Alternative Architectiture - Decoupling Generation and Simulation in an IP Test Bench

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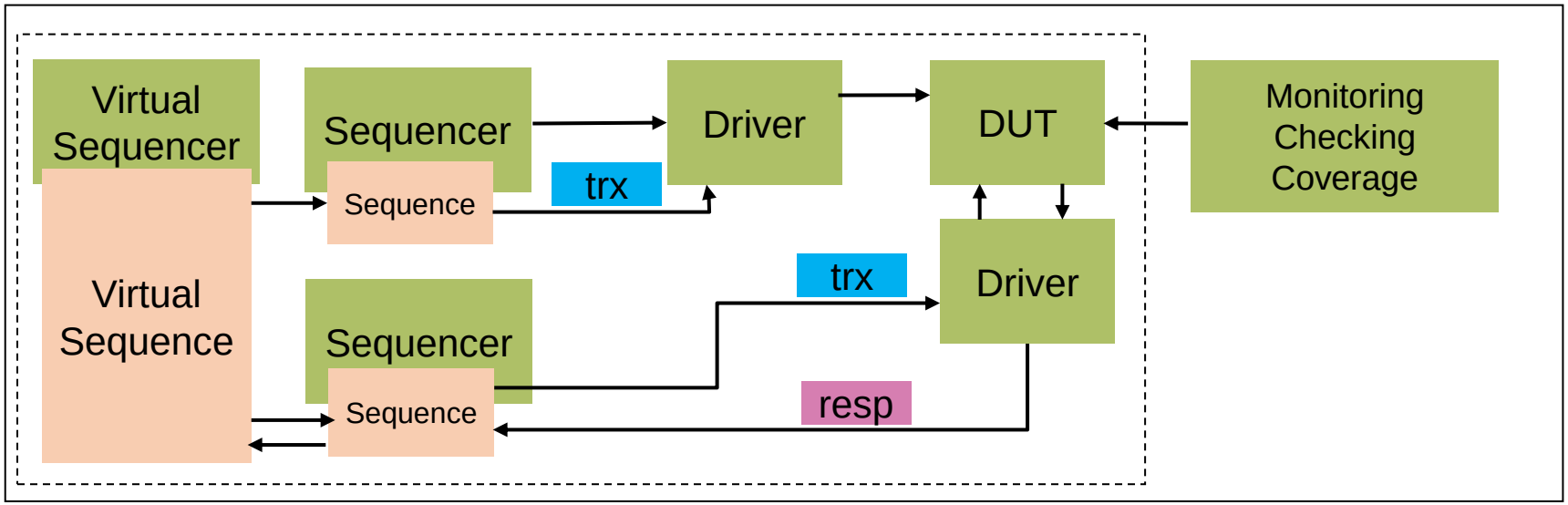
Introduction

- Standard IP test bench generation and simulation are closely coupled
  - After simulation completes little remains of the stimuli applied to the design
- Discuss benefits of decoupling generation and simulation in an IP test bench
- Decoupling here means
  - Randomisation of testcases is moved to a separate generator
  - Testcases are stored outside of the test bench

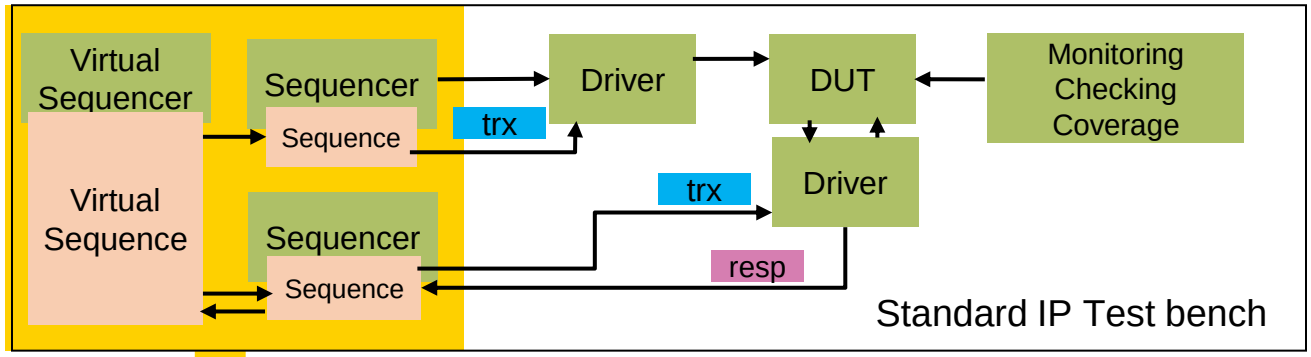
Decoupling

Standard IP Test Bench

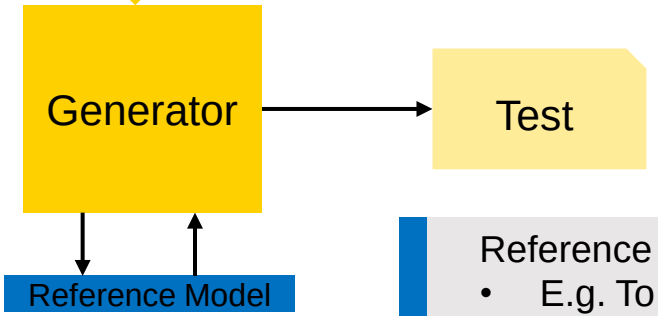


› Transactions generated in constrained-random manner in sequences before being driven to DUT by drivers

Alternative IP Test Bench - Generation



Constrained-random generation separated



Test contains information deterministically to generate a testcase e.g.

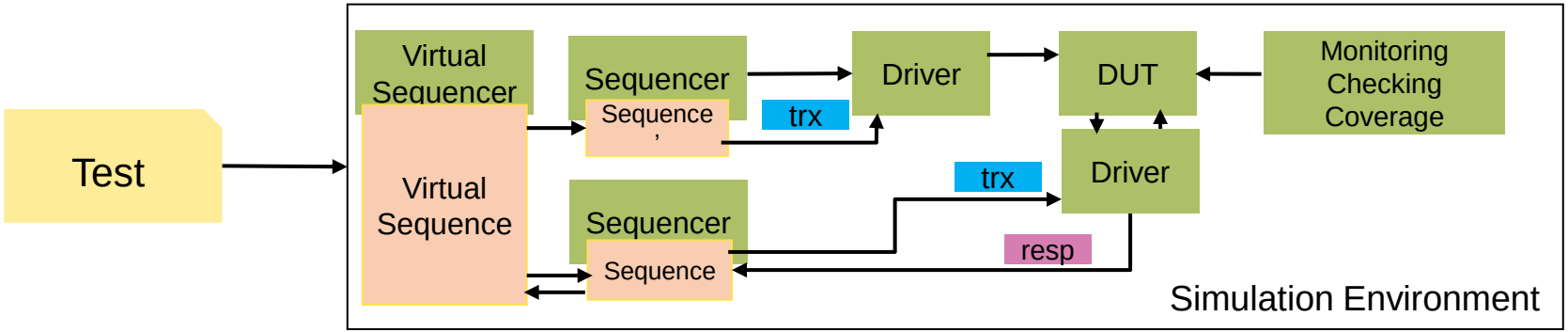
- The configuration of the DUT
- The transactions driven to the DUT

Test case may include synchronisation events

Reference model may or may not be needed

- E.g. To replicate response to driver
- Although for simple reactive sequences may not be needed

Alternative IP Test Bench – Simulation



- Sequences ‘generate’ transactions deterministically according to test
  - No randomisation in the simulation environment
- Possible tailorings
  1. Allow simulation environment to generate part of the transaction (e.g. number of delay cycles)
  2. Allow simulation environment to generate simple transactions (e.g. for sideband inputs)
  - Most of the benefits can be retained
  - Stored test can be modified during simulation so same testcase can be replayed

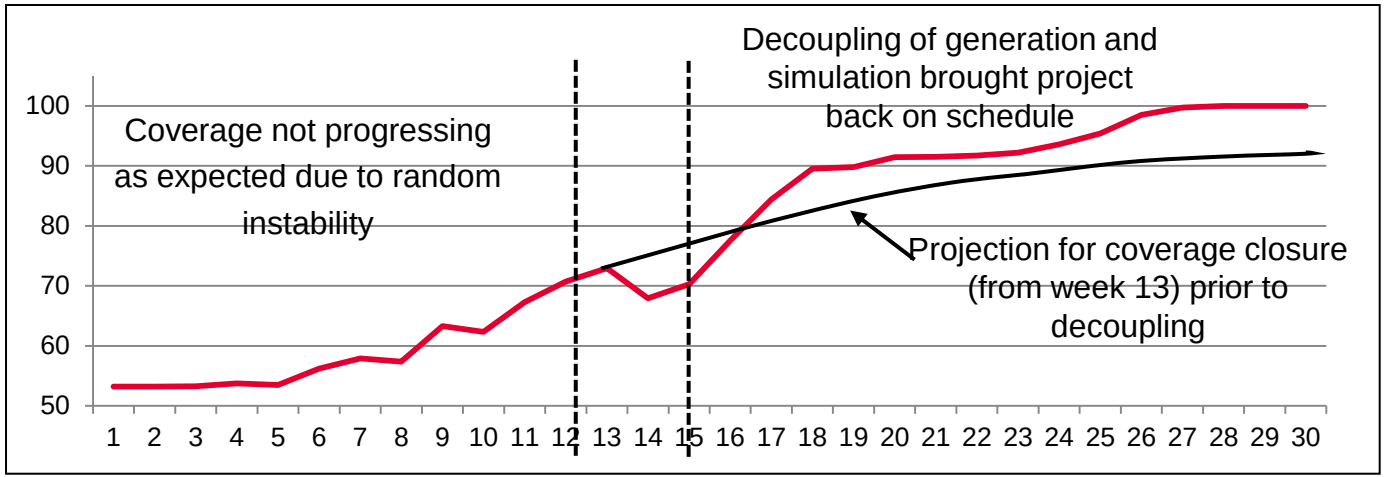
Summary

- Generation and simulation decoupled
  - Generated tests are stored
  - Stored tests used in simulation environment

Benefits and Drawbacks

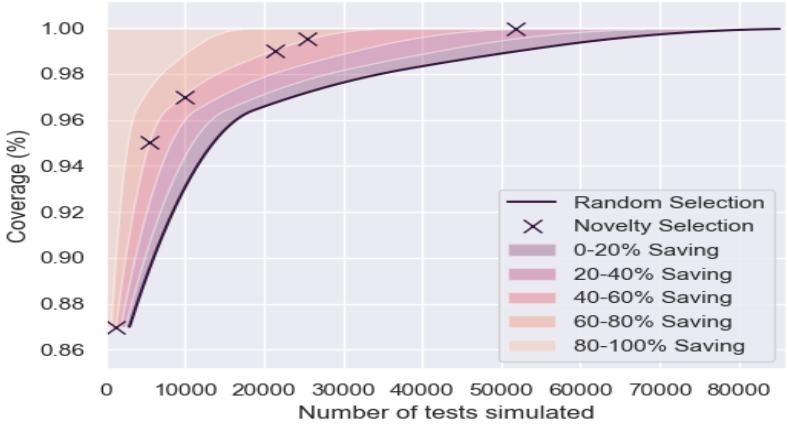
Improved Random Stability

- With standard approach, changes to generation constraints mean that tests can be generated very differently
  - e.g. caused by tightening of specification as a result of test failures
- Tests in a golden regression achieve different (lower) coverage (see below)
- Difficult to reproduce errors – particularly if interfaces change
- With decoupled approach, saved tests do not change



Post-processing of Generated Tests

- Test in golden regression can be updated (by script) for specification updates
  - Updates localised to change – no random instability
- Not all generated tests have to be simulated
  - E.g. use Machine Learning techniques to identify ‘interesting’ tests

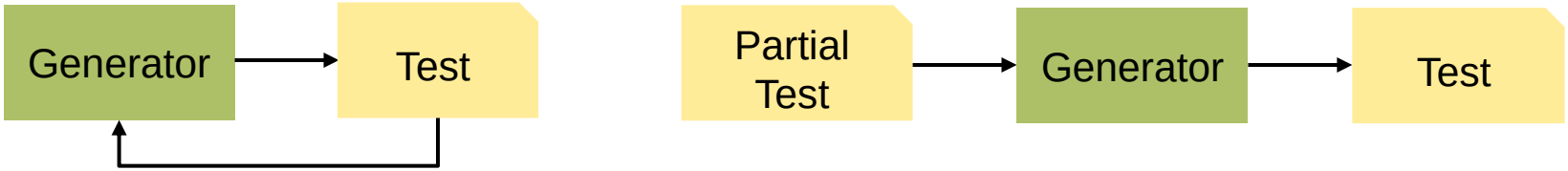


DVClub Europe February 2022
Novelty-Driven Verification: Using Machine Learning to Identify Novel Stimuli and Close Coverage

Machine Learning for test selection reduced time-to-coverage by around 60% compared to randomly generated tests

Re-Generation and Pre-Generation

- Generator can be constructed to allow tests to be fed back into generator
  - Easy to debug tests that have become illegal due to specification changes (generation contradiction)
- Partial test can be pre-generated by script before being filled out as legal tests by the generator
  - Pre-generation can be driven by block-box coverage model
  - Powerful way to create directed tests to ramp-up design quality quickly



Others

4. Mixed languages
   - Generation and simulation environments can be in different languages
5. Portability
   - Tests can be ported to other environments
   - PSS is example of de-coupled environment
6. Look-ahead generation
   - Can try out generated transactions of reference model before committing them to a test

Why not pre-generate testcases?

- Interactive generation
  - Need for cycle-accurate generation of testcases
  - Not only the timing of the driving of the transaction depends on design state but also the generated values
  - In reality this rarely needed
- Main reason not to use this approach is that the benefits of the approach are not relevant

Questions?

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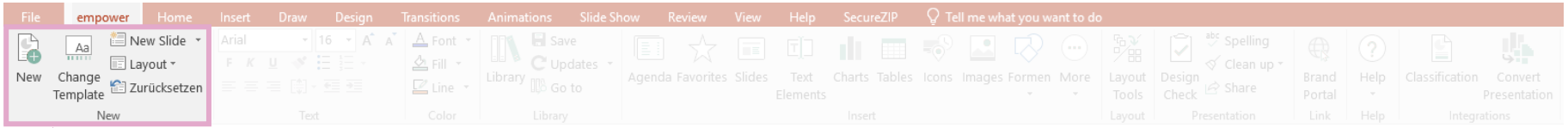

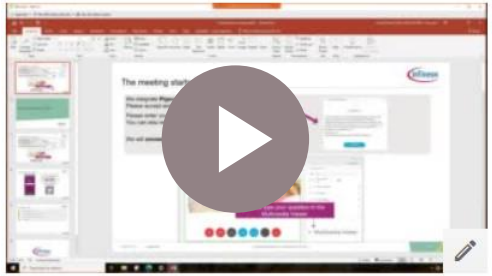

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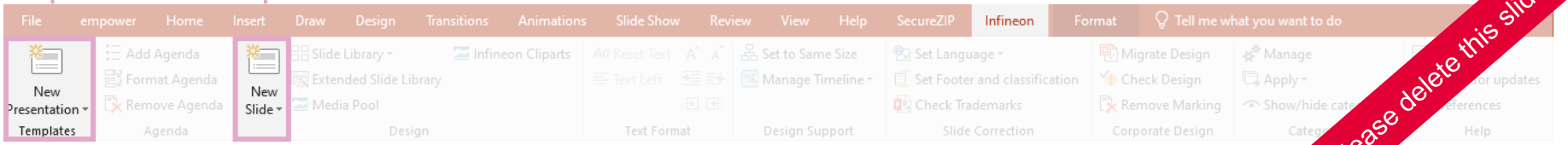

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