DVCon 2012
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There's something wrong between Sally Sequencer and Dirk Driver

(Why UVM sequencers and drivers need some relationship counseling)

by

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Overview

- The UVM Stimulus generation architecture
  - Sequencer, Driver, Sequences, Sequence Items
  - Dates from the eRM, OVM, now UVM

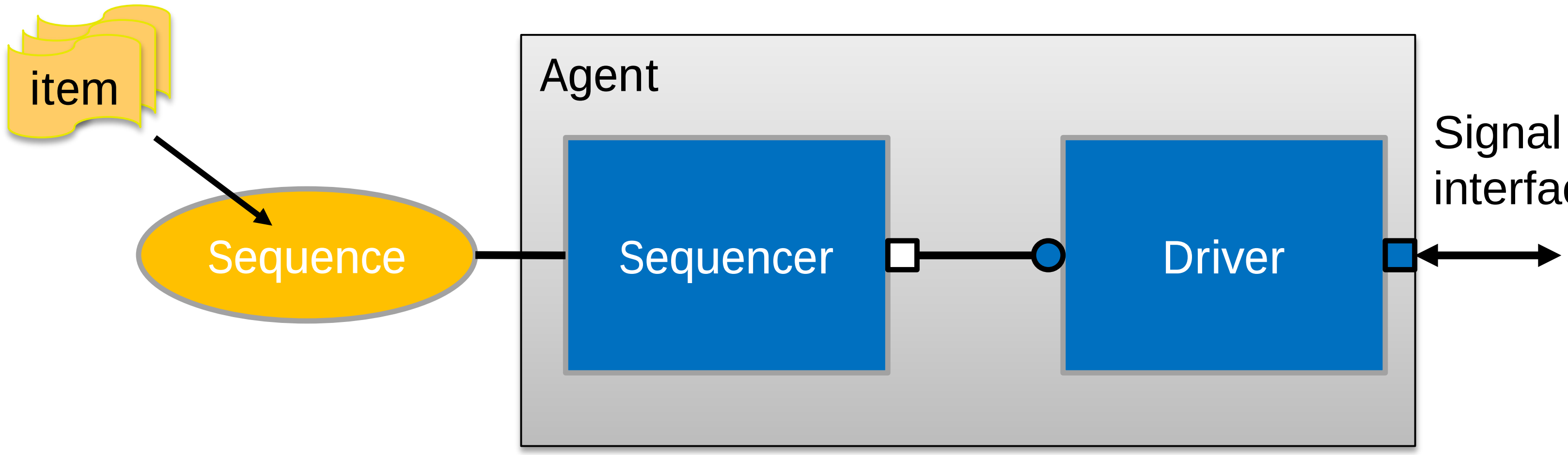
- Is it still fit for purpose?
- Is it time for an update?

- As an alternative
  - Would TLM2 be a better starting point?

How The UVM Is Positioned

- Consistent API enables reusability
  - Interoperability between components
- Test cases written by engineers with design domain knowledge
  - Rather than detailed testbench (UVM) knowledge
  - Working at a higher level of abstraction (TLM)

Transactions
(High level
Transfer description)



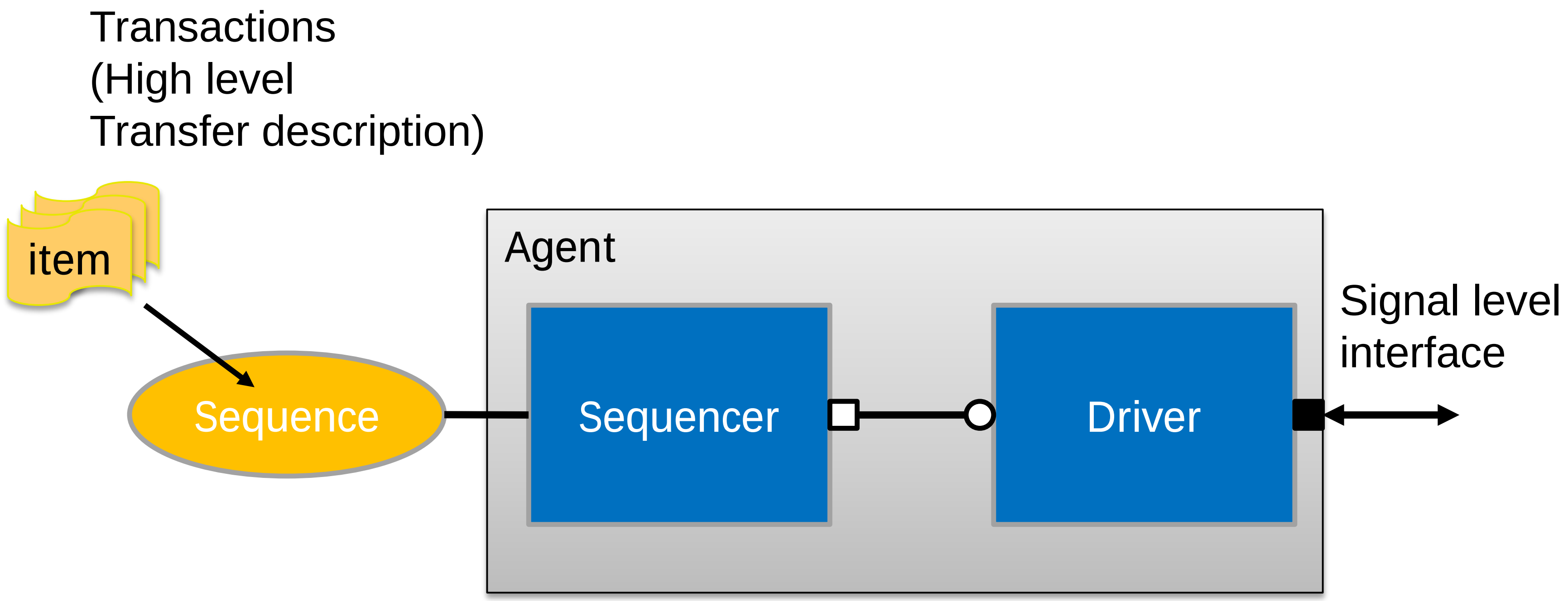
Where The Cracks Appear

- Writing sequences
  - API is confusing with too many choices
  - Implementation has to match the driver

- Methodology is about “freedom from choice”
  - Abstraction can be powerful
    - But not if it’s complicated

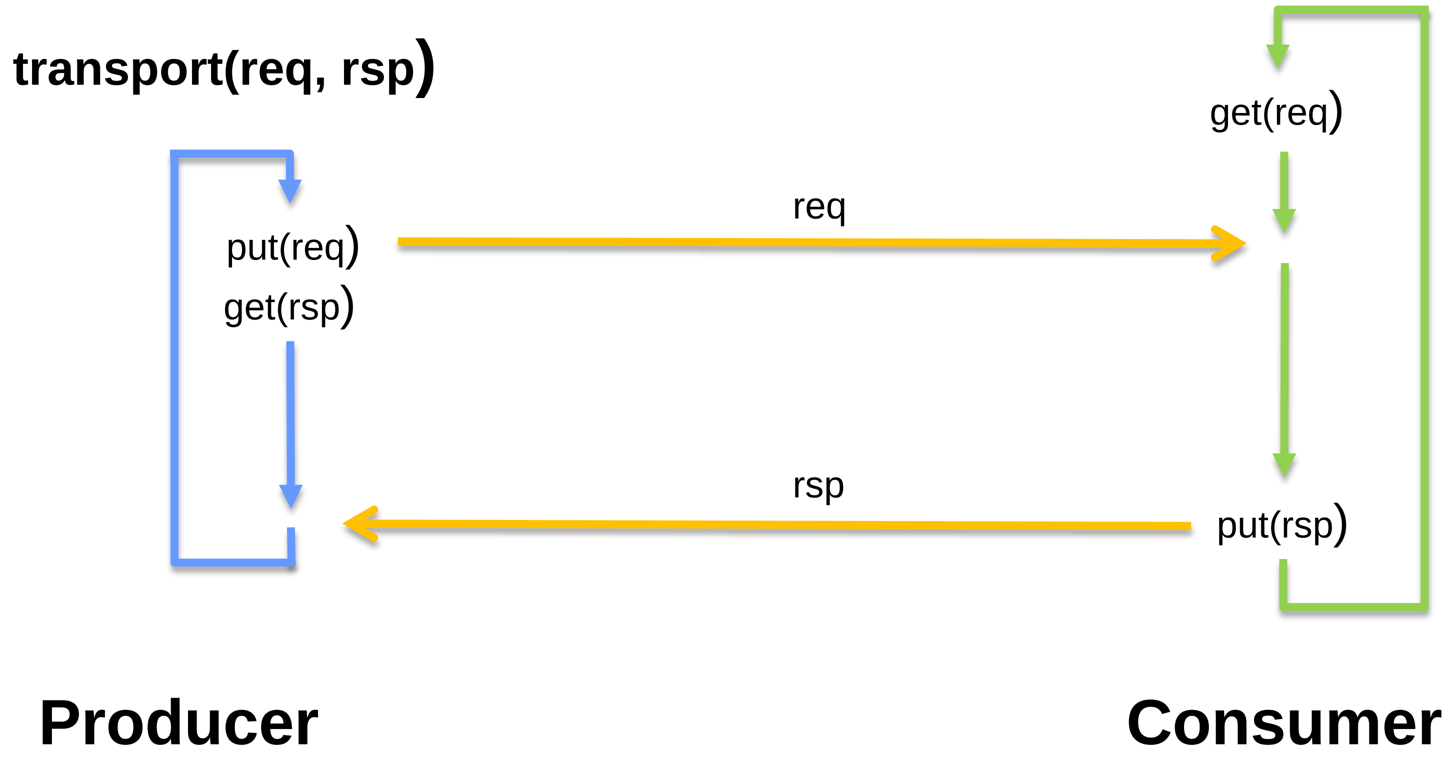
Stimulus Generation In The UVM

- Sequence_items (aka transactions)
  - Generated by sequences
- Sequencer
  - Arbitrates between multiple sequencers
  - Implements TLM 1 port proxy for sequences connecting to drivers

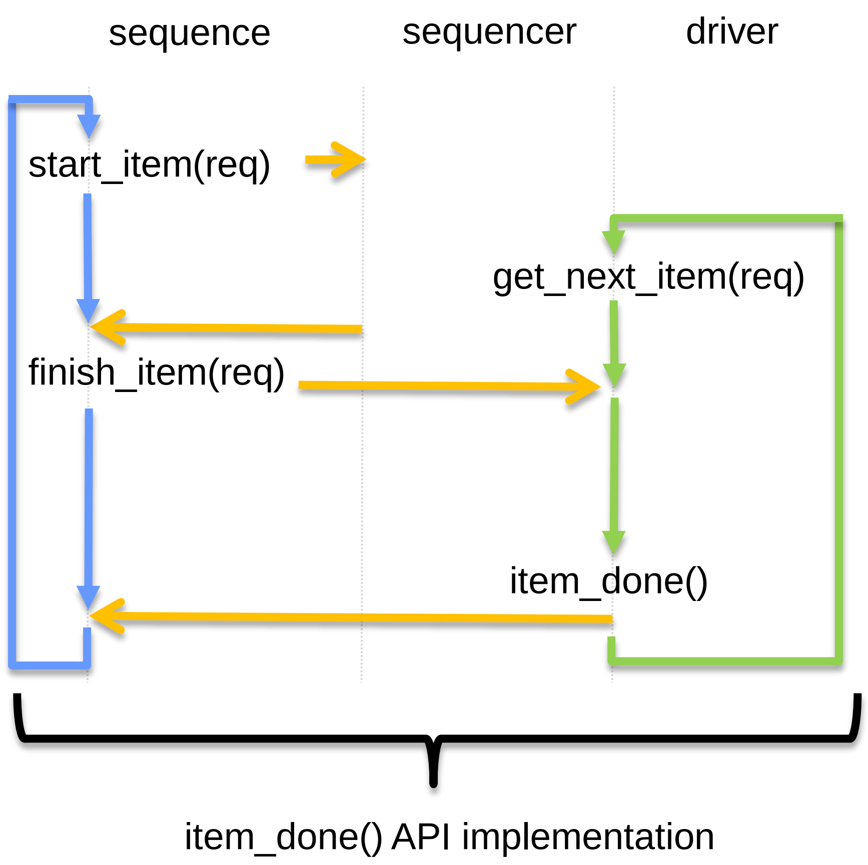


TLM 1 API -Producer, Consumer

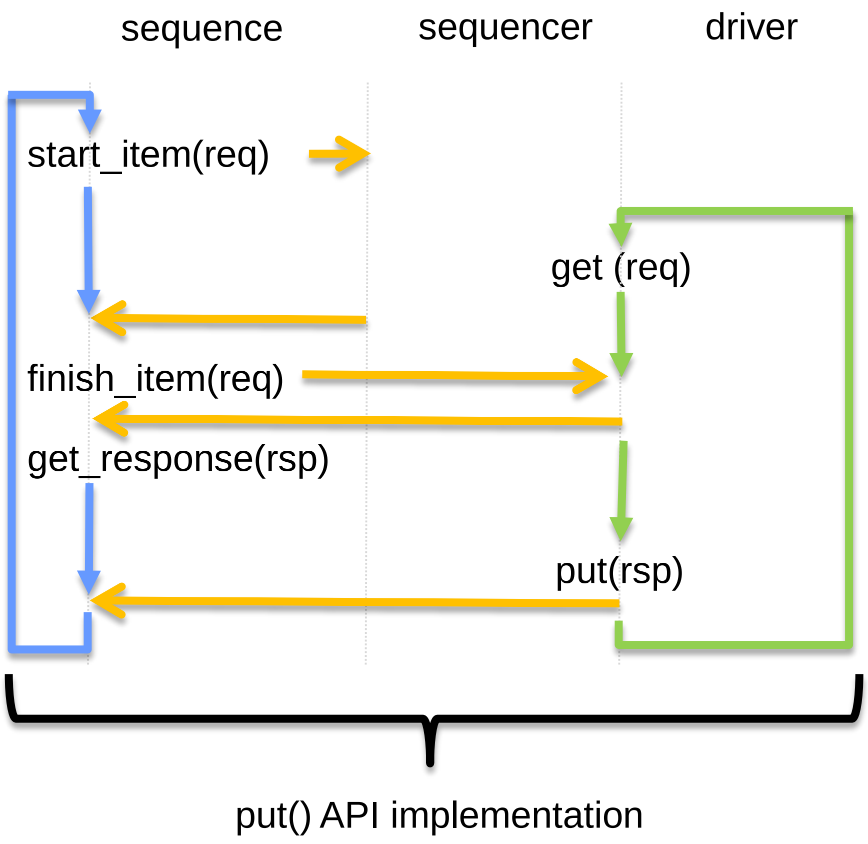
- Simple API
  - transport(), put(), get()
  - Unidirectional flow
  - Point to point connection



Bidirectional Transfer



item_done() API implementation

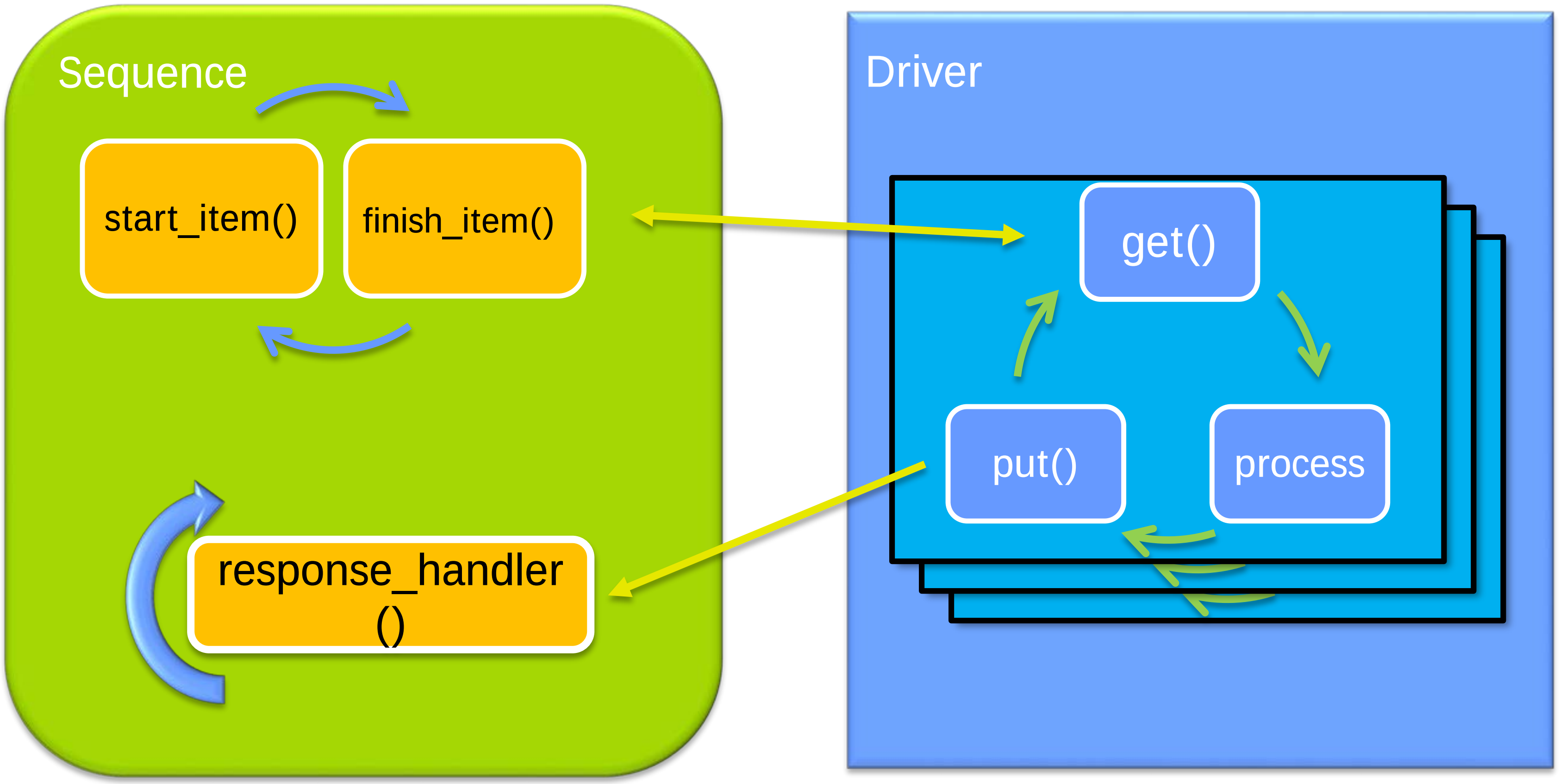


put() API implementation

Observations

- There are at least two implementation models
- Departure from TLM principles
  - The sequence writer has to understand something about the driver implementation

Fully Pipelined Transfers



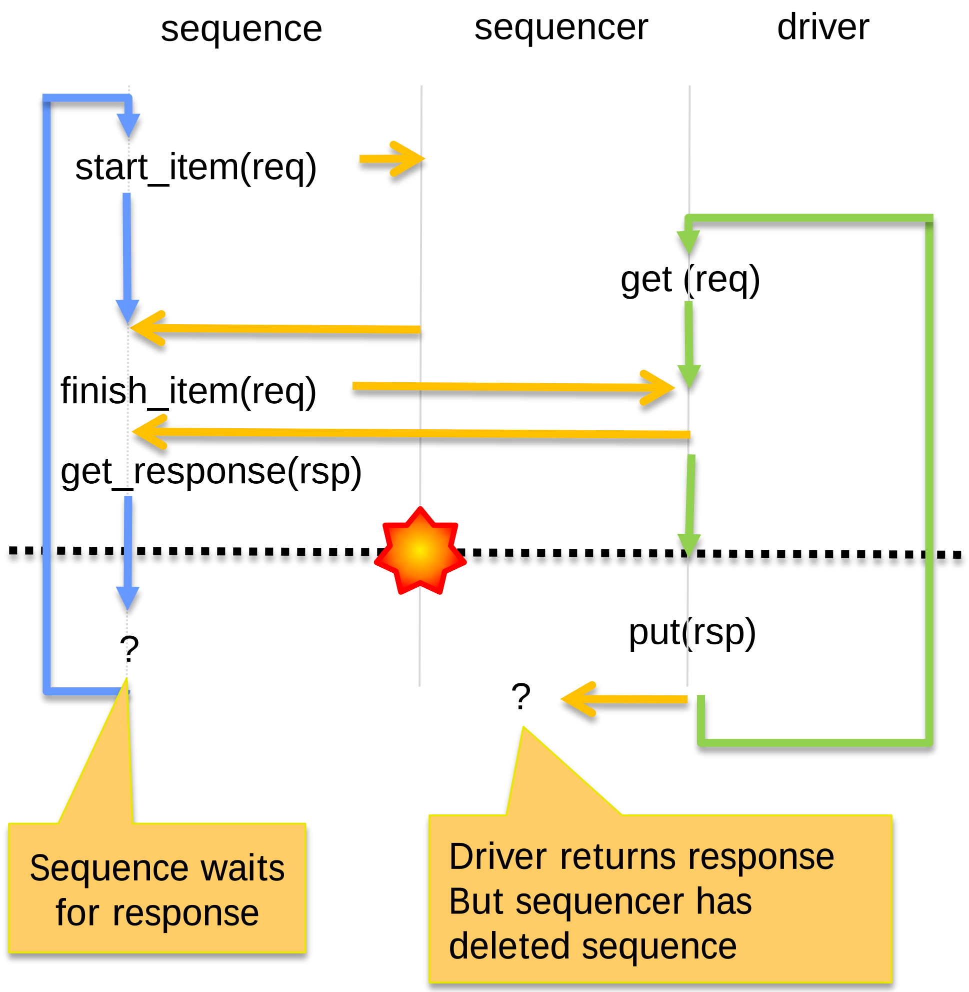
Separate stimulus and response threads

Thread for each pipeline stage

Handling Disruptive Events

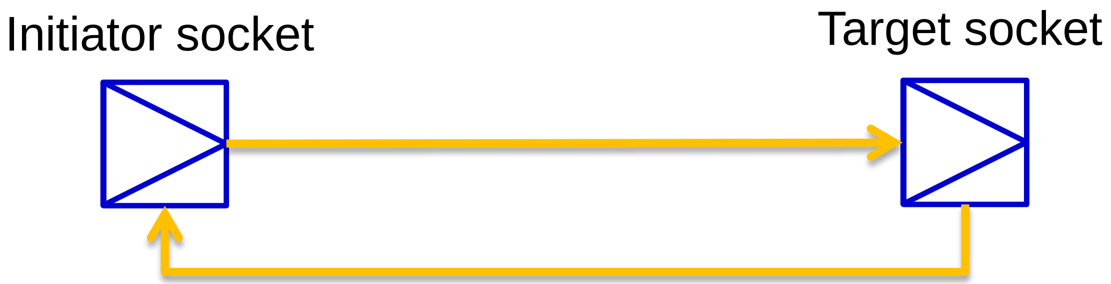
- Disruptive Events:
  - Hard or soft resets
  - Errors
    - Deliberately injected
    - DUT error
  - UVM Phase change

- Very easy to deadlock
- Up-front thought required

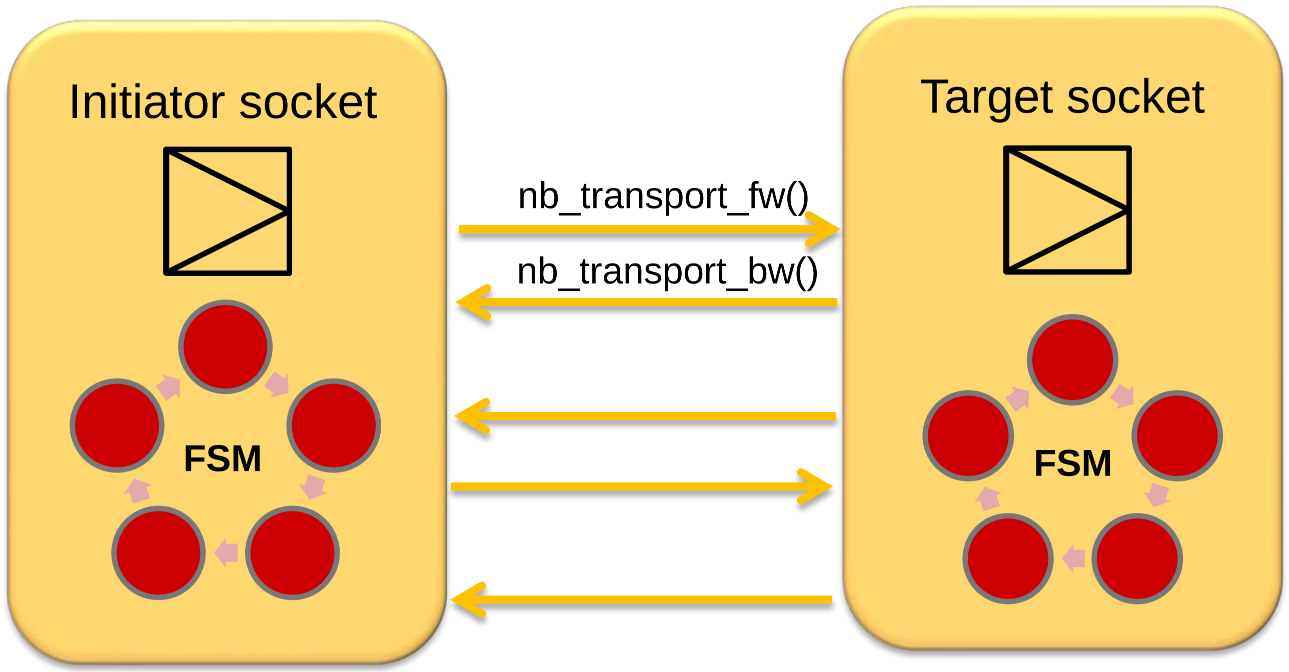


Alternative Using TLM 2

- TLM 2 Initiator and Target Sockets support both:
  - Blocking transports
    - Single method, returns when response ready
    - Equivalent to item_done()
  - Non-blocking transports
    - Initiator calls nb_transport_fw() method
    - Target calls nb_transport_bw() method independently
    - Phase and status information passed together with data

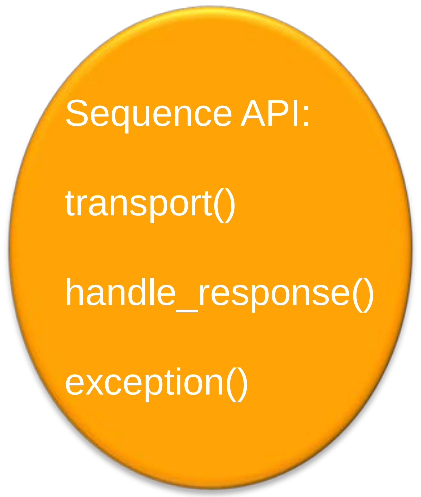


Non-Blocking Transport Implementation

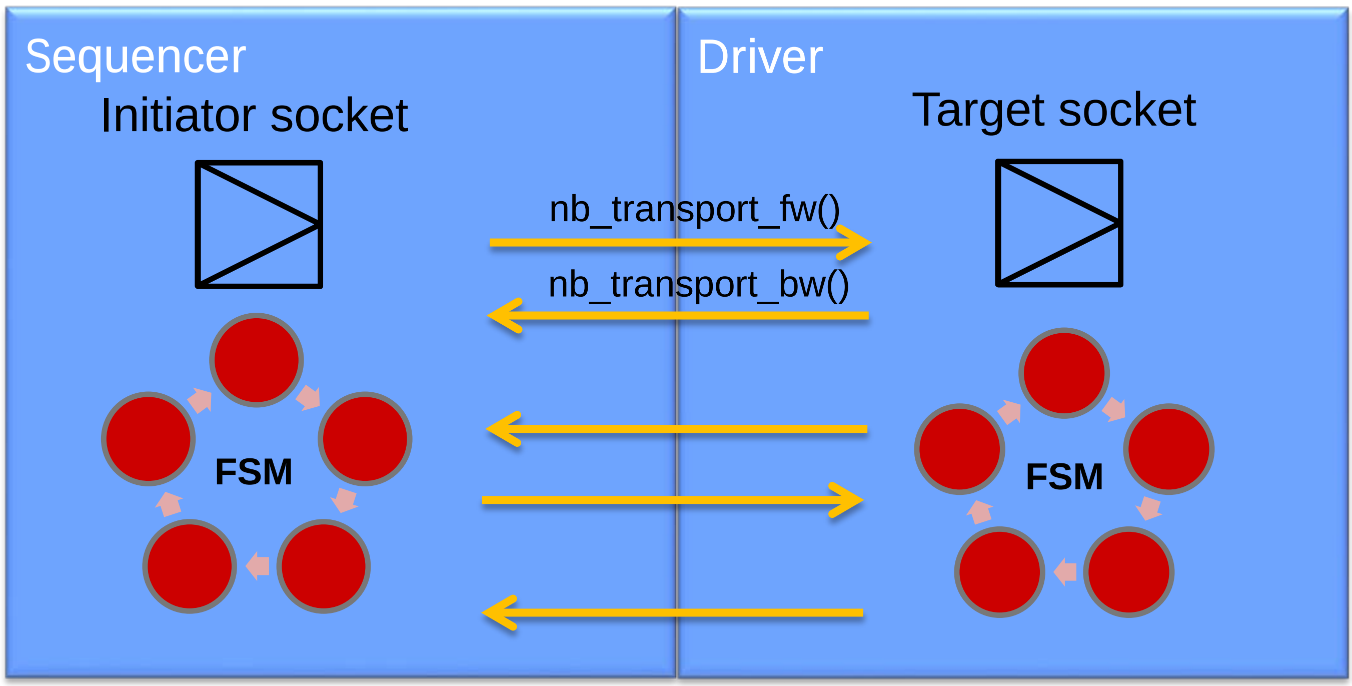


- Target can call nb_transport_bw() any number of times
- Transaction always passed with status and phase
- Allows state tracking on either side

Alternative Sequence Driver API



Well defined and simple API

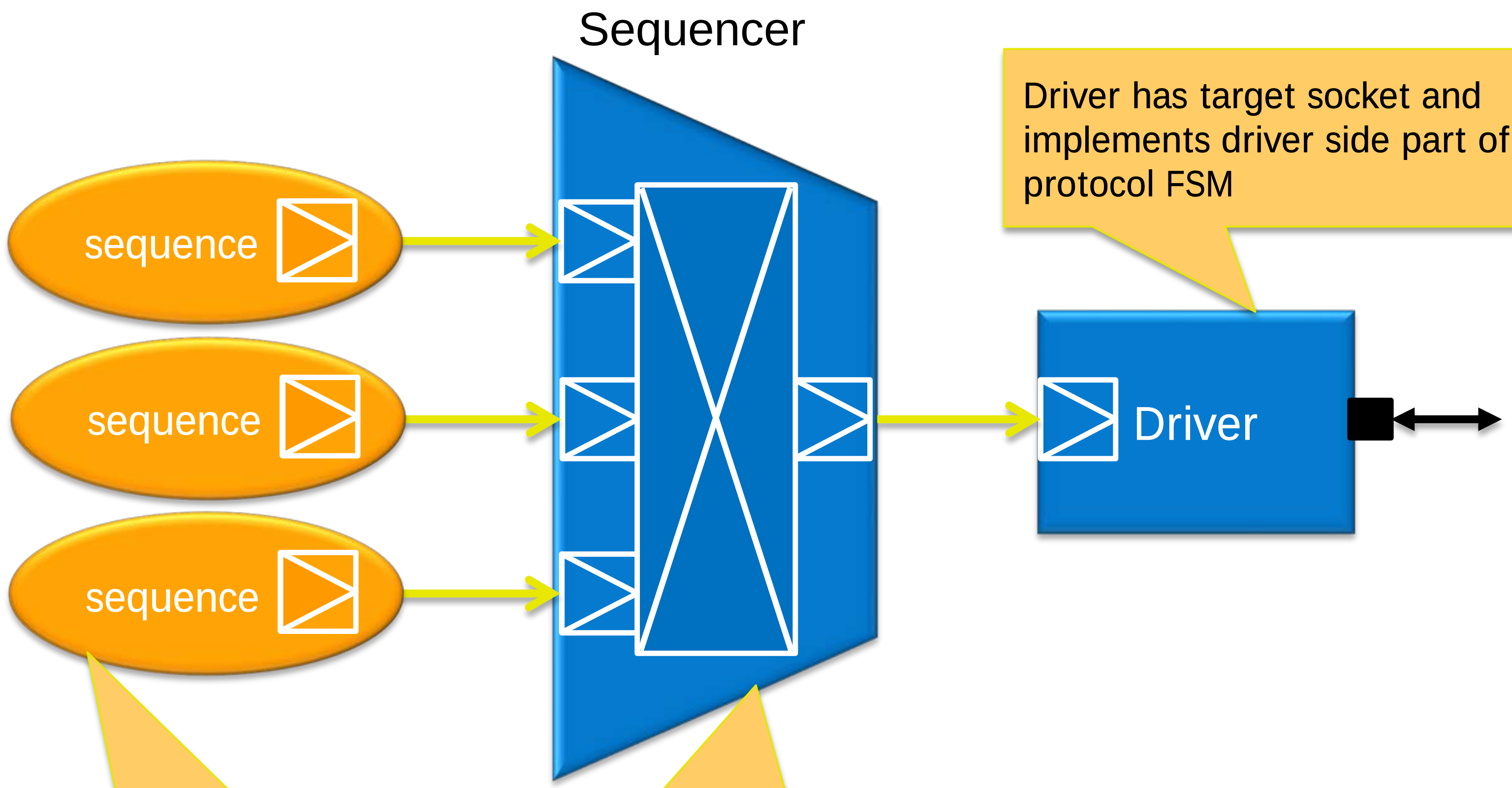


Protocol specific initiator and target state machines handle protocol complexity

Sequence - Driver API

- transport()
  - Can be blocking or non-blocking
    - Depending on the protocol FSM implementation
  - Response may or may not be valid on completion
- handle_response()
  - Call back to process pipelined or out of order responses
- exception()
  - Call back to handle disruptive events

Envisaged Implementation



Driver has target socket and implements driver side part of protocol FSM

Sequence API implemented around initiator socket

Sequencer creates target sockets on fly, hooks them into n to 1 switch.
Has initiator socket bound to driver target socket with protocol policy object.

UVM Implementation Issues

- Current (UVM 1.1a) TLM 2 implementation Issues
  - Sockets are components and can only be constructed during the build_phase
    - They don’t need to be
  - Separate blocking and non-blocking sockets
    - This is not compliant to TLM 2
  - Socket _bw transport method registration is per parent rather than per socket
    - This can be worked round, but is awkward

Conclusions

- UVM Sequence – Driver API
  - Inconsistent and difficult to understand
  - Struggles at the extremes of protocol behaviour
- TLM2 based alternative
  - Consistency and ease of use
  - Proven state model for VIP side to handle complex protocols
  - Currently stymied by UVM implementation issues
- Whatever happens
  - The eRM/OVM legacy will be with us for some time
  - There is work to be done to implement the TLM 2 solution
- The TLM2 solution could solve today's and tomorrow's problems
  - Particularly cross platform/engine communication

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Thank You!