Accellera Federated Simulation Standard (FSS) Proposed Working Group

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SYSTEMS INITIATIVE™

SYSTEM C™ EVOLUTION DAY
NOV 16, 2023 | MUNICH | GERMANY

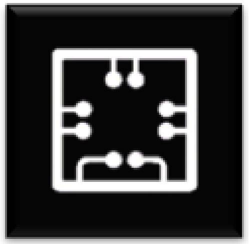

Groom
Bride


SMP2
TLM2

Problem Statement

Different simulation approaches and standards…





Avionics	**Space**	**Semi's**	**Automotive**	**Mechatronics**
VISTAS / VHTNG	**SMP2**	**SystemC** **TLM** **IP-XACT**	**openADx** **openDRIVE** **openSCENARIO** **openCRG** **openPASS**	**FMI / FMU**

How to bring these industries and simulation approaches together?

Context: Cross-Industry Collaboration Initiative

- A “Core Team” has been established in 2019 to exchange knowledge and best-practices
  - Inventorize existing simulation standards, its usage and coverage
  - Understand requirements, potential overlaps, and points of interaction
- Foster and initiate actions to improve and co-ordinate standards development and integration of simulation technologies
  - Collaborative action to make standards evolve according to our needs (e.g., interoperability, scalability, …)
  - Explore cross-industry collaboration between Standards Developing Organizations and Consortia supporting open innovation and collaboration

Core Team members*

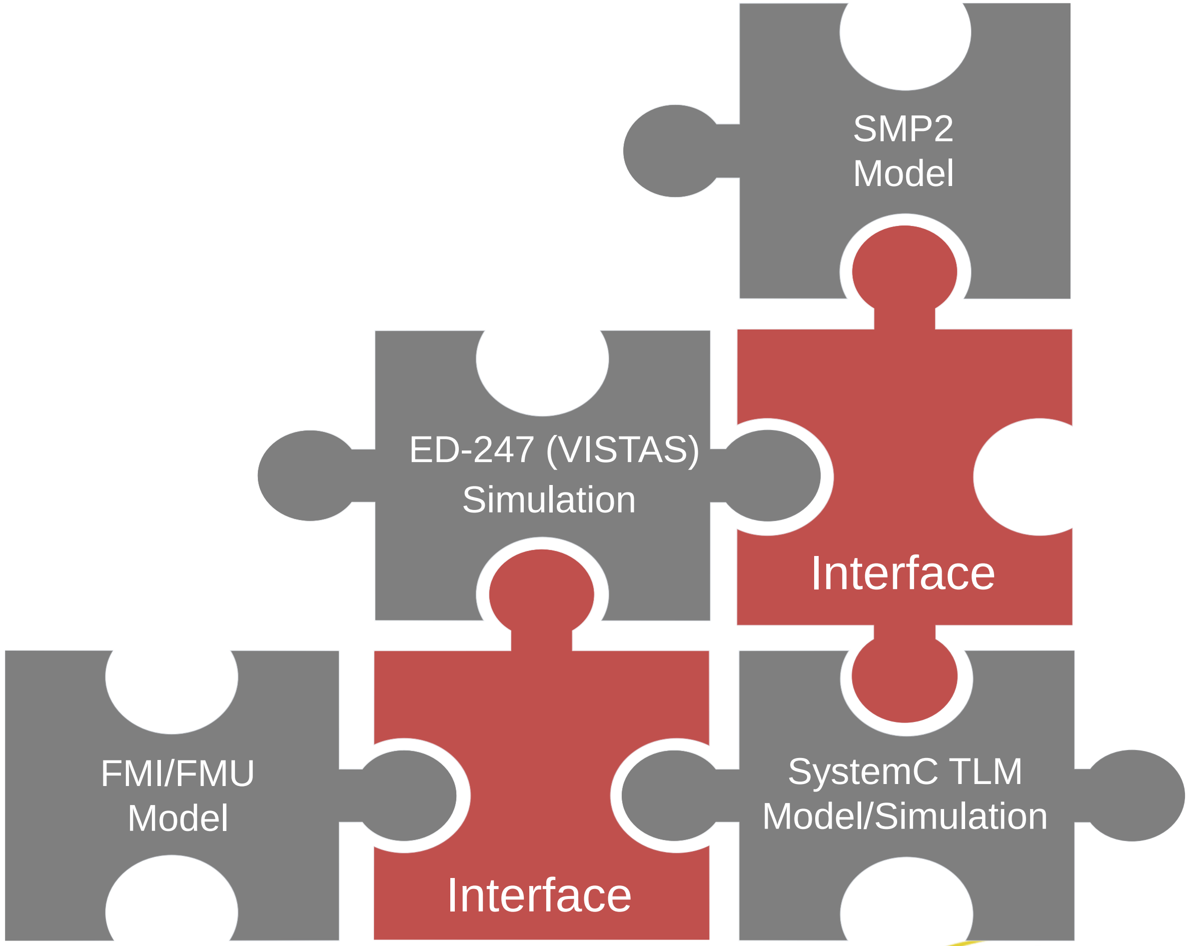
Airbus
Aptiv
AVL
Bosch
Collins Aerospace
IRT Saint-Exupery
NXP
Qualcomm
Shokubai
Spacebel

Federated Simulation Standard – Proposed WG

- Charter
  - Cross-industry collaboration to improve the interoperability of product and environment simulation using existing and new open standards
- Scope
  - Develop a standard (API) and open infrastructure to enable cross-industry interoperability of simulation frameworks
- Purpose the Proposed Working Group
  - Identify industry interest and requirements for a standard / API covering addressing interoperability of simulation
- Leadership
  - Chair: Martin Barnasconi (NXP), vice-chair: Mark Burton (Qualcomm)
- Envisioned Stakeholders
  - Companies active in different industry segments (e.g., Semiconductors, Automotive, Avionics, Space, …)
  - Companies active in different stages of the value chain (Tier2, Tier1, OEM)

FSS: Enabling cross-industry interoperability of simulation frameworks

- Approach: Leveraging and connecting existing standards and industry formats
  - Not re-invent wheels
- Introduce standardized interfaces
  - Enabling interoperability between simulation frameworks
- Targeting a scalable simulation and modeling ecosystem
  - Support models and simulation domains used at different levels of the 'OSI stack'



The problem

SPI
Ethernet
CAN
I2C
UART
GPIO

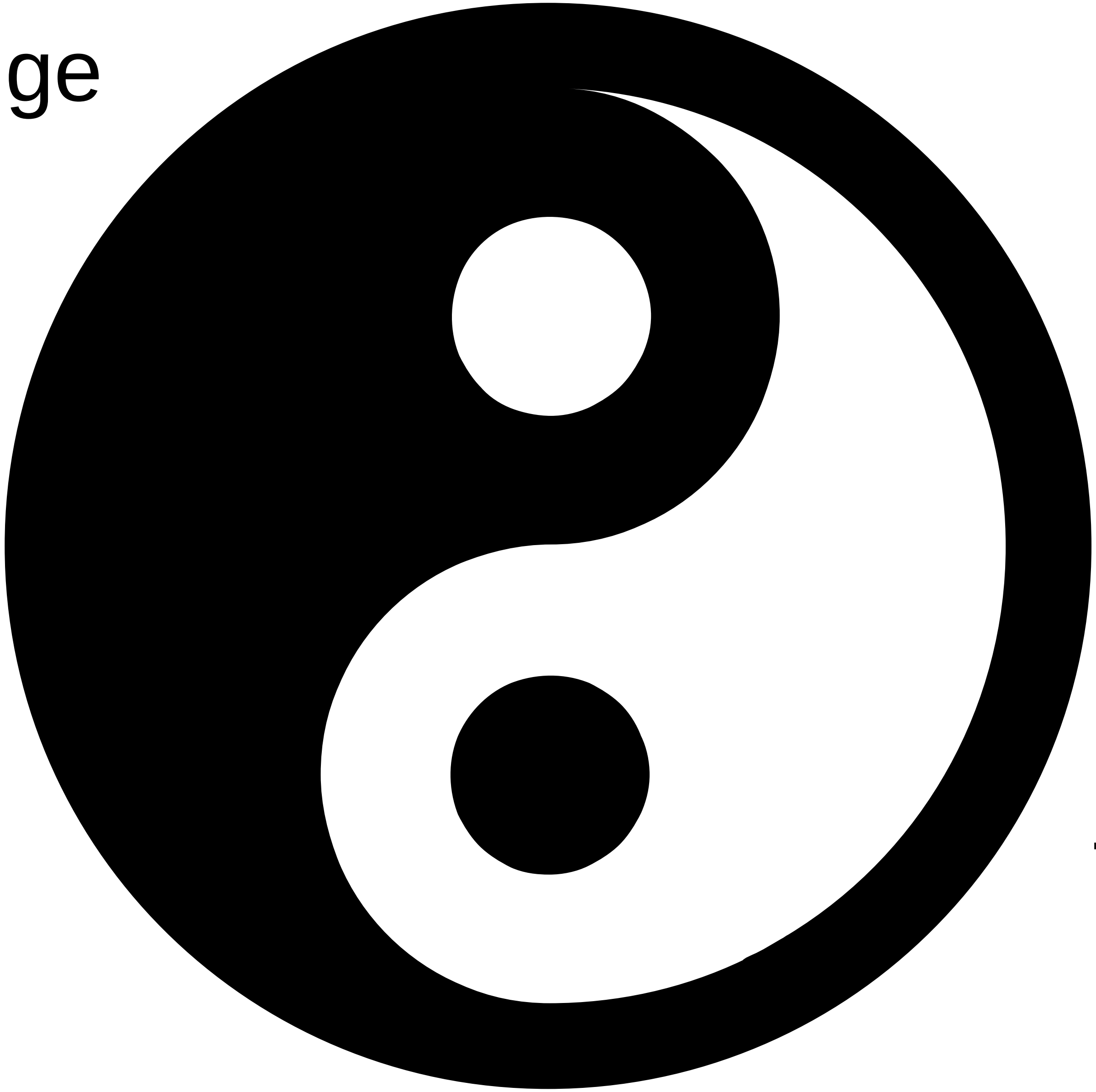
For some the problem is “only” the serial interfaces

How do we connect Engine controller A to device B.

But our problem is deeper….

How do I re-use models
How do I connect models of one type to another
How do I even connect models of the ‘same’ type!
And How do we deal with HW/SW ‘connections’…

DATA Exchange
(easy?)



TIME Sync
(HARD?)

Time (waits for no man)

Every simulation environment has a different notion of "time"

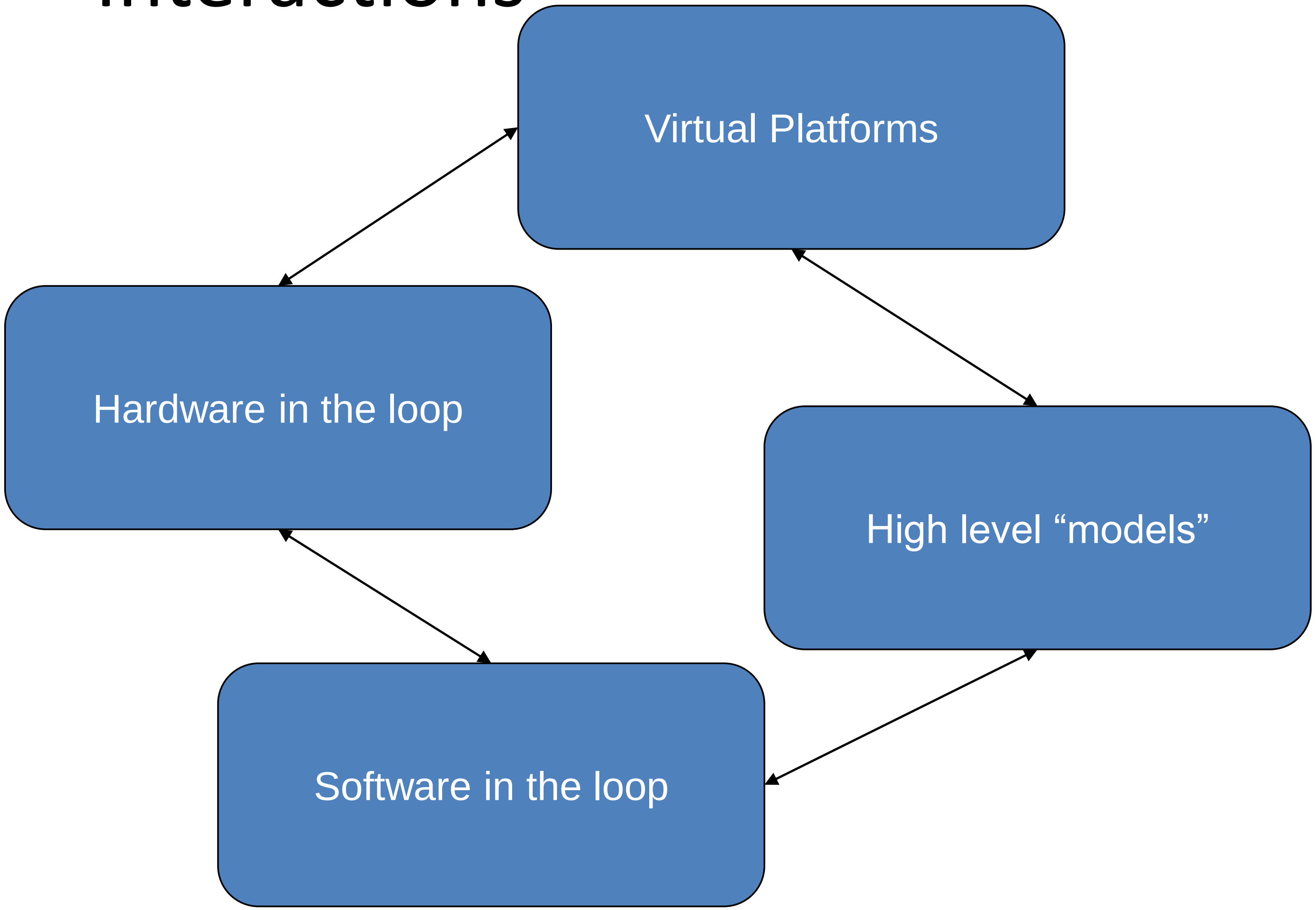
Many have multiple "times" :
(Wall clock, simulation time, local time, quantum time . . .)

Interactions

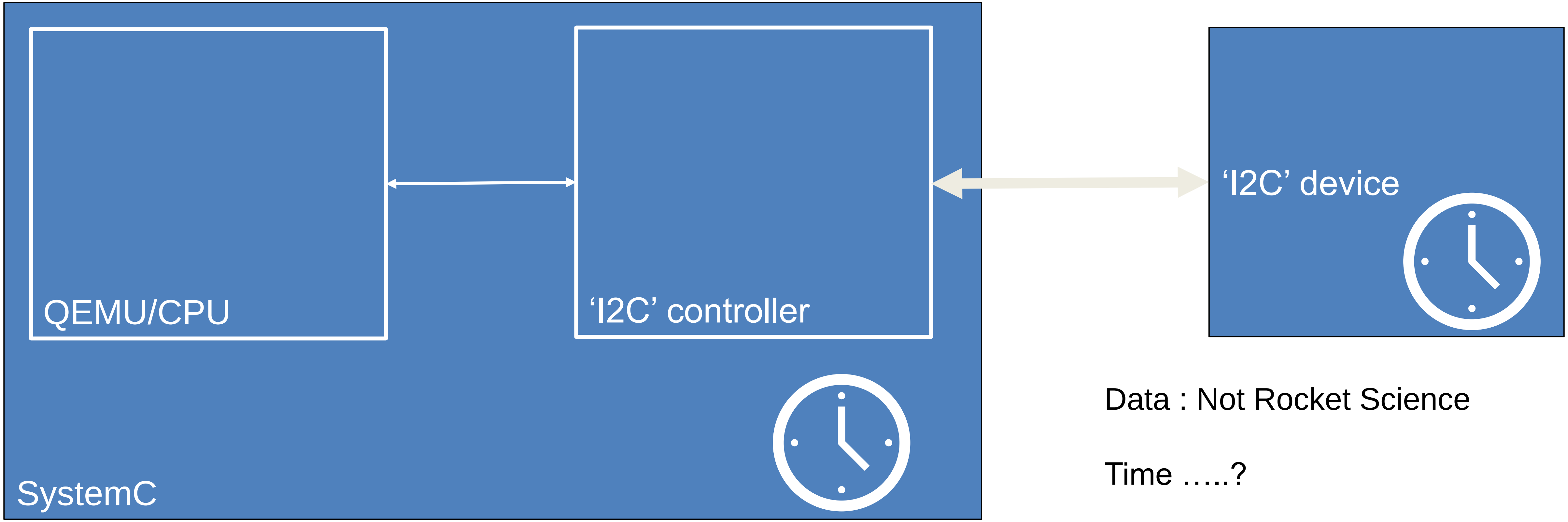
Abstracting data is not trivial…

But…

Each have a notion of 'time'
Ensuring that each is "happy"
_IS_ hard !



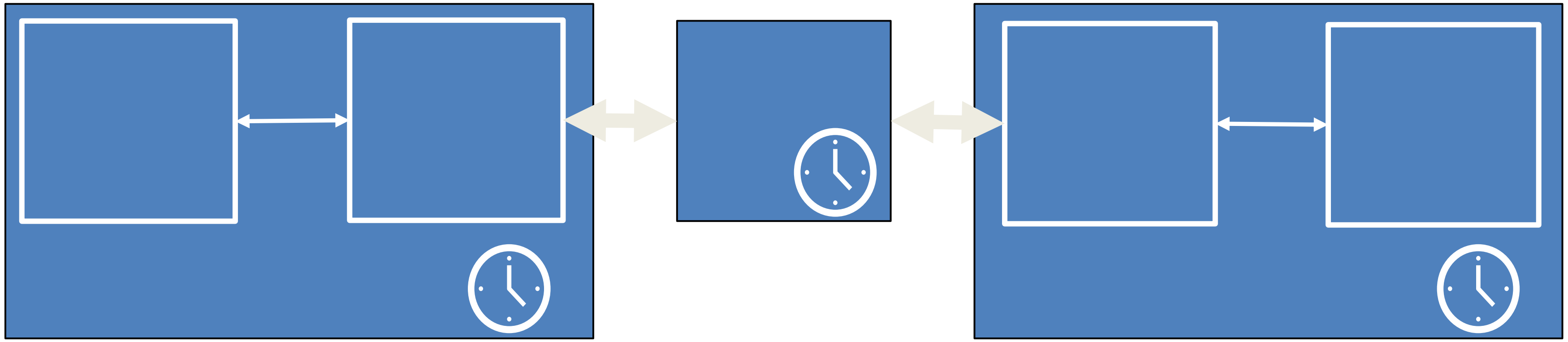
SystemC VP



Data : Not Rocket Science

Time …..?

Mixed VP



When Synchronisation becomes n-way:

- central controllers
- “global” notions of time

But when the simulations beginning combined do not share these?

- Adapters/shims are only possible when the ‘concepts’ of time match
- If time is variously ‘abstracted’ things are more tricky. . .

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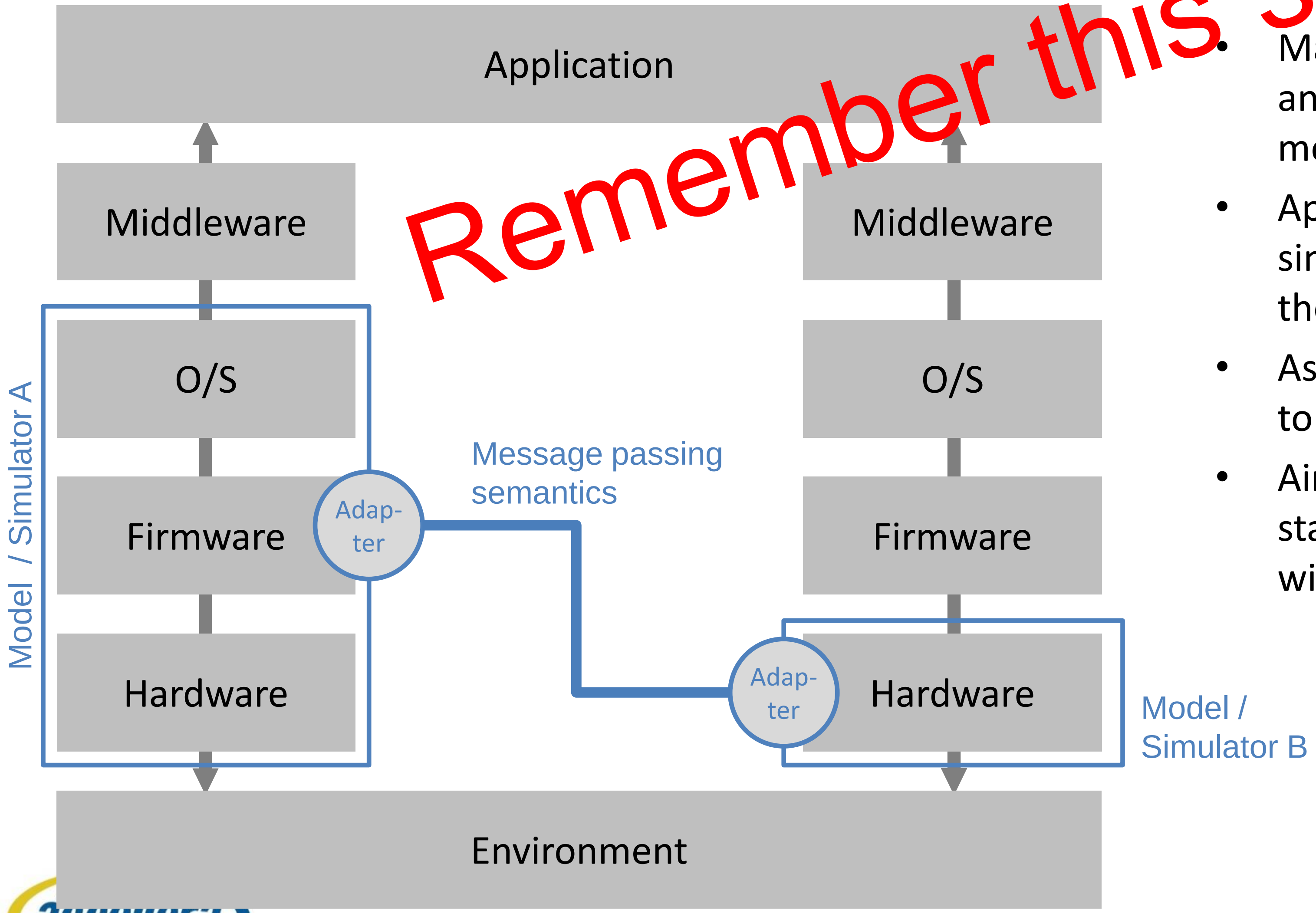
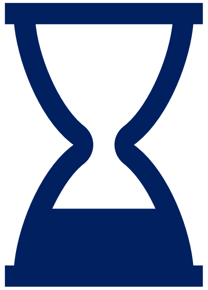
Federated Simulation Standard – Ideas (1)

Remember this slide?



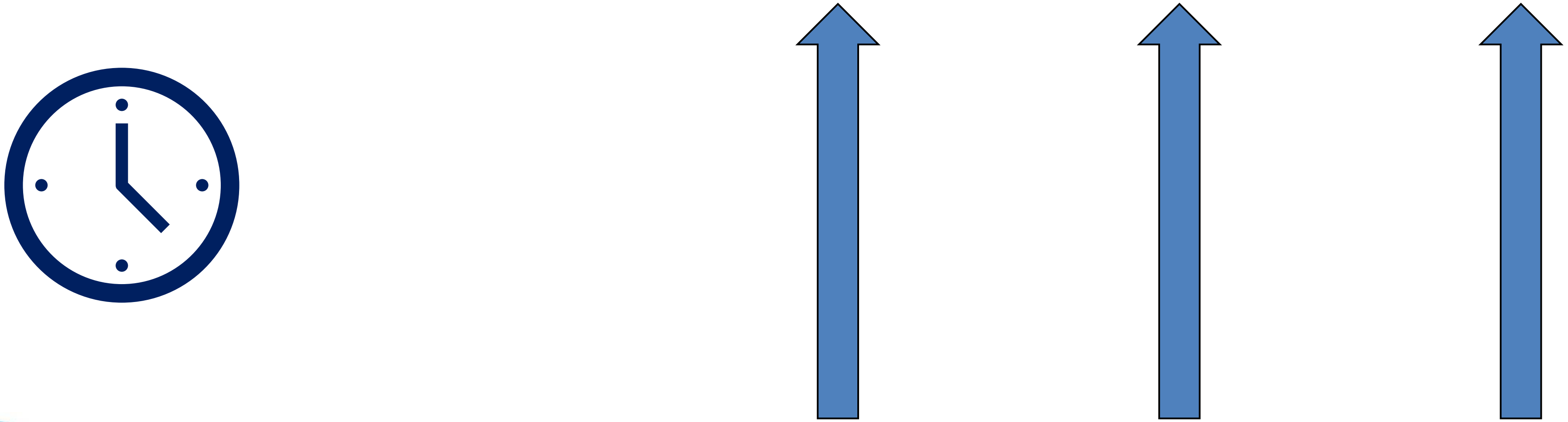
- Main idea is to introduce a 'message passing' and 'adapters' approach to bring different models / simulation domains together
- Approach should support system models and simulation domains used at different levels of the 'OSI stack'
- Assess available standards and their capabilities to enable interoperability
- Aim is not to replace existing standards, but to standardise how they can be adapted to work with each other

Example: S/W and H/W

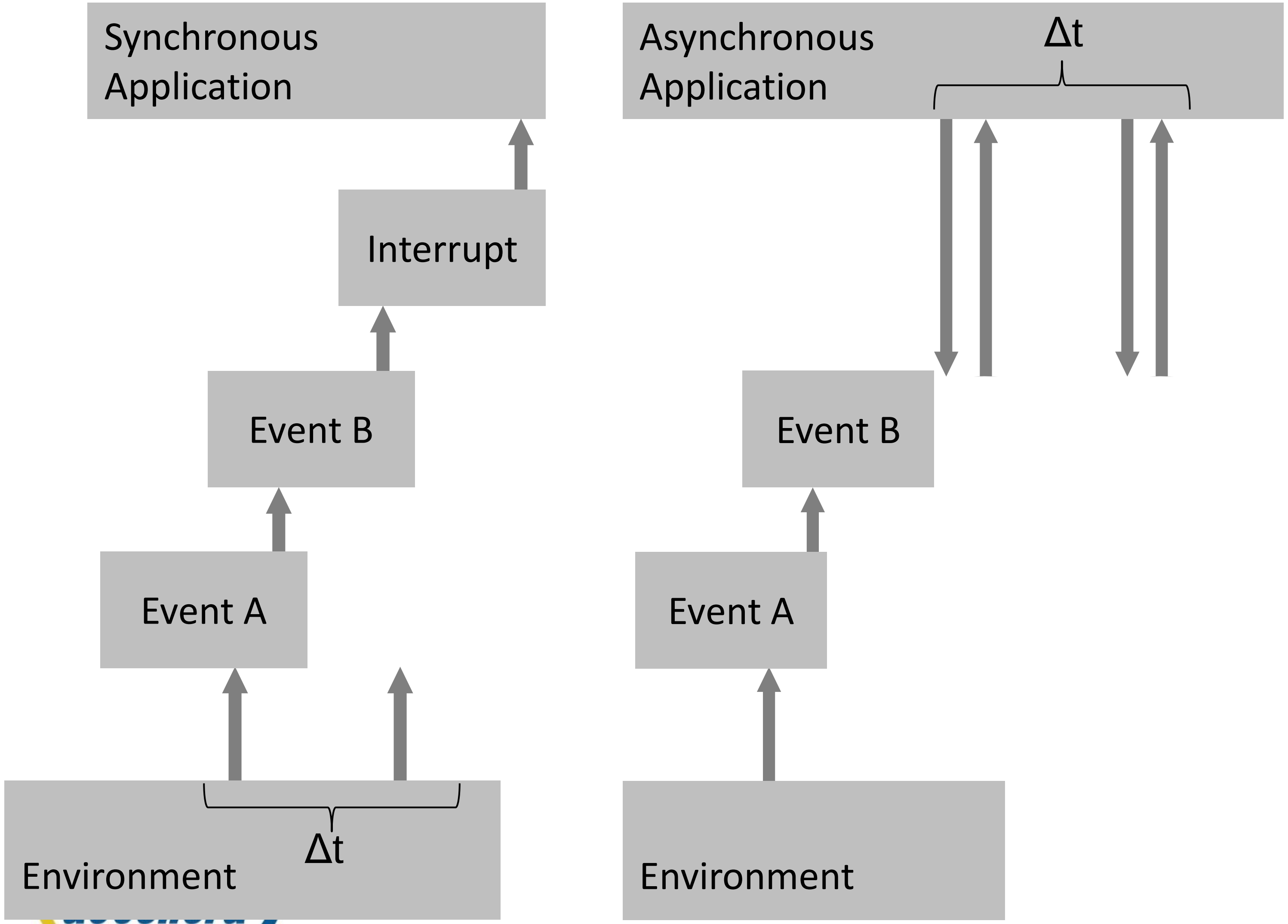


S/W expects timer interupts at the end of each period, but….

A Virtual Platform may not know that time it is !!! Interrupts might fire too quickly….

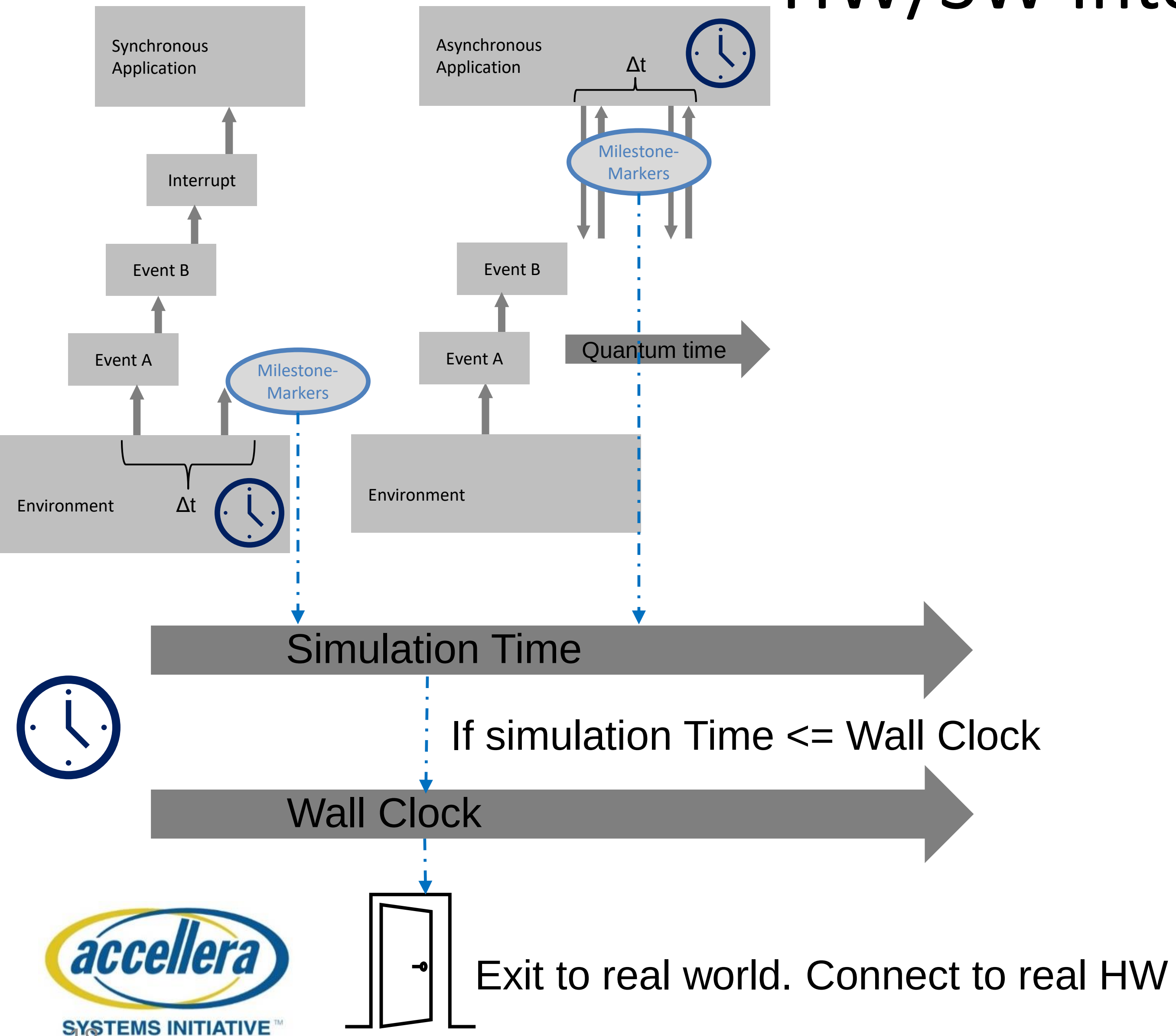


HW/SW Interaction



- Synchronous Application can execute in zero simulation time. Time is an intrinsic artifact of event types and loops.
- Asynchronous Application polls for events every Δt
- RTOS is formed by combining Asynchronous and Synchronous
- Audio, Video, HMI follows Synchronous model
- Synchronous resembles Software in the loop
- Asynchronous resembles Hardware in the loop
- Assess available standards and their capabilities to enable interoperability

HW/SW Interaction



- Simulation needs awareness that certain events must be completed before or after corresponding Milestone Marker

- Solutions to this exist… but
  - “We’re not talking” to each other.
  - Not universally adopted
  - Not connected

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Don’t throw the baby out with the bathwater!

- Lots of standards exist
- All have good/bad points

- Plan is to link/reuse
- NOT replace

How will we work?

FMI2

dcp

FMI3

SystemC

TLM

SystemC
IEEE 1666-2011

SystemC
IEEE 1666-2023

VHTNG

ED247/ VISTAS

ED247 Revb (DDS)

HLA / IEEE1516

HLA on DDS

HLA on Zenoh

Group2

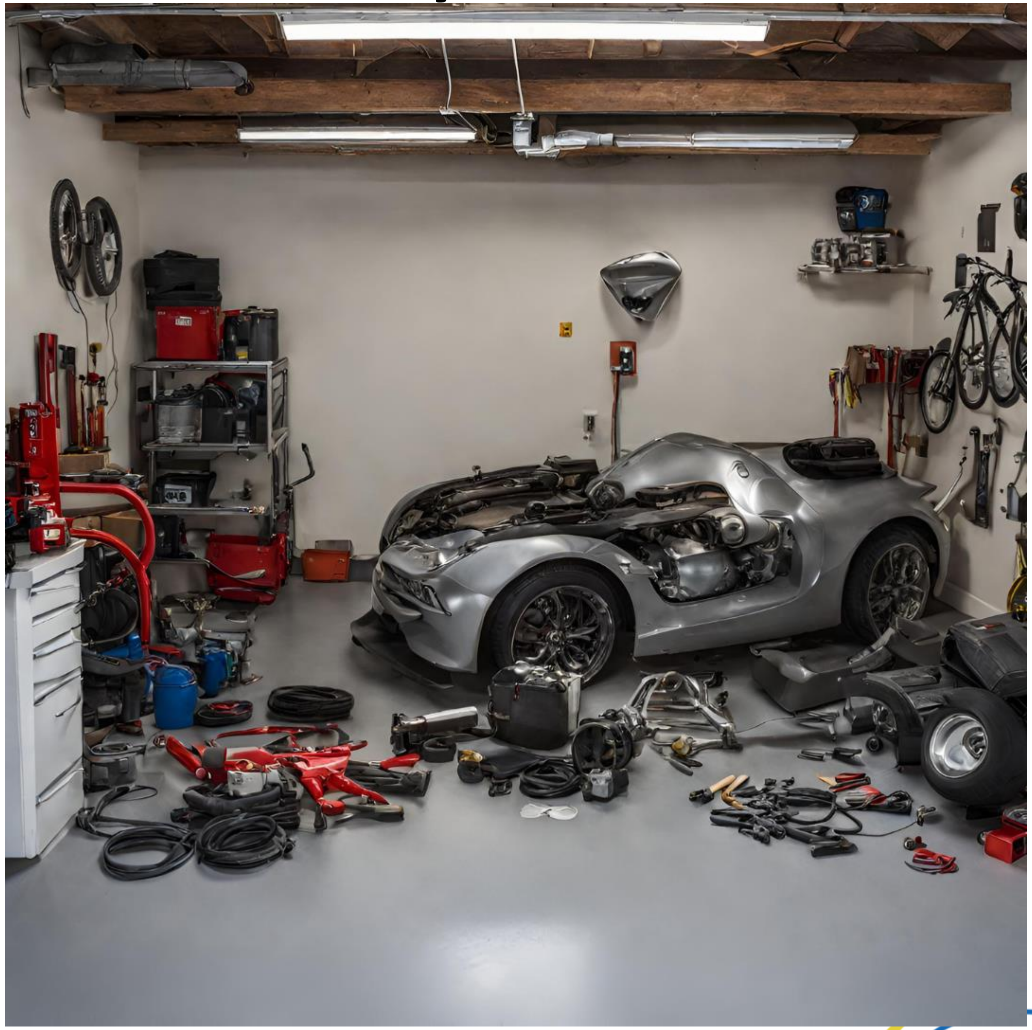
Group1

Group3

Demonstrators

How does this this relate to SystemC?

- What parts are there?
- Are there enough?



Sync primatives : Do we have enough?

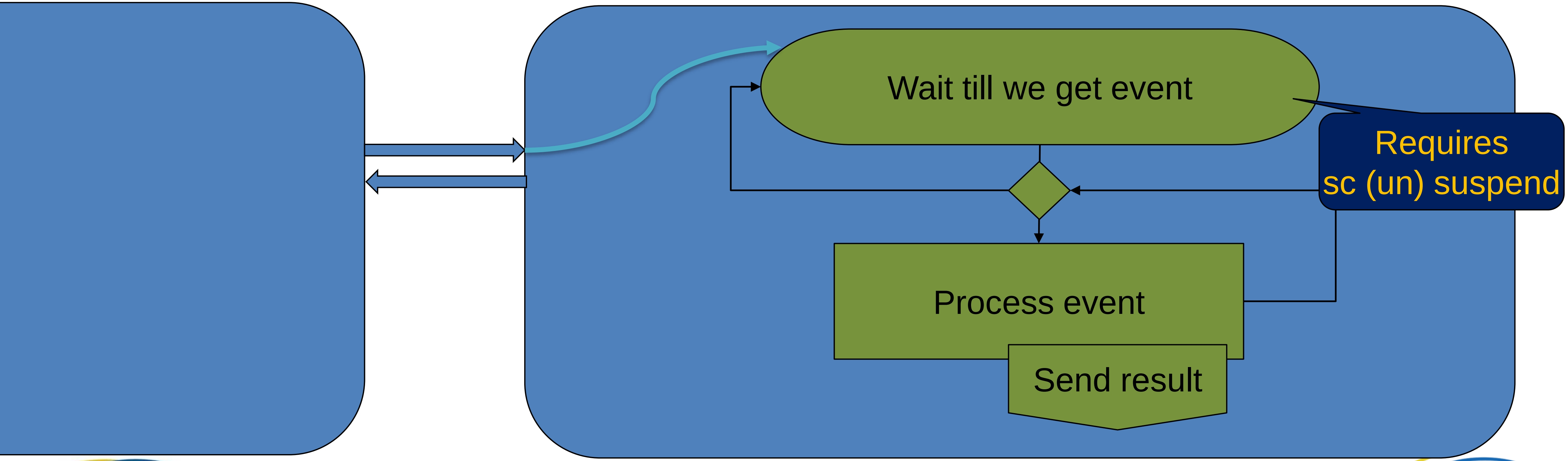
Primative	Description
sc_suspend_all() sc_unsuspend_all() sc_suspendable() sc_unsuspendable()	Suspend all systemc threads if none are unsuspendable. Unsuspend. Mark suspendable. Mark unsuspendable, such that systemc can not suspend all.
class async_event	Wrap “request_update” (the only thread safe method in SystemC) in a convenient sc_core::sc_event type. async_attach_suspending/async_detach_suspending to ensure SystemC does not quit on event starvation. NB “request_update” events are executed by the kernel even if the kernel is suspended.
Class RunOnSysC	Convenience layer to sckedule a lambda expression to be run by the SystemC thread. (NB this will run on the next delta cycle). Provides: bool run_on_sysc(std::function<void()> job_entry, bool wait = true)
realtimelimiter	A module which prevents time from advancing beyond realtime.

NOW UPSTREAMED

"Cloud TLM"?

Code available
github:quic/qbox

- Basis of any "external" interface: (un)suspend interface



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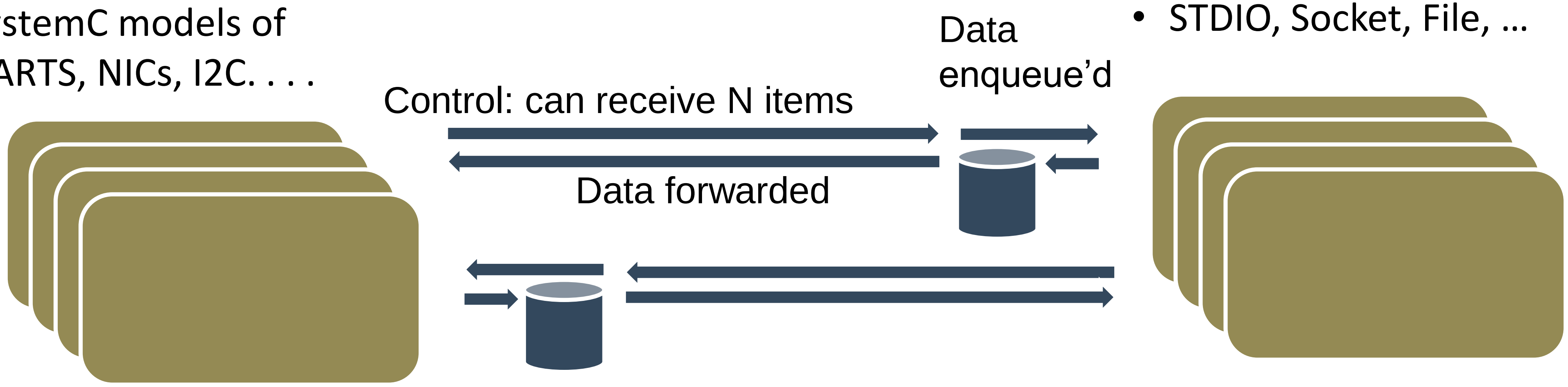
Bidirectional serial socket

Code available
github:quic/qbox

- Simple set of standard TLM sockets, can cover most serial interfaces
- Not ‘standard’ just one way of modelling interfaces

  - SystemC models of UARTS, NICs, I2C. . . .

- STDIO, Socket, File, …



- 4x tlm 2.0 GP interfaces.
- Not all fields used, but protocol used for compatibility.
- (May be sent over RPC remote)
- Convenience layer provided to enqueue data

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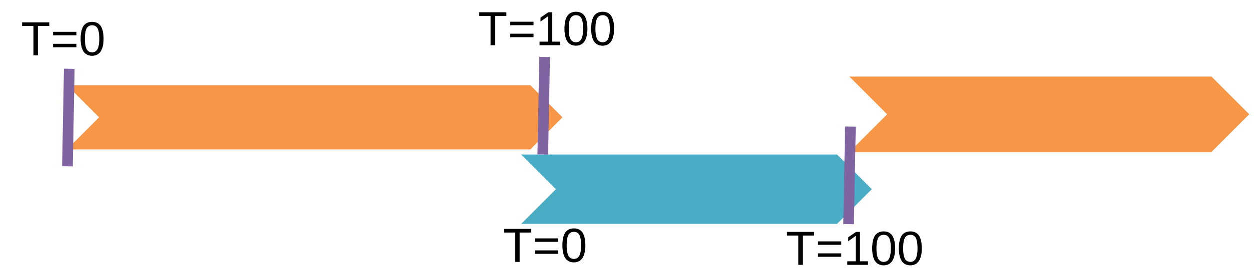
Code available
github:quic/qbox

RPC tlm

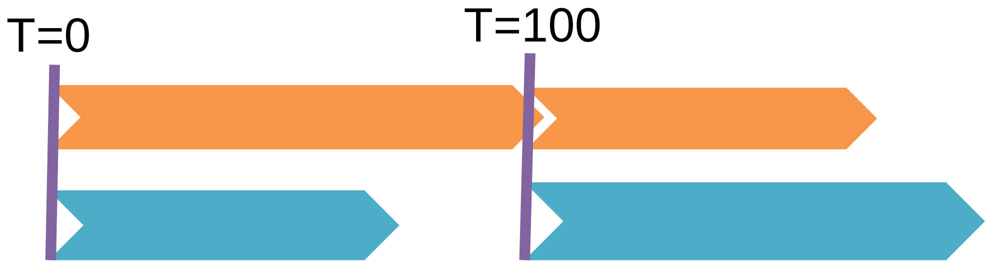
- **‘n’ inputs/outputs, etc..**
- **Relies on (un)suspend interface, and ‘asyncronous’ events.**
- **Pass TLM-2.0 interface over RPC**
- **CCI parameter database is shared (names de-mangled)**

Sync policies

Code available
github:quic/qbox



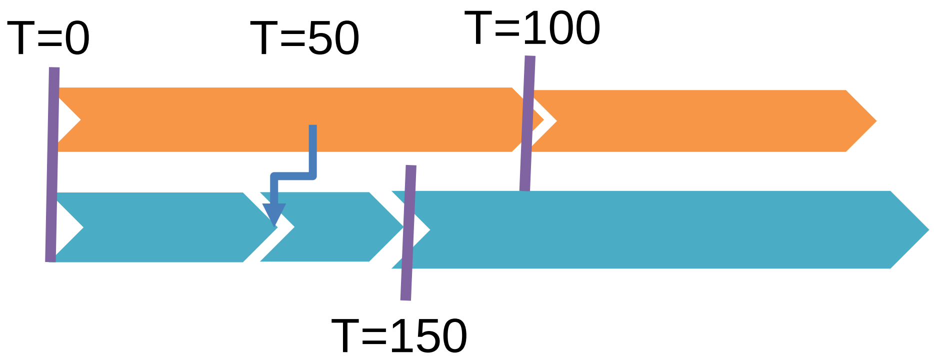
- TLM 2.0
  ONLY DETERMINISTIC MODE



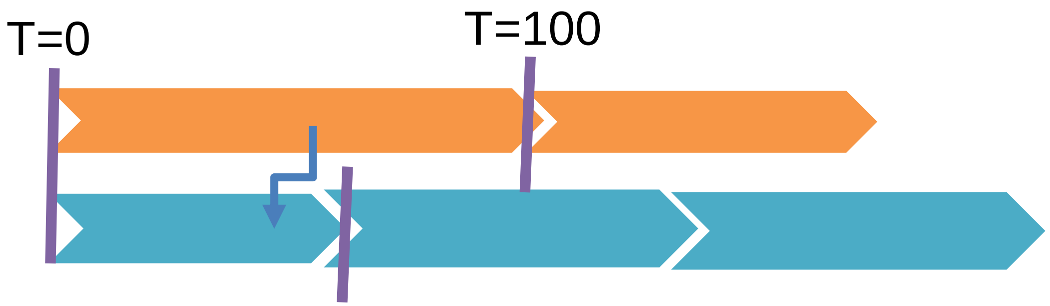
- ‘parallel’ TLM 2.0
  With a fixed Quantum.

Code available
github:quic/qbox

Sync policies



Each b_transport indicates a time, which can be used to allow SystemC to advance.



- ‘Windowed’ quantum
- Unconstrained

Conclusion

- Lets get married
- Lets start the conversation
- Lets work on bringing standards together.