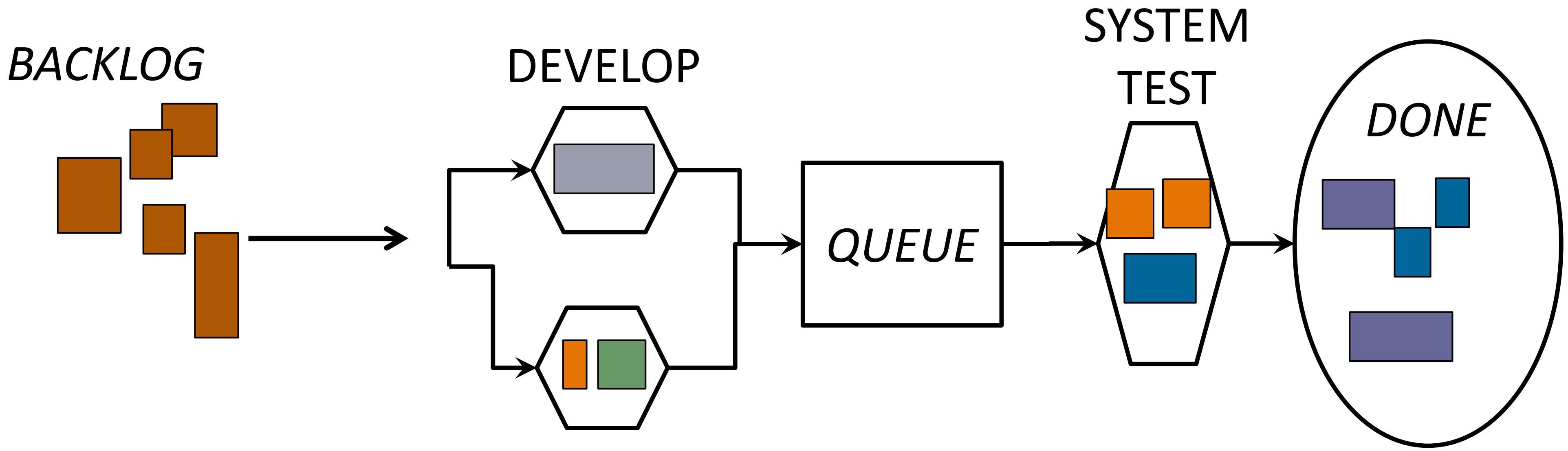


Agile methods split work into ***small batches***.

Each batch ***delivers value.***

*"Working software is the primary measure of progress."*

## Agile Principle: Optimize the Flow



Tools for optimization:
batch size, cadence, WIP control

# Queueing Theory Explains the Tools

- Queueing theory is a mathematical description of work flowing through a system.
- Invented by Ågner Krarup Erlang in 1910
- Used in manufacturing line design, internet packet-switching, traffic control, and much more

Queueing theory tells us ***when and how*** to use the tools in systems which are not classically agile.

Ågner Krarup Erlang

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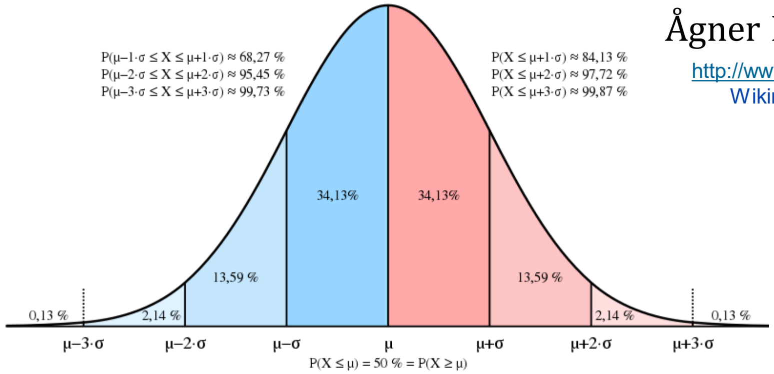

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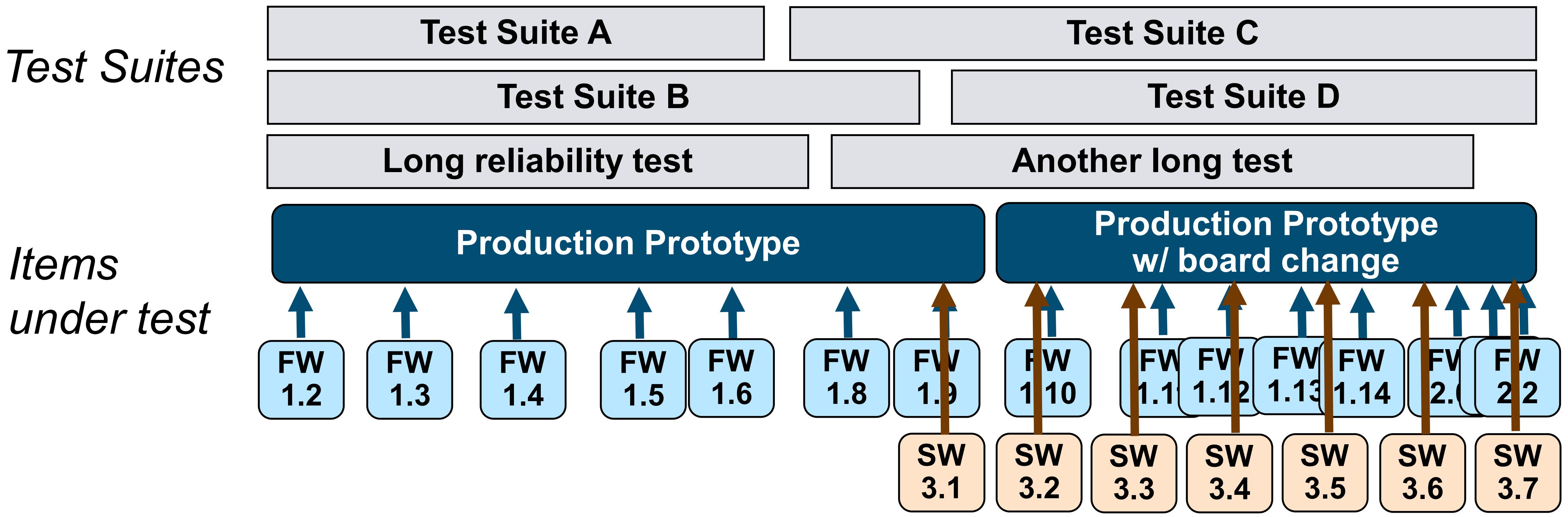
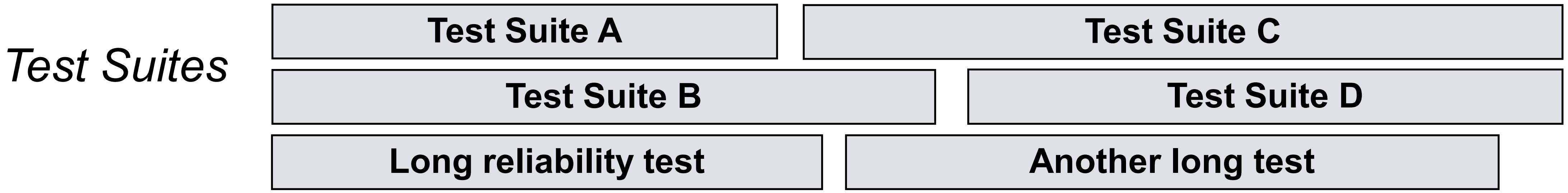
# Mixed HW/FW/SW: Where's Our Batch?



# Batch Size Considerations

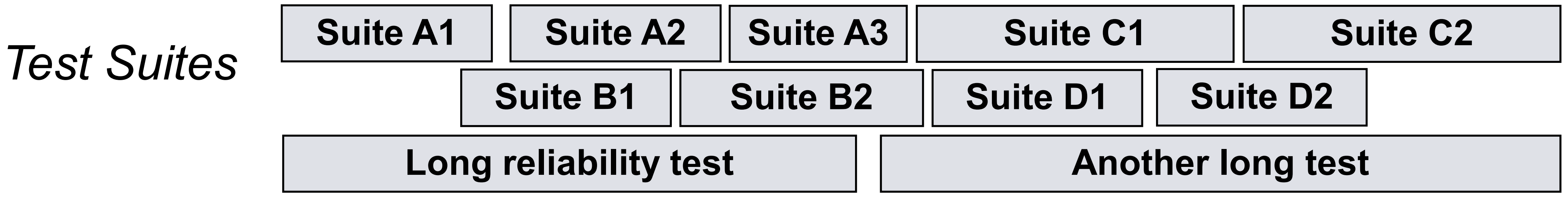


Queueing theory tells us:

Small batches deliver value earlier.

Too small = more overhead than that earlier value is worth.

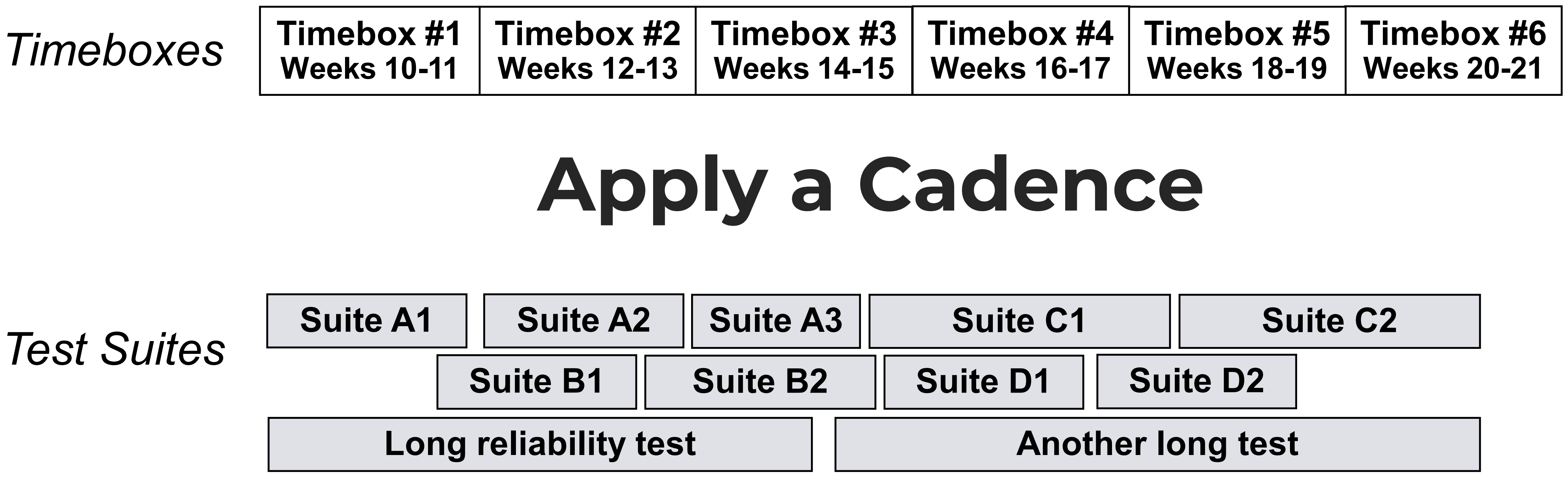
# Split Up Your Test Suites



Ideal size depends on ***your*** overhead per test suite

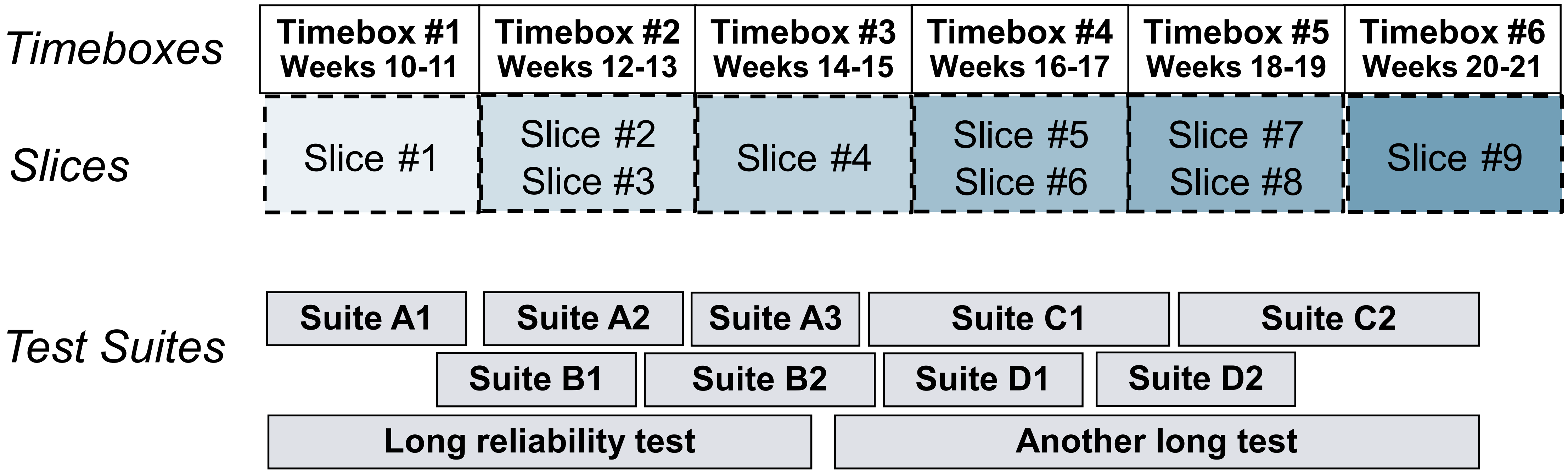
- Setup and teardown time
- Cost of additional prototype units
- What else?

## Apply a Cadence



Split your calendar into ***timeboxes***
which are just large enough for most test suites.

If firmware sprint length seems reasonable, try that.



***Connect*** all the teams
by defining slices of
***user-visible behavior.***

## Some Sample Slices

#1: Printer can print a test page in response to button press

#2: Printer can print a page sent from a connected PC

#4: Printer can remind user to purchase more ink

#5: Printer can recover from running out of paper

#6: Printer can run mfg. test for correct cartridge alignment

*Much bigger than user stories!*

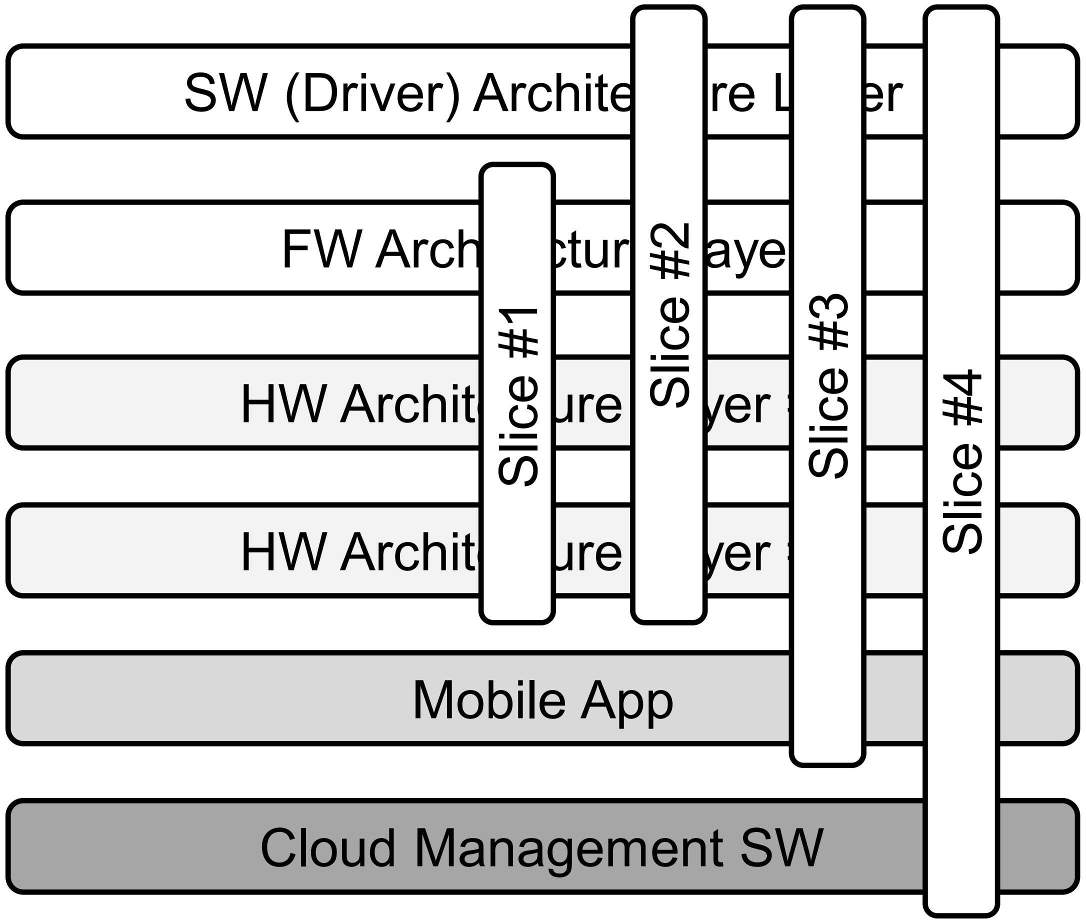
# Slice Through the Architecture

#1: Printer can print a test page in response to button press

#2: Printer can print a page sent from a connected PC

#3: Printer can print a page sent from a mobile app

#4 Printer can remind user to purchase more ink

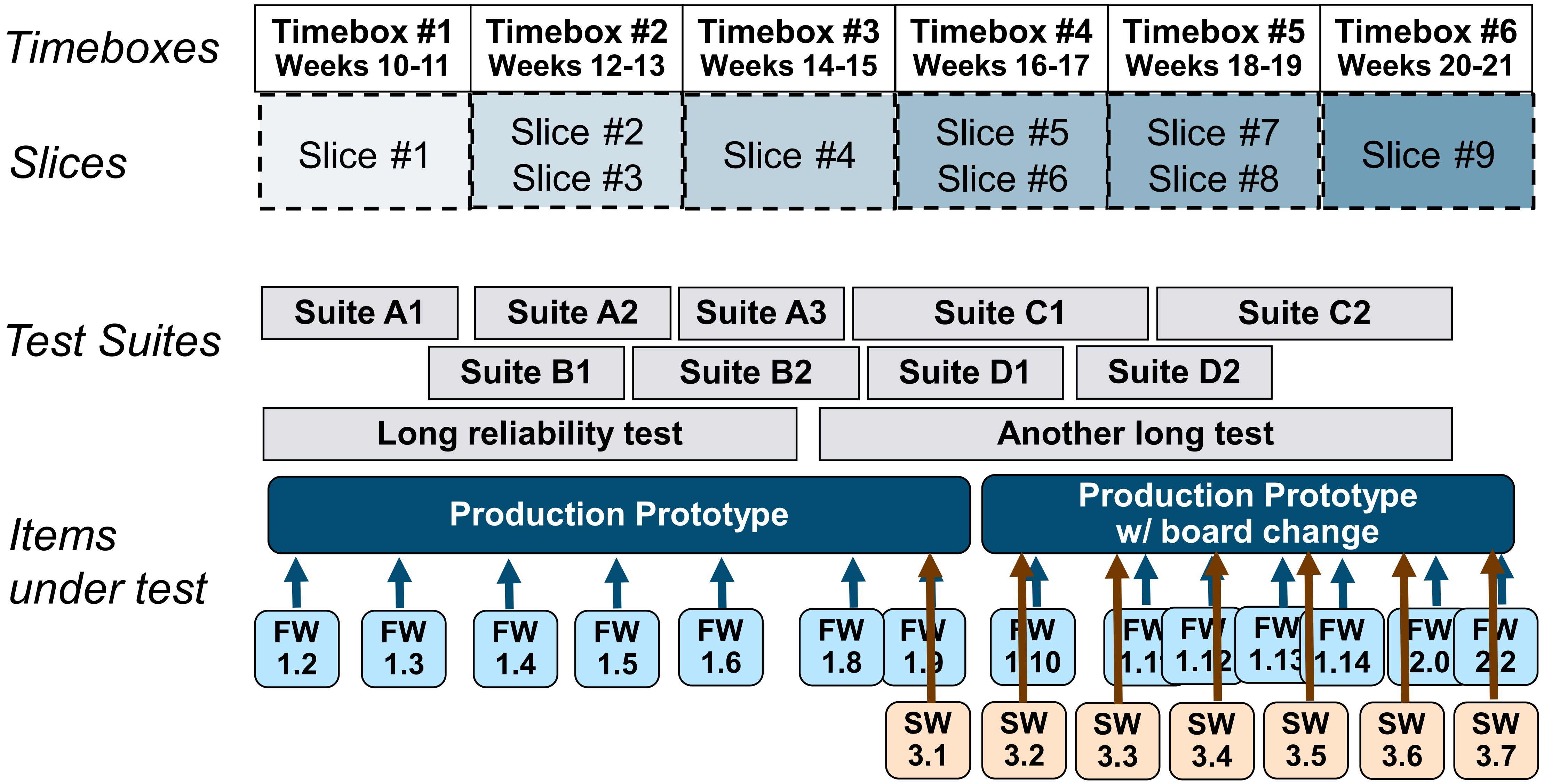


# Where to Look for Slices

- Slices can be suggested by
  - Test suites and test cases OR
  - Contents of firmware or software drops

- Starting from requirements specification doesn’t work well.
  - Not mapped to order of development
  - Often incomplete

- Defining slices is a collaborative, iterative process.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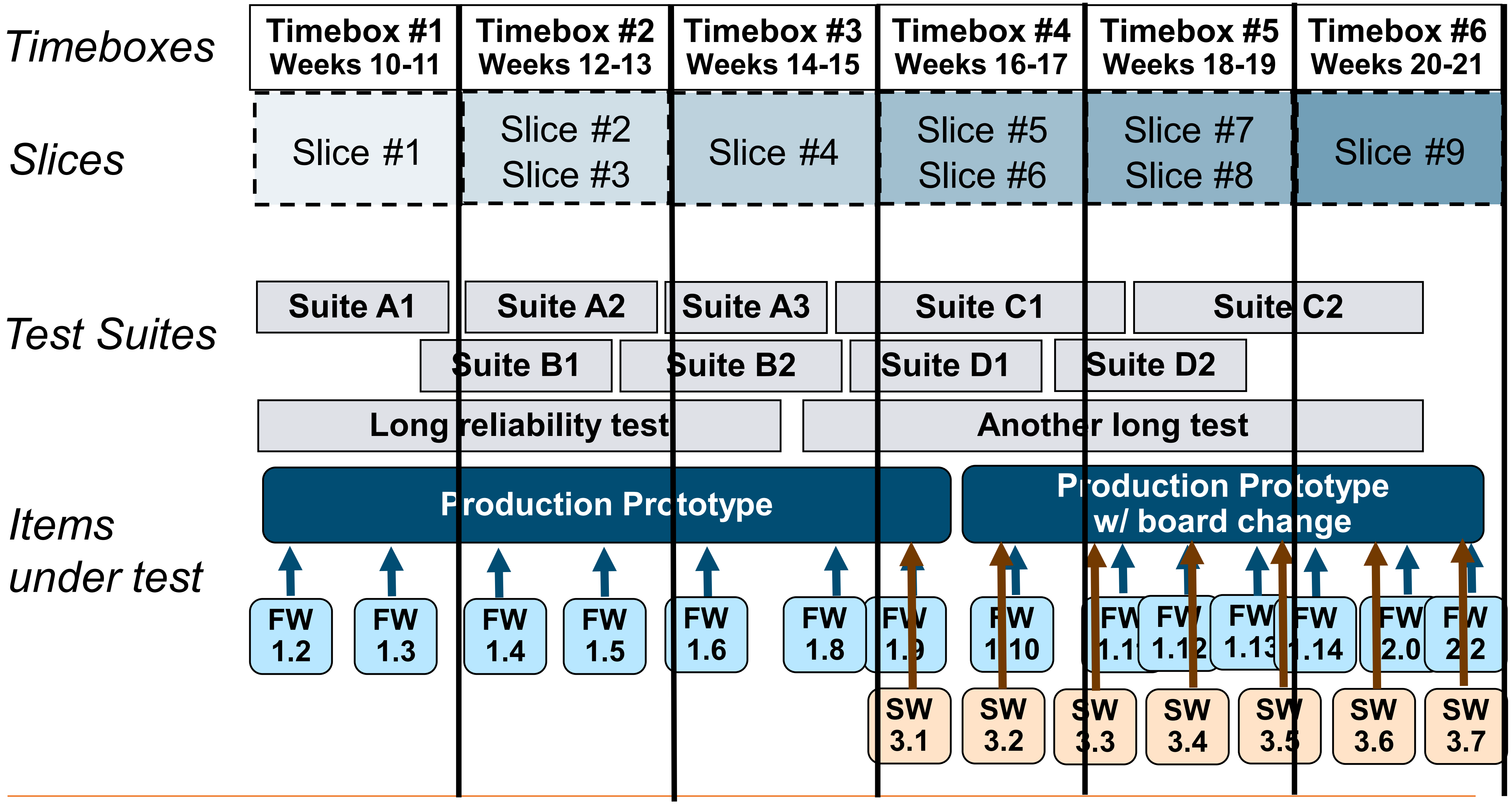
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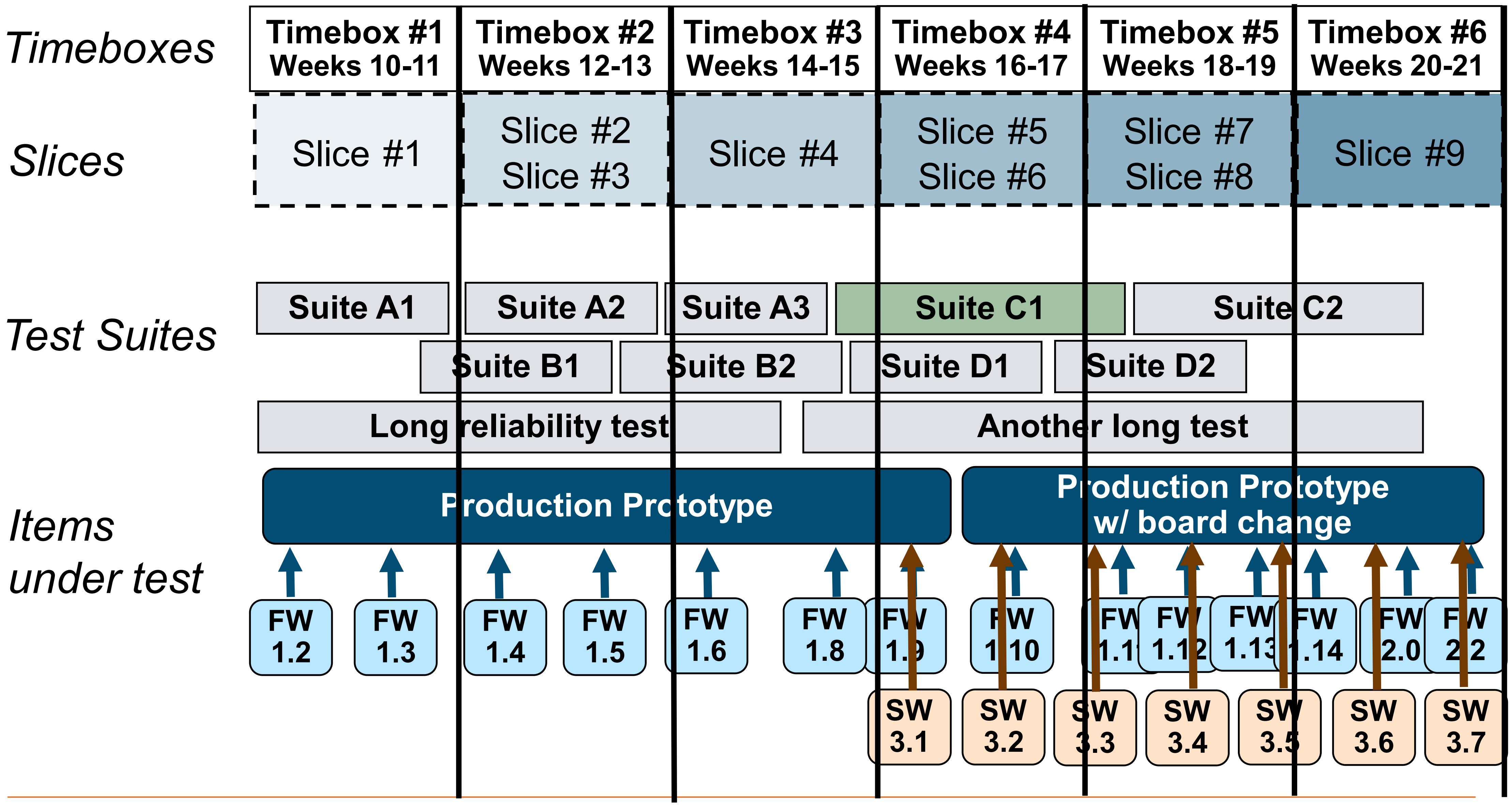

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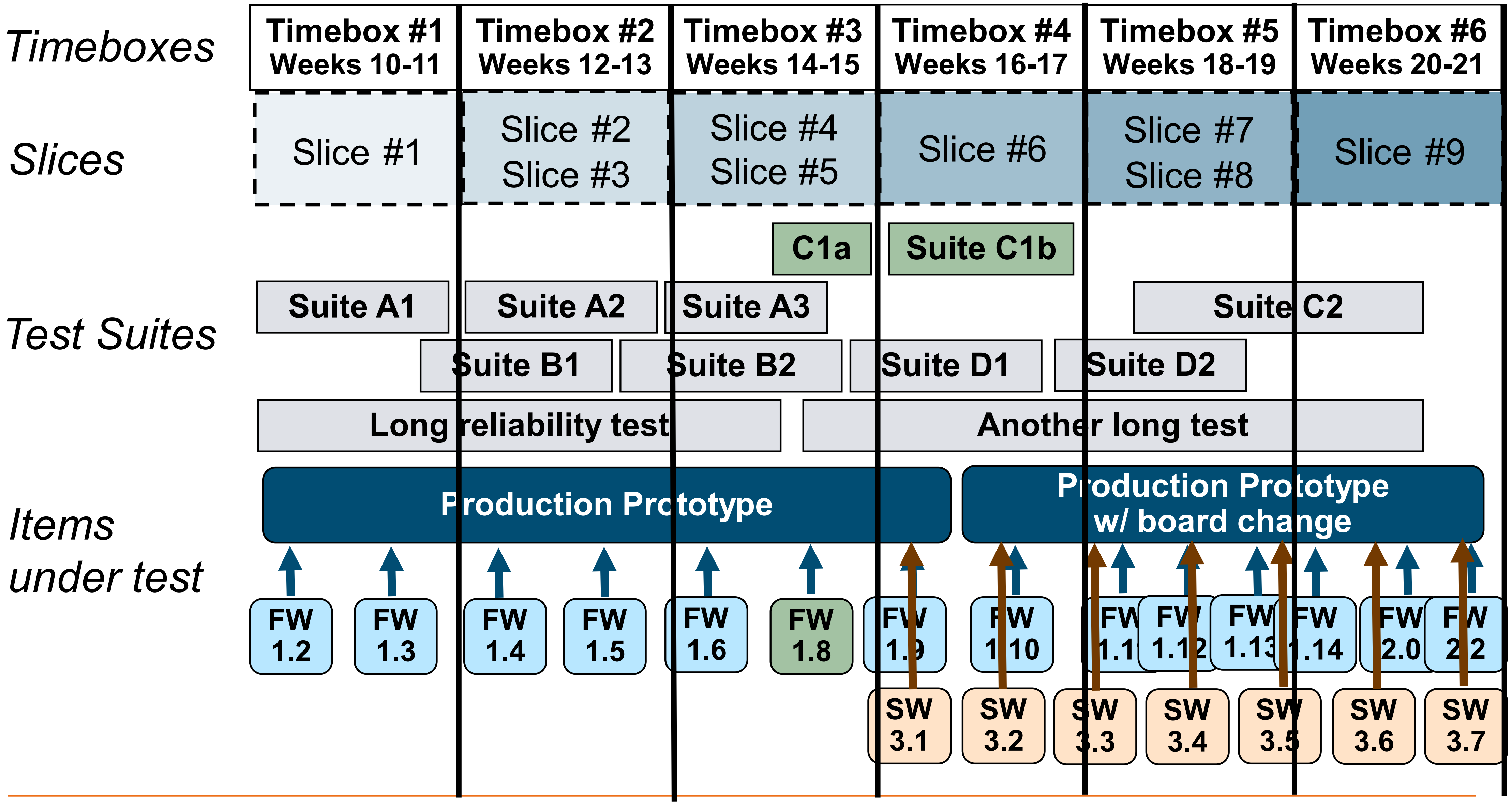

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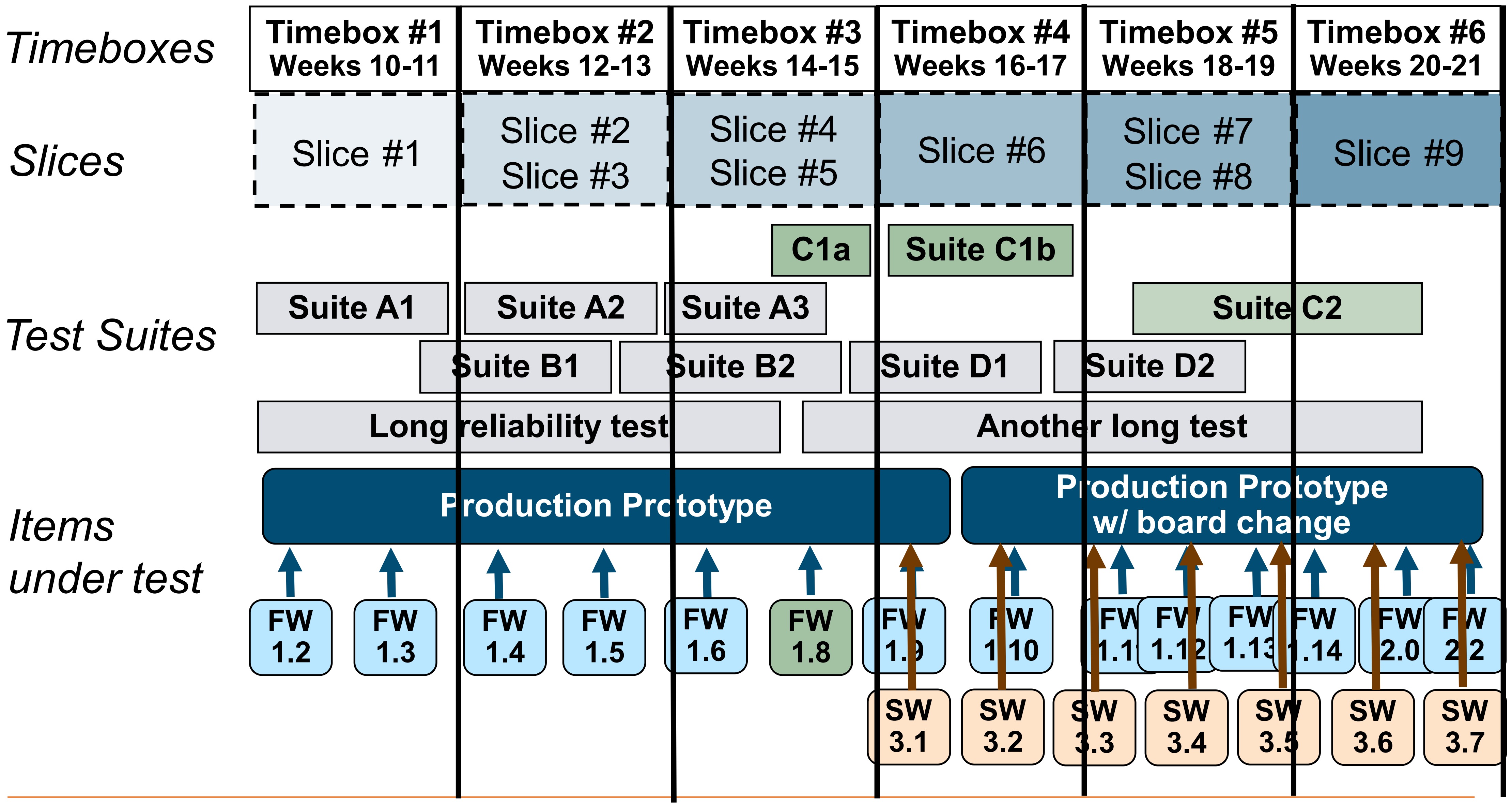

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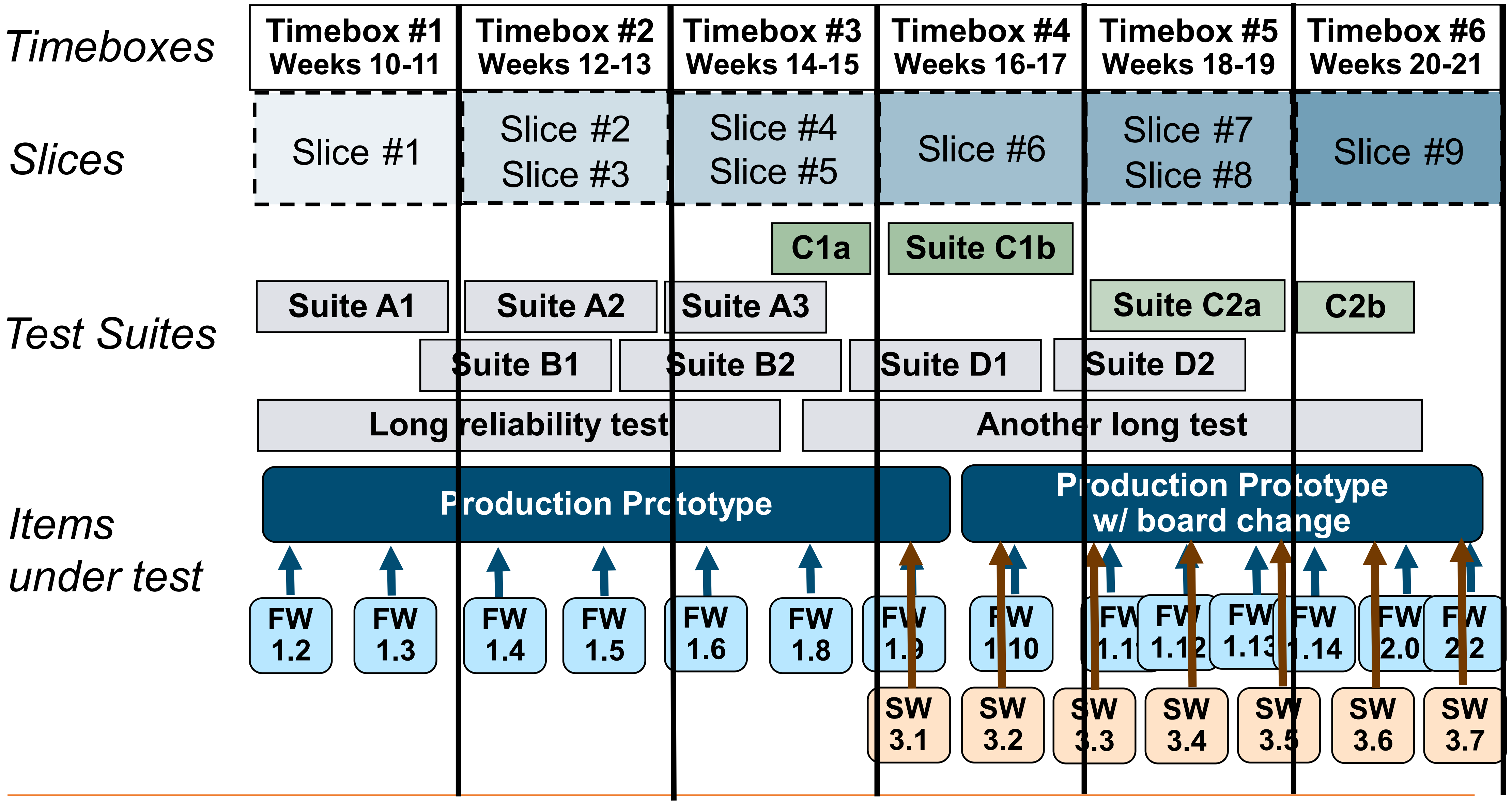
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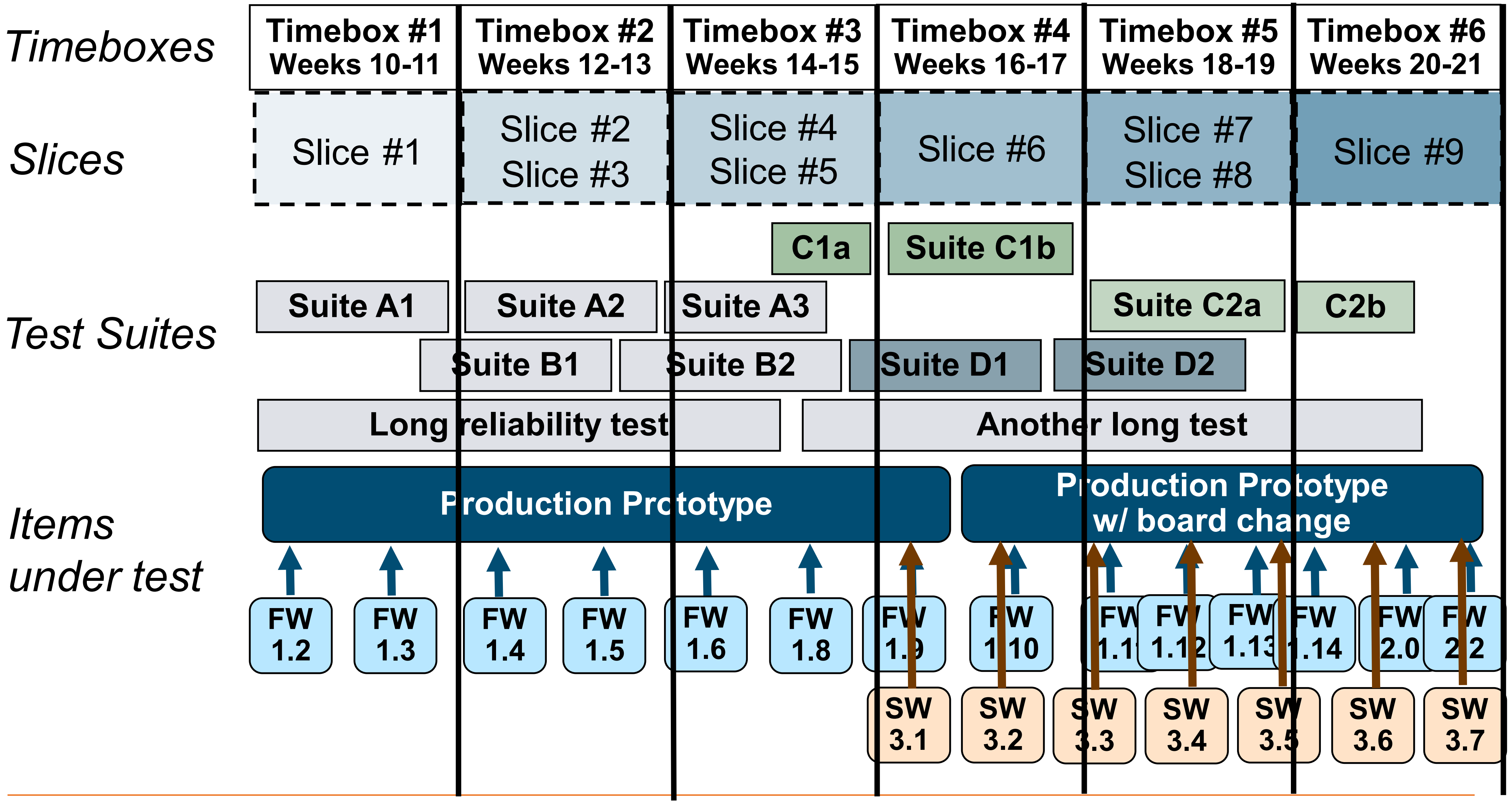
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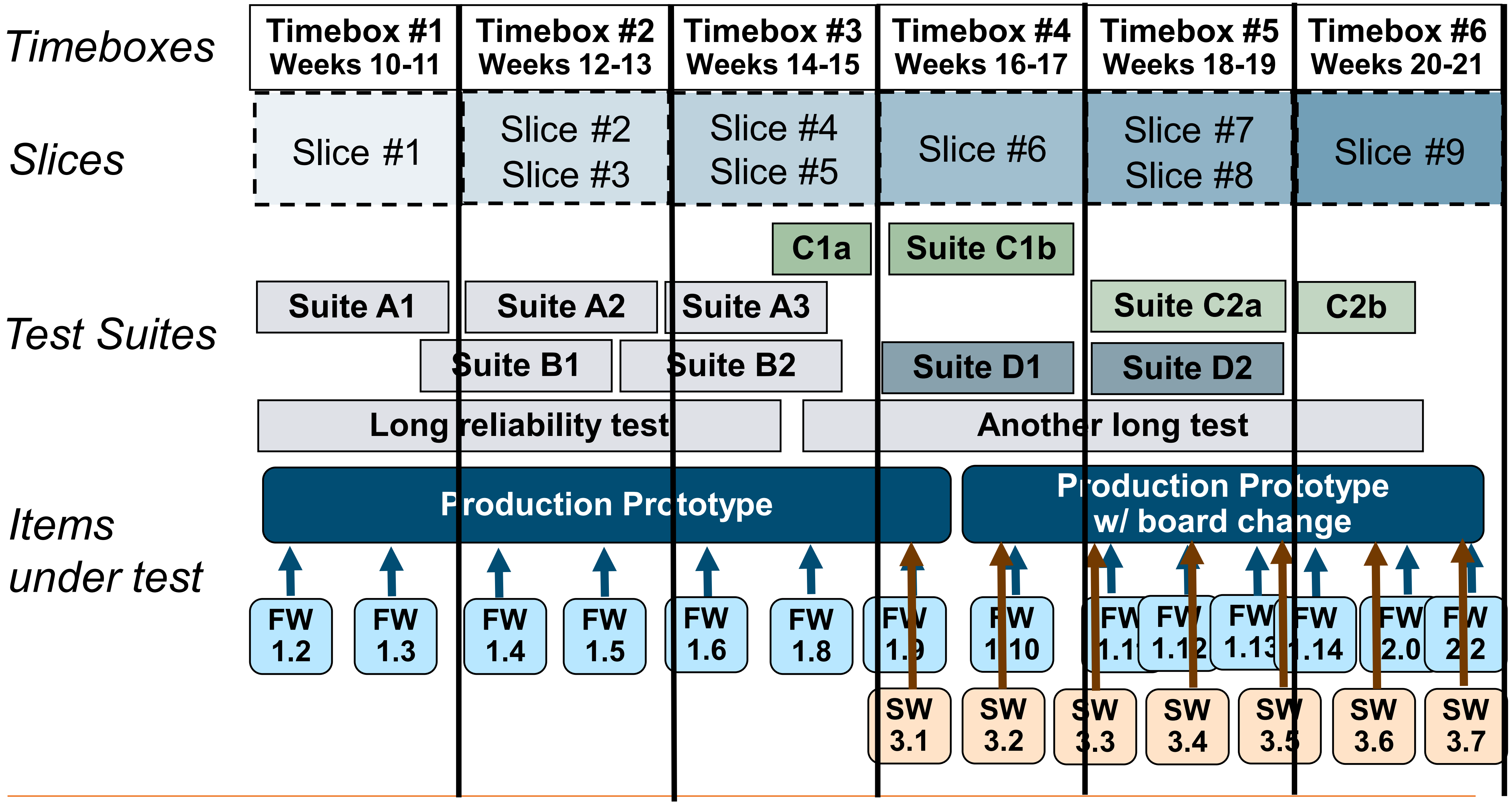
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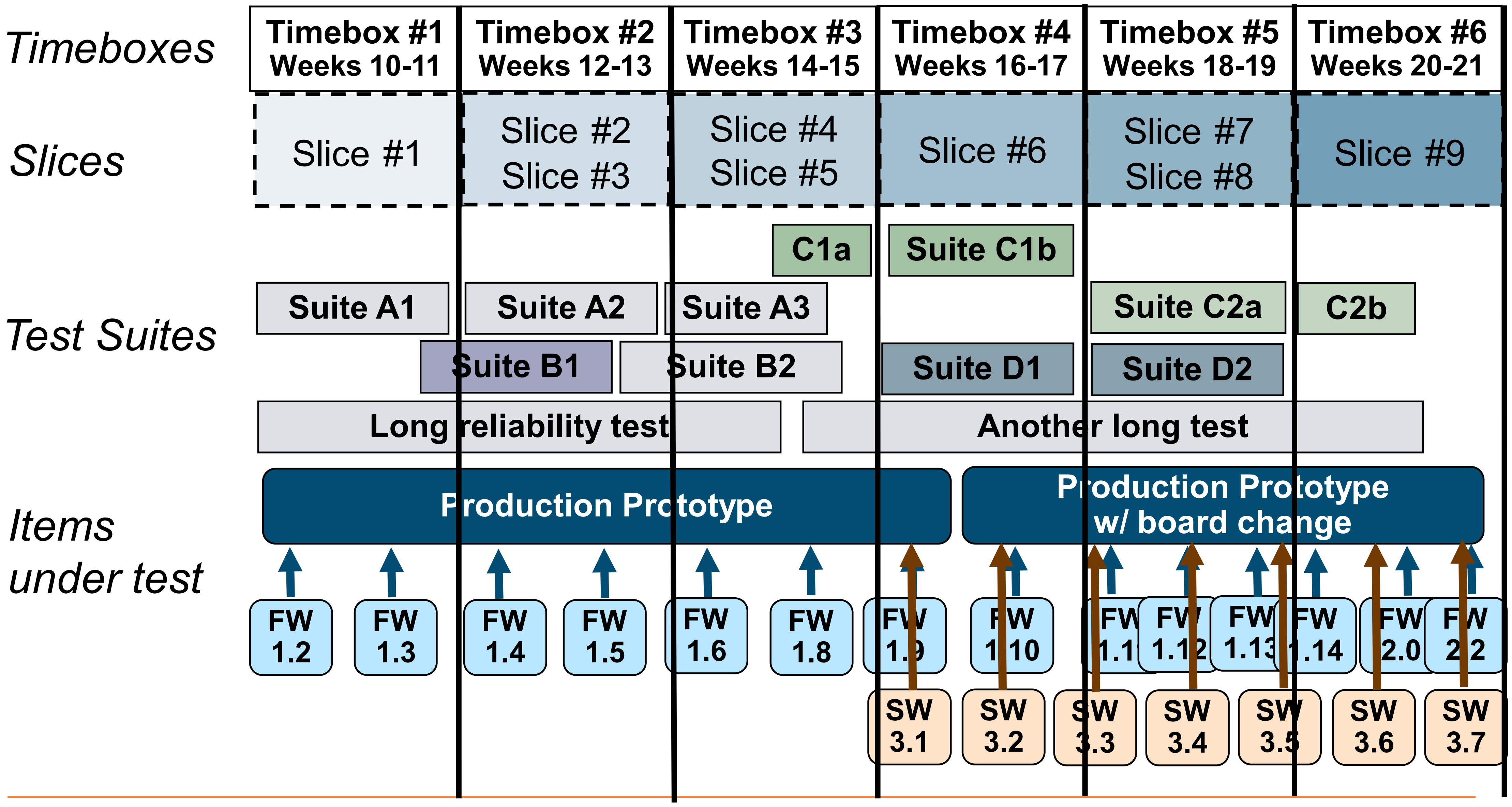
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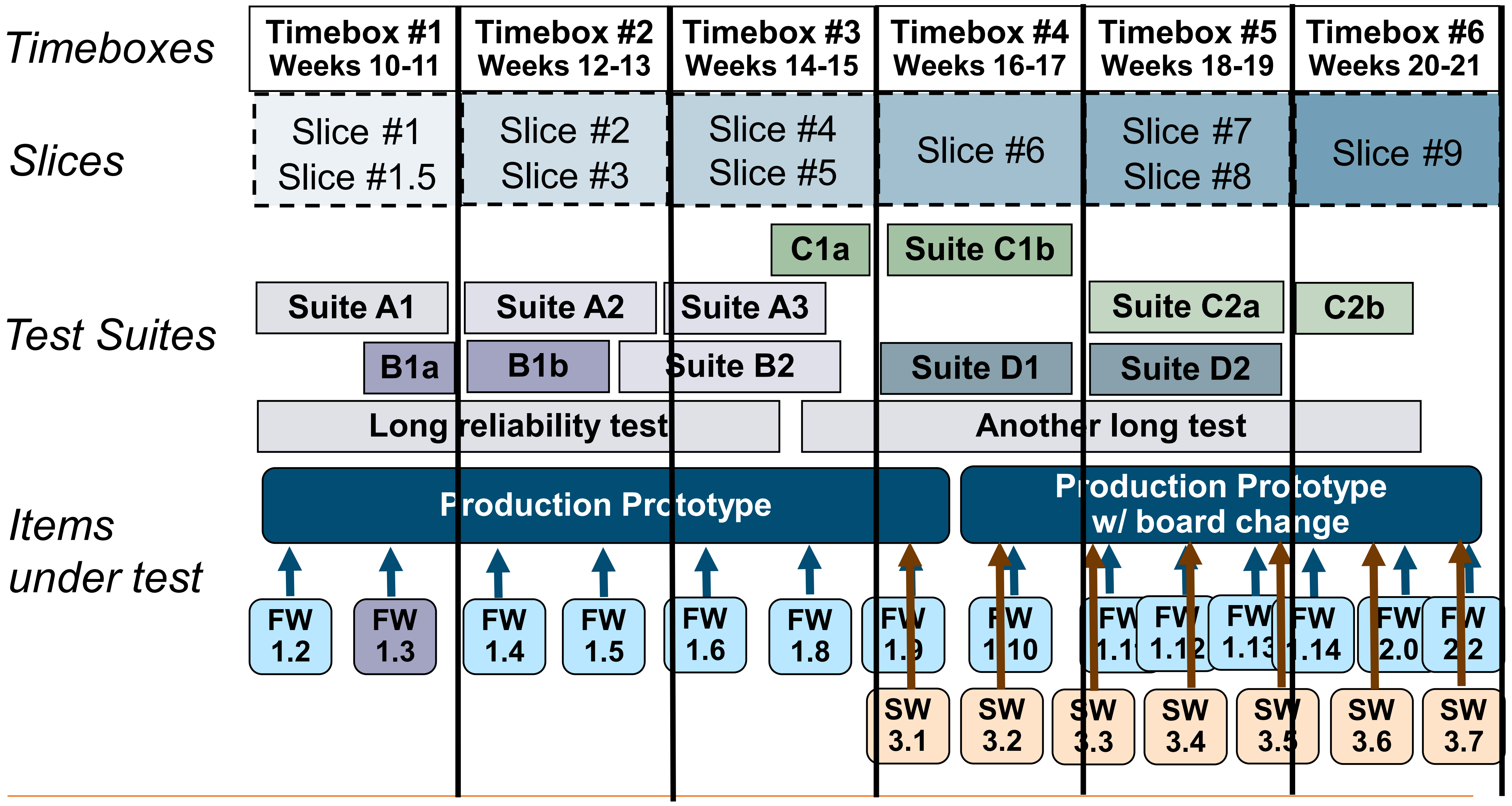
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# A Slice-Based Integration Plan

| Timeboxes | Weeks 10-12<br>Mar 08-Mar 28 | Weeks 13-15<br>Mar 29-Apr 18 | Weeks 16-18<br>Apr 19-May 09 | Weeks 19-21<br>May 10-May 30 |
|---|---|---|---|---|
| **Slice Definitions:** | - Print test page | - Print from PC<br>- Rev 4.2 boards integrated | - Print from mobile app<br>- Edge-to-edge photo printing | - Mfg. alignment test works<br>- Purchase more ink reminder |
| **System Tests Planned:** | - Basic functionality<br>- UX button response<br>- Life test | - Print from all OS<br>- Board regression<br>- Life test, cont. | - End-to-end mobile printing<br>- Full photo printing suite<br>- In-box durability | - Mfg. verification of cartridge alignment<br>- Low on ink<br>- Deplete ink |
| **Proto Build:** | **Prototype 1** | | **Prototype 2** | |
| **Hardware Deltas:** | <none> | GRS board 4.2 | Initial packaging | TBD – board 4.3 release? |
| **Firmware:** | Drop 1.2 3/08 | Drop 1.5 4/01 | Drop 1.9 | TBD |
| **Mobile SW:** | <none> | <none> | Release 1.13 4/22 | Release 1.14 |

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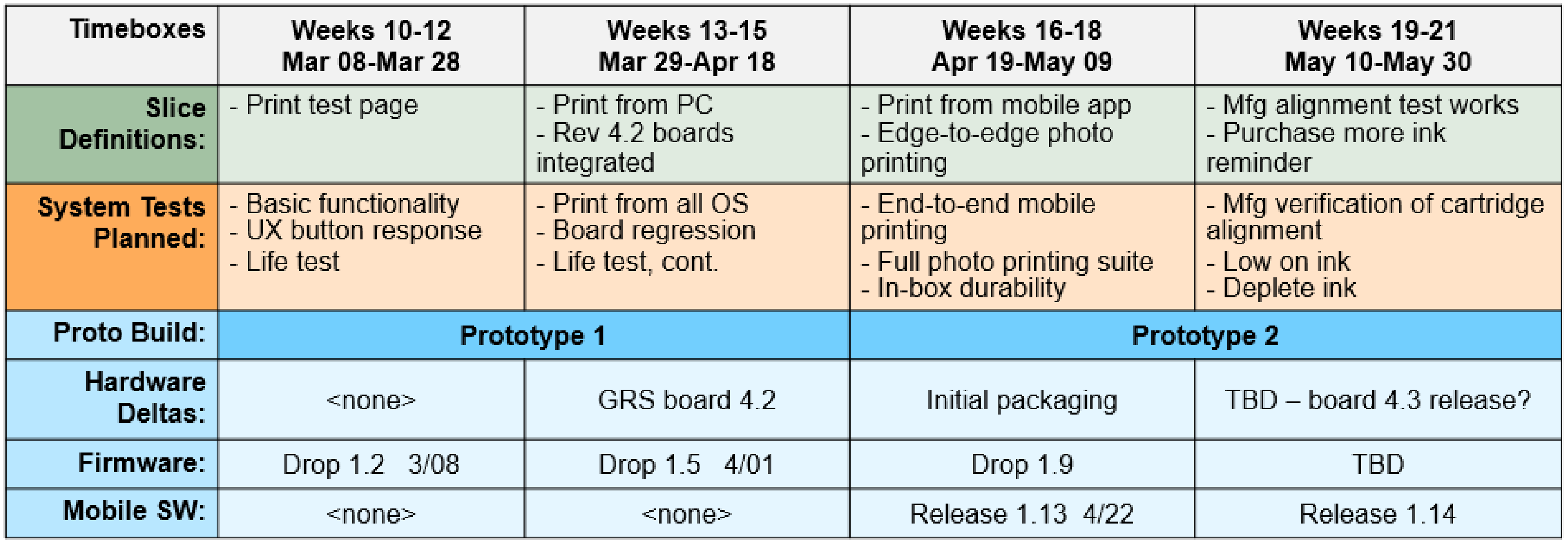
# Manage the Plan

- Cross-functional team review weekly
- Not a status meeting
- The three questions:
  - Has your planned delivery or testing changed?
  - Is anything blocking your plan for the next timebox?
  - What else do we need to know?



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## Slice-Based Integration Planning

1. Find the smallest practical test suite size.
2. Split your calendar into timeboxes accordingly.
3. Split up test suites to fit into timeboxes.
4. Your test suites suggest slices for each timebox.
   Define those slices in terms of user-visible behavior.
5. Use the slices to align test suites and deliveries.
6. Collect into a visual plan,
   where everyone can see the slices and the mapping.
7. Manage the plan weekly.

# Is This Agile?

Our slices:

- Are chunks of the **entire system**, not just the software.
- Are defined by a **cross-functional team**.
- Are centered around **features or behavior**.

**Like Agile Software:**

- Use cadence and WIP control
- Burn-up chart shows progress

***Not* Like Agile Software:**

- Numerous interdependencies
- Slices not individually shippable

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## HW/FW/SW Integration

- The challenge
  - FW, HW, SW have different batch sizes for good reasons
  - Language used is different in each discipline

- Result:
  - Difficult communication
  - Plans don’t align
  - Wasted time and effort

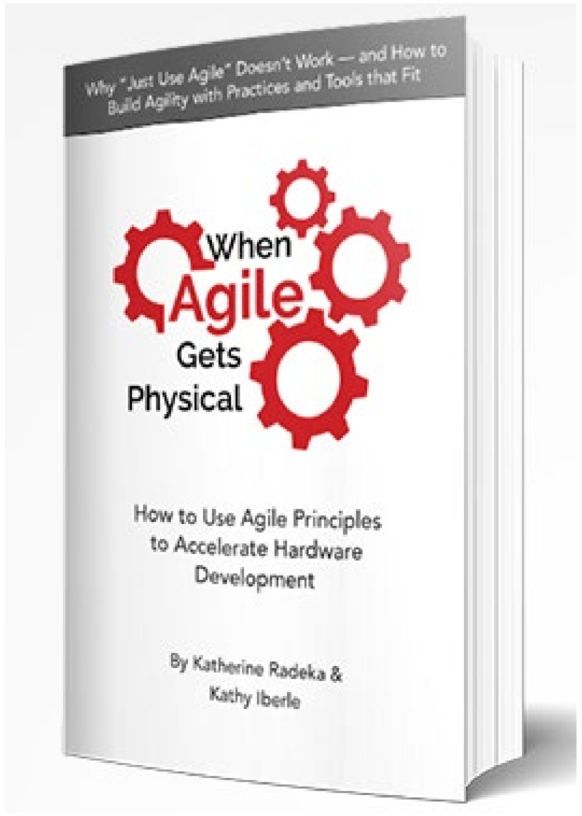
## Slice-Based Integration Planning

Apply agile principles to improve communication and flow:

- **Small batches**: Split tests into smaller suites.
- **Common language**: Slices of user-visible behavior.
- **Cadence**: Timeboxes align development drops and tests.
- **Cross-functional planning**: Technical leads from all teams.
- **Simple communication**: Visual plan.
- **Expect change**: Stand-up meetings, rolling-wave planning.

## LEARN MORE

- Read the paper in the PNSQC Proceedings
- Read the book: **When Agile Gets Physical**
  How to Use Agile Principles to Accelerate Hardware Development
  By Katherine Radeka and Kathy Iberle
- Contact me: kiberle@kiberle.com


Why "Just Use Agile" Doesn't Work — and How to Build Agility with Practices and Tools that Fit
When Agile Gets Physical
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40TH ANNUAL PACIFIC NW SOFTWARE QUALITY CONFERENCE OCT. 10–12, 2022

## QUESTIONS?

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# THANK YOU

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