

The cruelest and pleasant things I've ever used with the IEEE SystemC/TLM standard

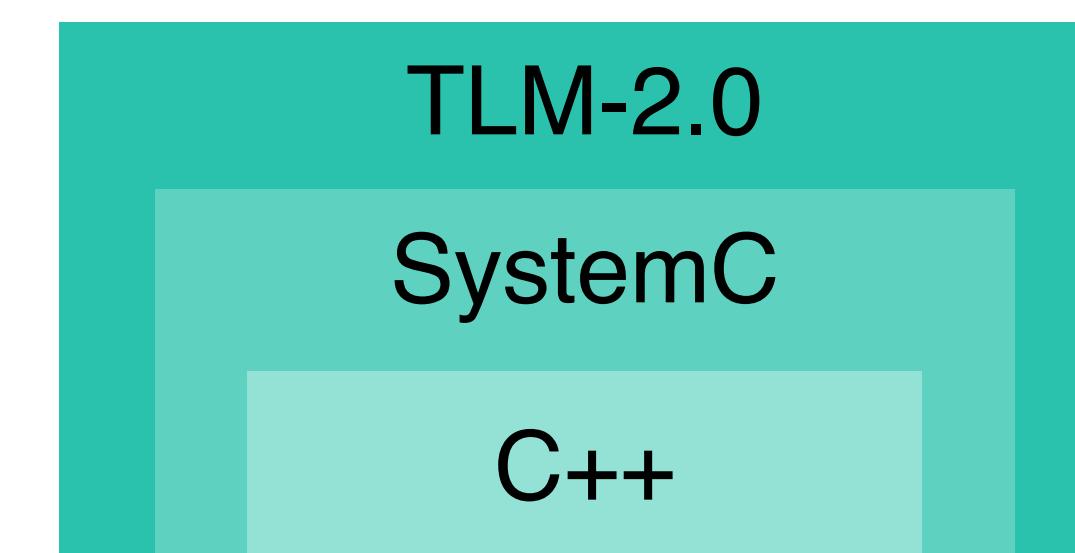
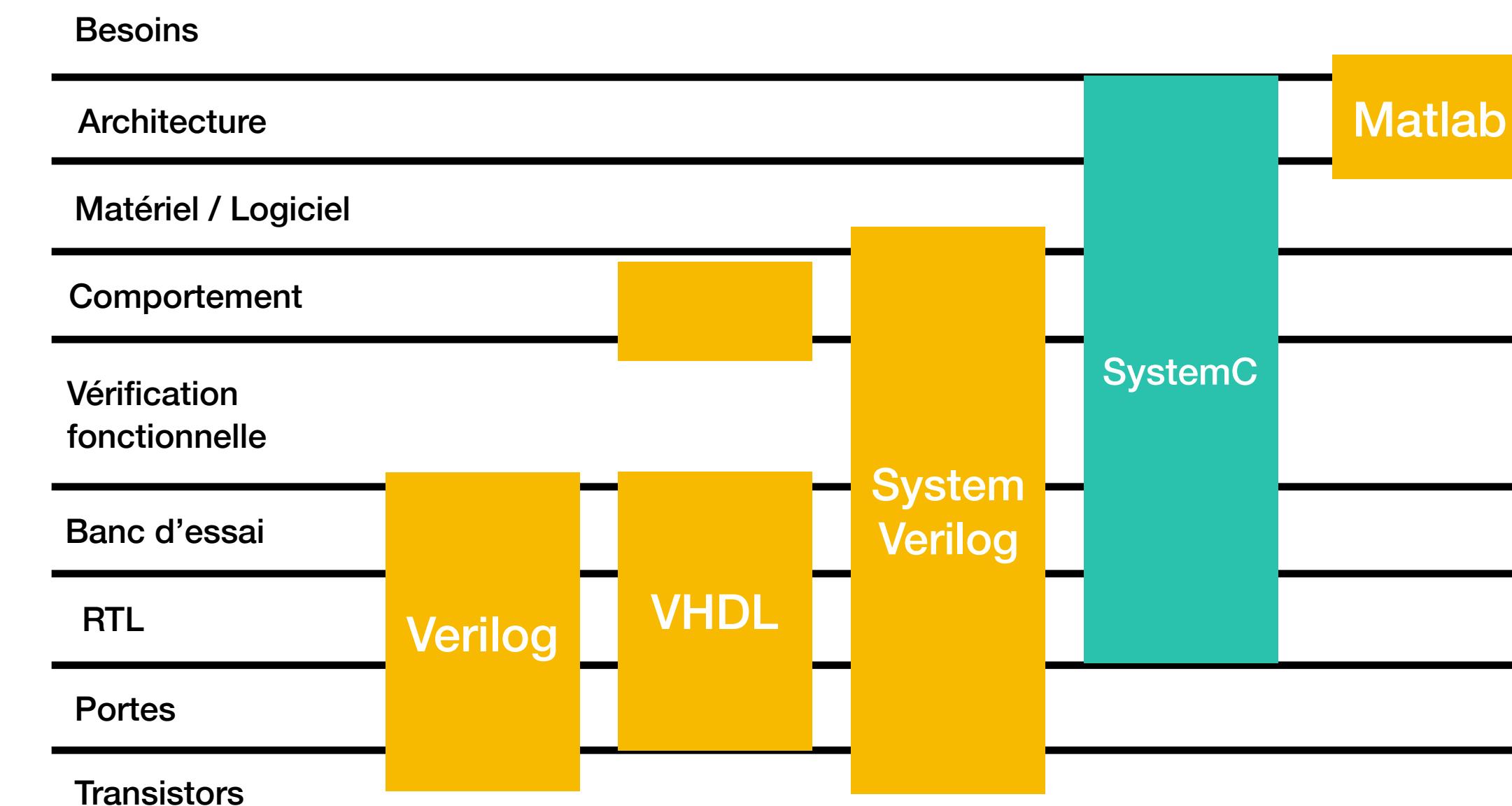
Guillaume Delbergue - Co-Founder and CEO
guillaume.delbergue@hiventive.com



Hiventive

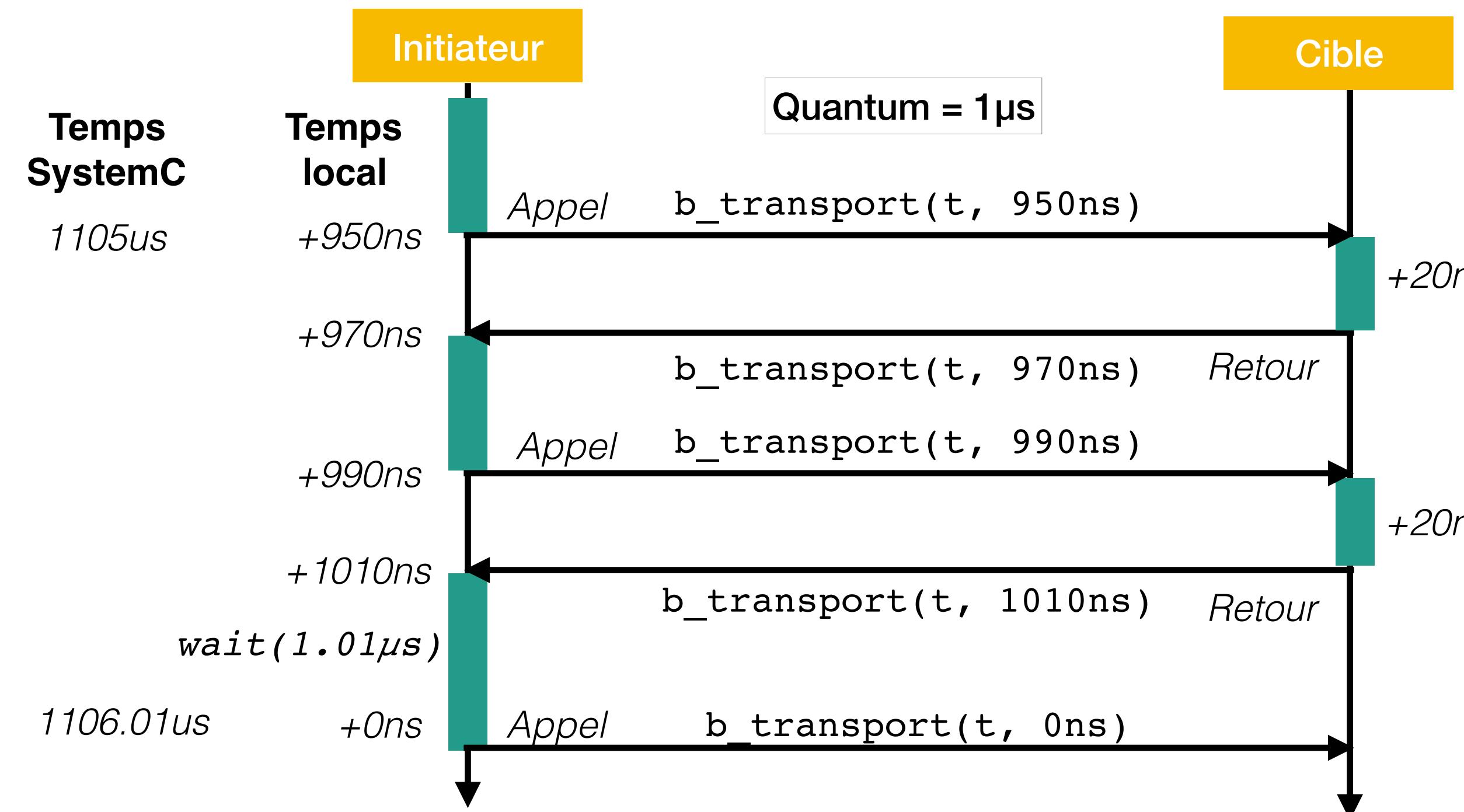
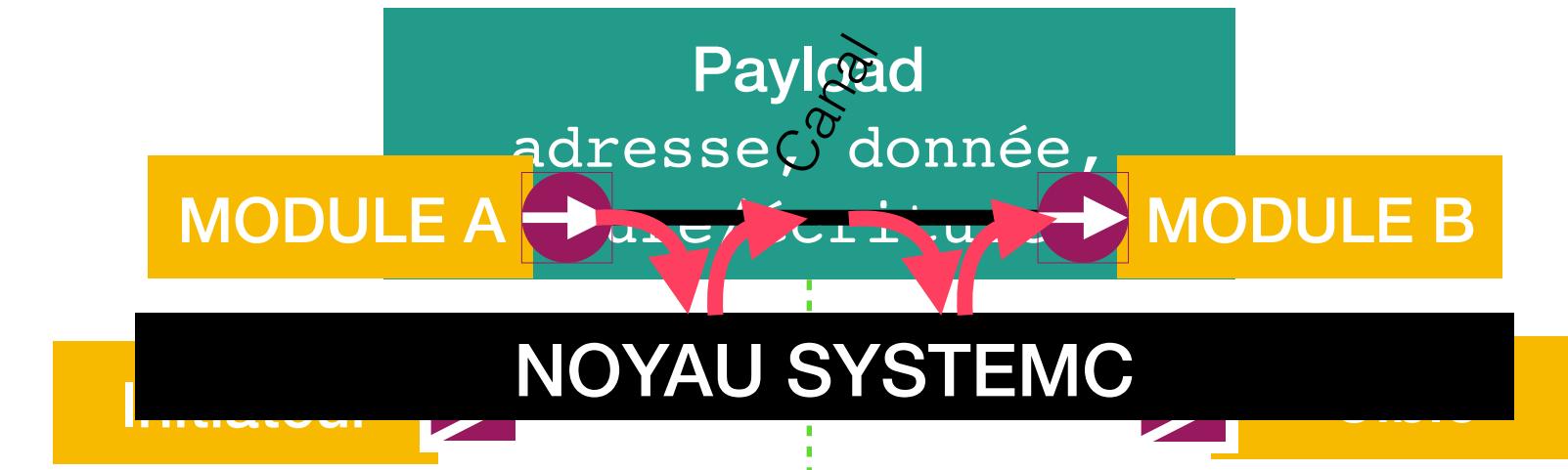
SystemC: la bibliothèque logicielle pour le matériel

- ❯ Langage SystemC
- ❯ Notion de temps, concurrence, types matériels, ...
- ❯ Différents niveaux d'abstraction
- ❯ Noyau de simulation
- ❯ Usage multiple
- ❯ Extension : TLM-2.0



TLM-2.0 et le quantum

- Abstraire pour accélérer les communications



- Réduire les changements de contexte
- Permet une exécution en avance du temps global SystemC
- Quantum trop long ou trop court peut ralentir la simulation

What's existing? And could help!

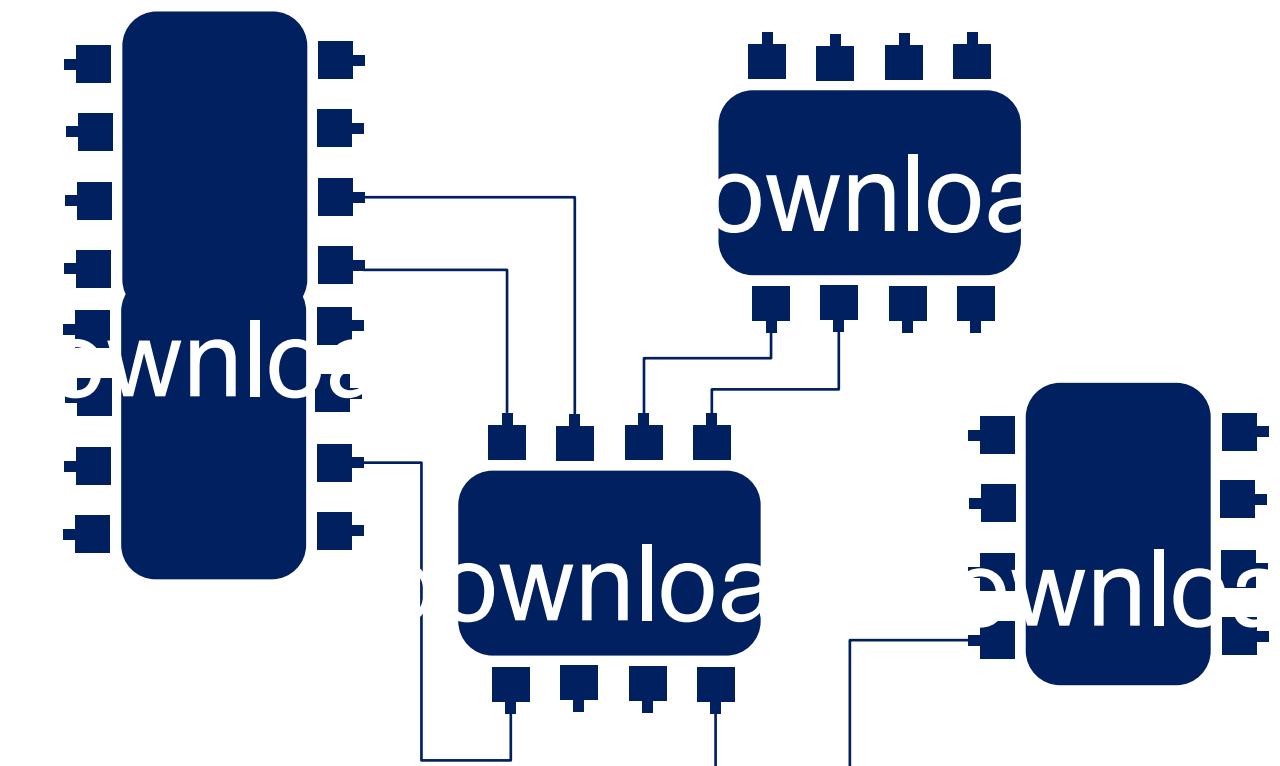
Virtual prototyping technology

Provides platforms virtually assembled

A virtual prototype is a **software application simulating the hardware behavior**. It provides a ready-to-execute environment for your next platform.

That simulates complete hardware

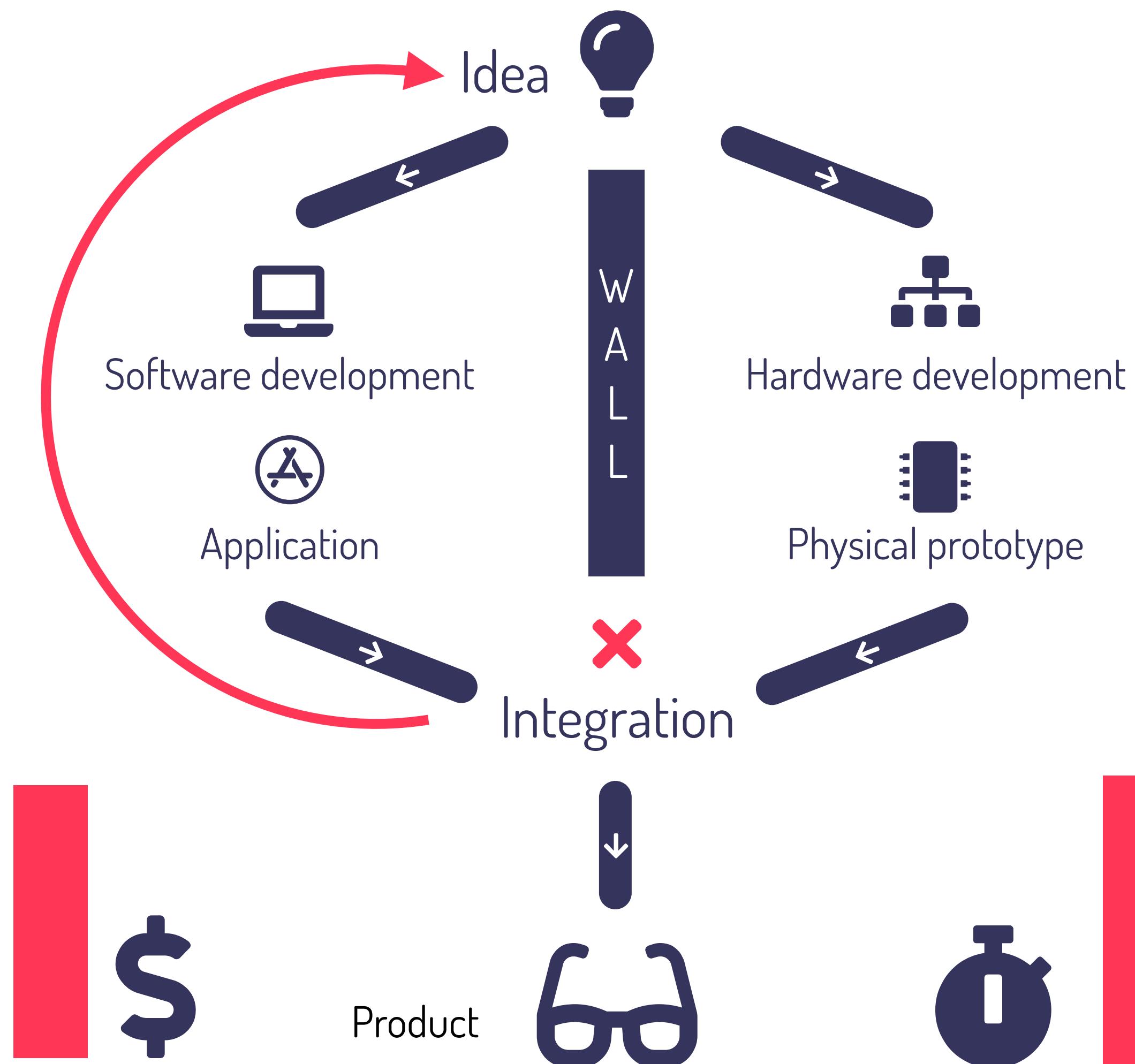
Fast virtual prototype allows HW/SW co-simulation



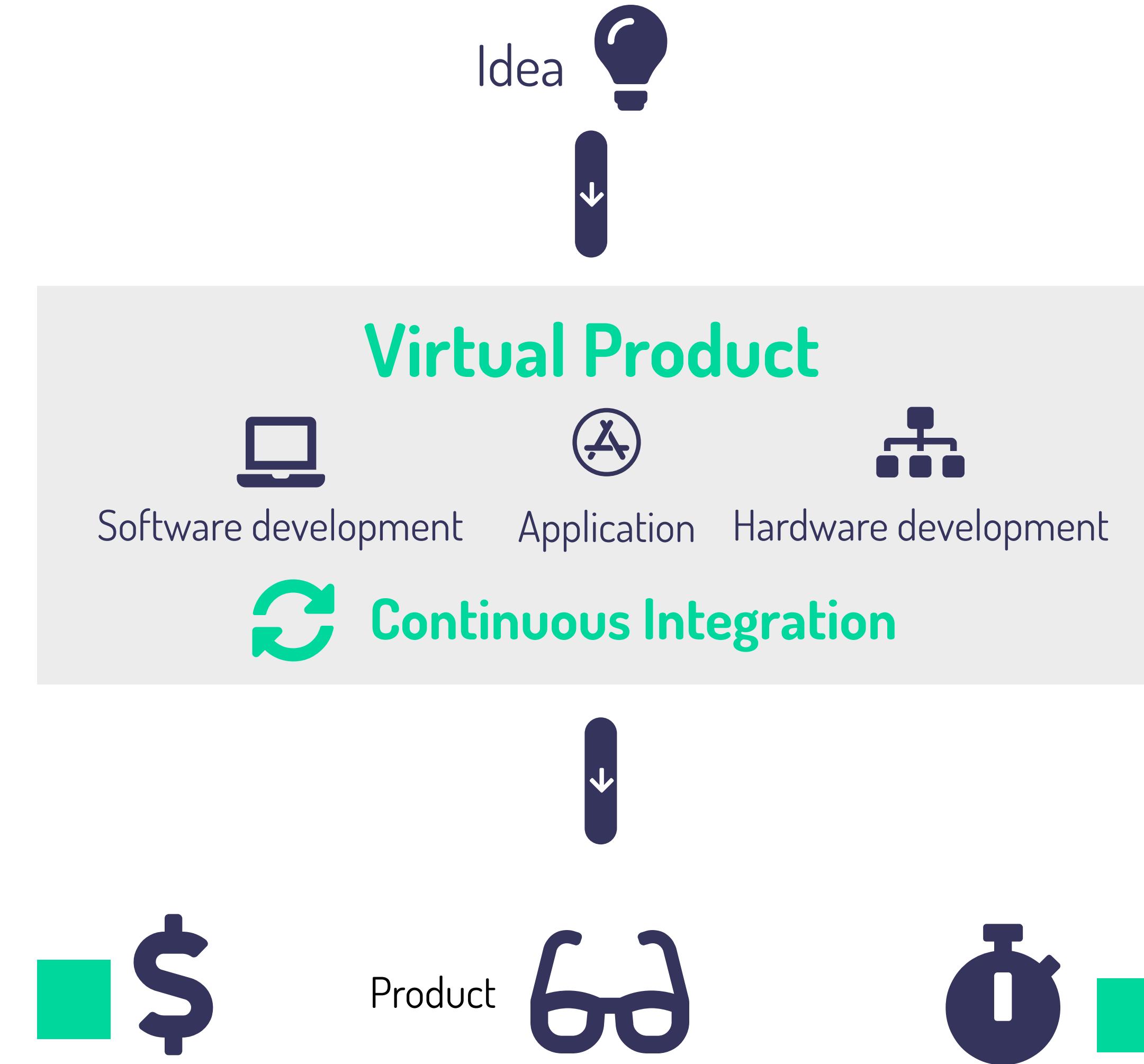
Virtual component assembly
to simulate a platform

Electronics Products Design Flow

How you design your product now

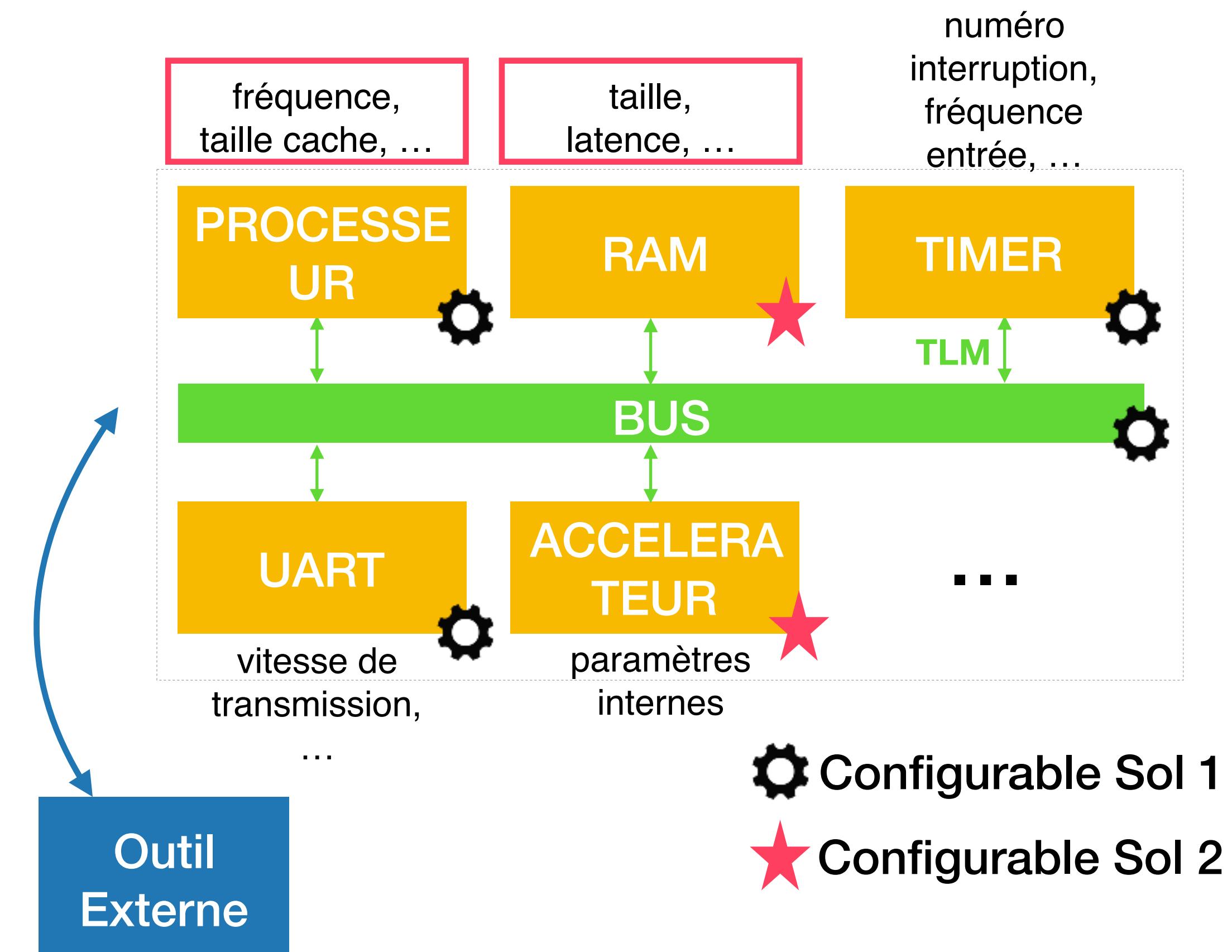


How you will design your product tomorrow



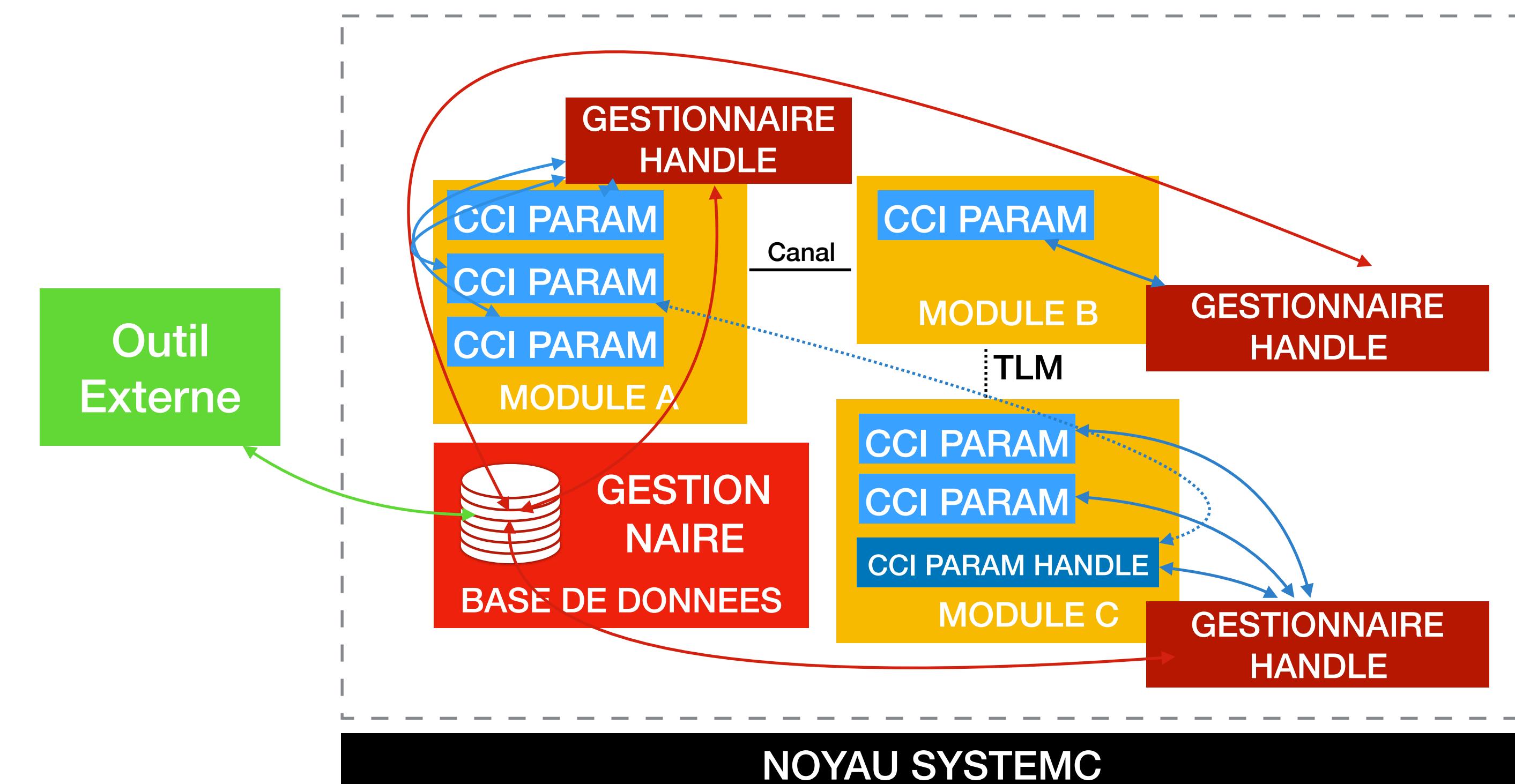
Les besoins en flexibilité dans les plateformes virtuelles

- Architecture finale inconnue : besoin de souplesse
- Etre capable de modifier des éléments clés des modèles sans modification du code
- Etre capable de s'échanger des modèles sans utilisation de pont
- Etre capable de pouvoir interagir avec les outils



Proposition : un standard pour la configuration (mais pas uniquement)

- ❯ CCI (Configuration, Contrôle et Inspection)
- ❯ Module(s)
- ❯ Paramètre(s)
- ❯ Gestionnaire(s)
- ❯ Outil(s) externe(s)



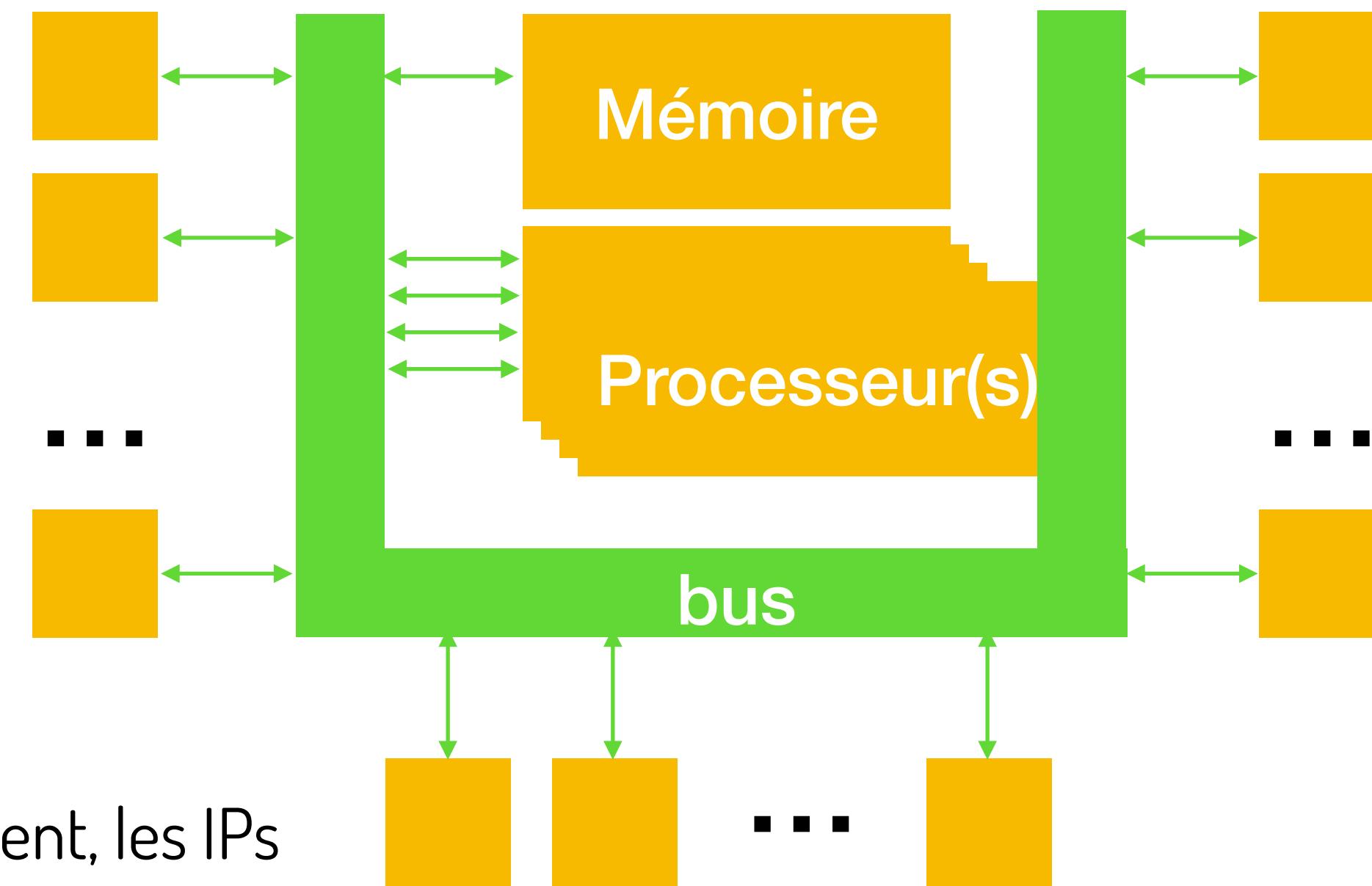
Impact des contributions



Atouts

- ✓ Configuration des modules à travers des paramètres à l'initialisation et à l'exécution
- ✓ Echange de paramètres
- ✓ Accès aux paramètres à travers des outils
- ✓ Compatible avec les solutions existantes
- ✓ Standard CCI

IPs système, DMA,
PLL, alimentation, ...

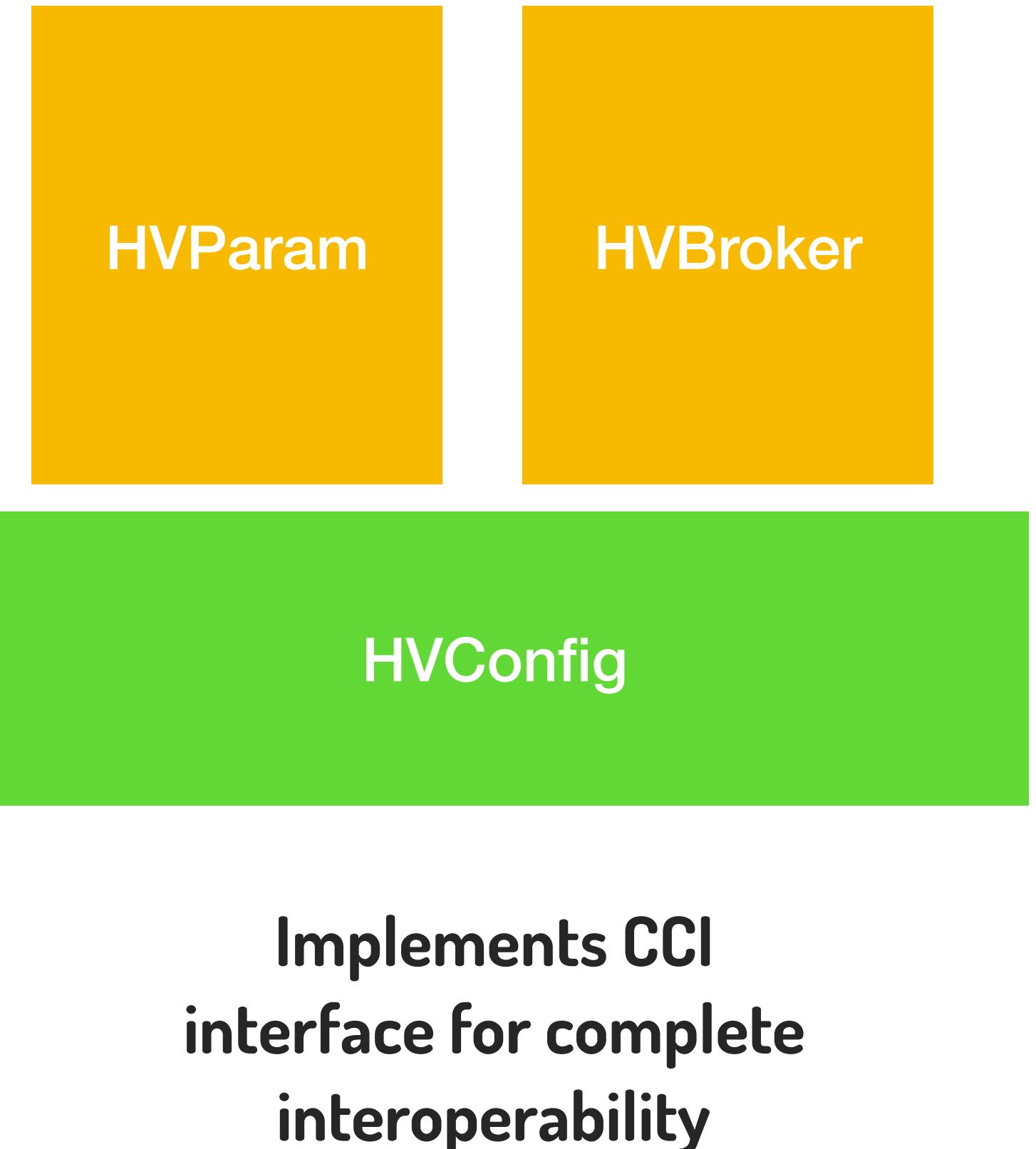


Généralement, les IPs viennent de différentes sociétés

IPs accélérateurs et co-processeurs

How we use CCI at Hiventive today :

- A complete parameter class
- A broker to manage parameters
- CCI-Compliant : interoperability is the key
- Support for configuration files and command line arguments
- Easily extendable

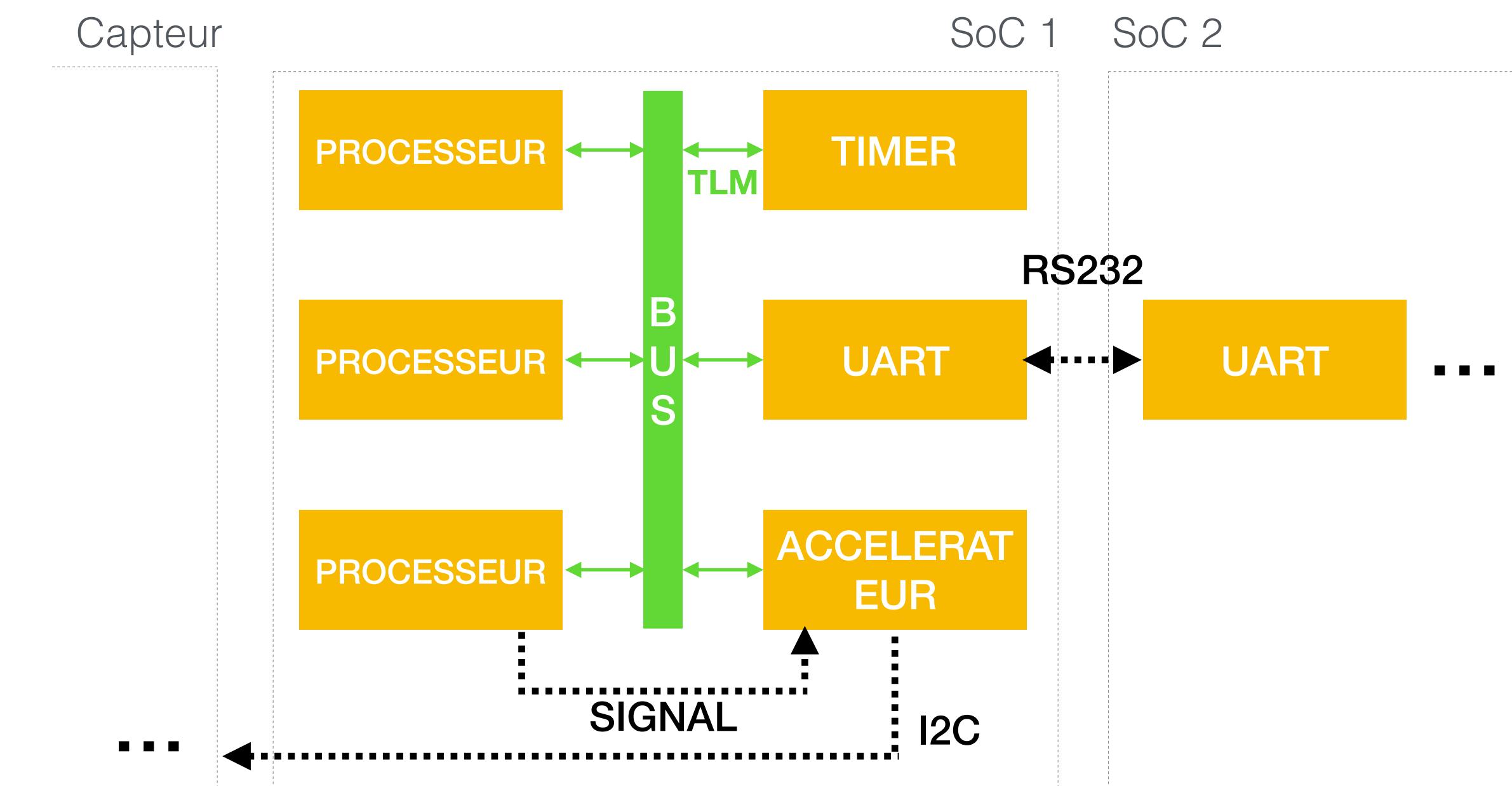


What we would like

- **Standardisation des noms des paramètres**
- Uniformisation des paramètres aux **sc_object** existants
- Bug fixes (we provide patches)

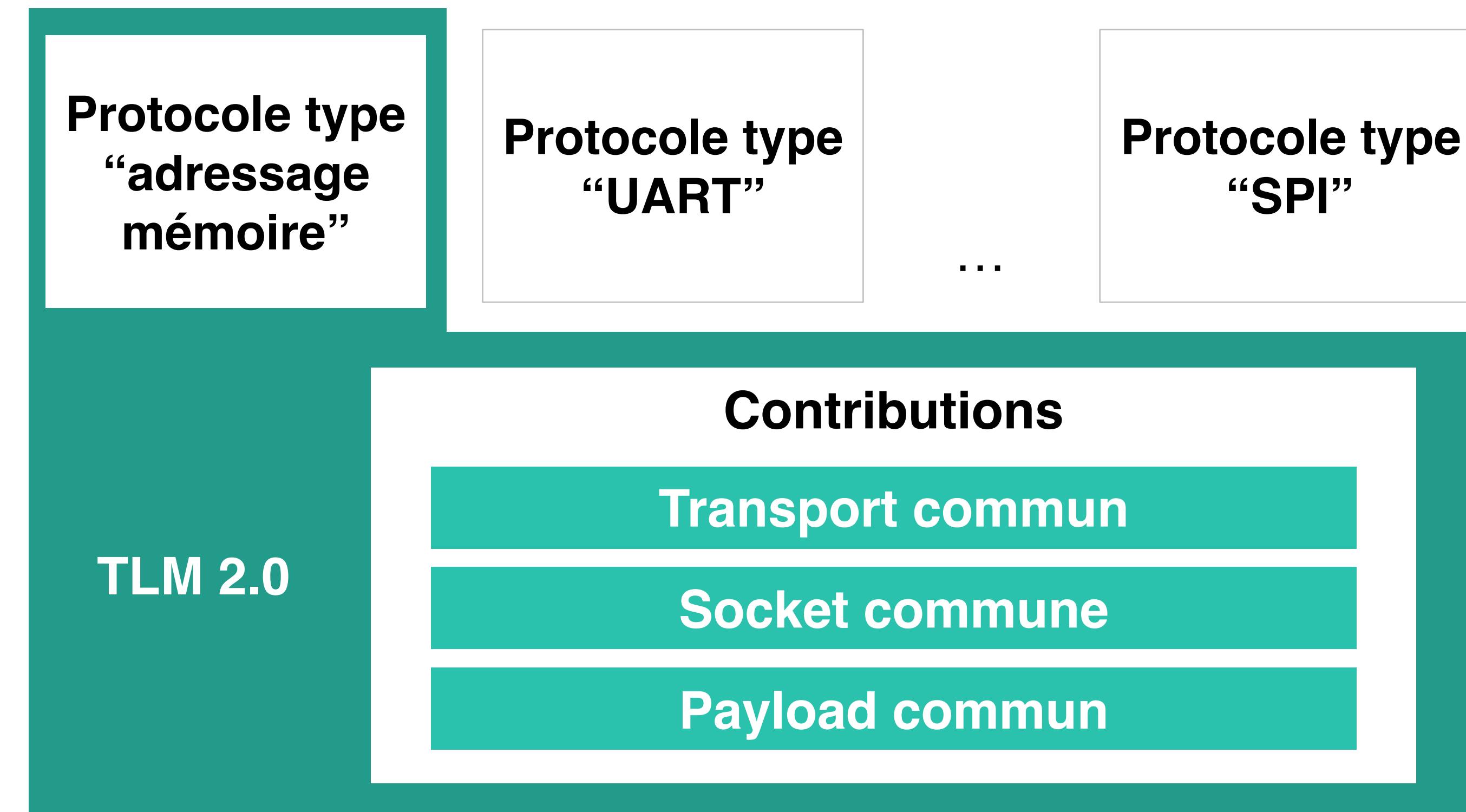
Les besoins en communication dans les plateformes virtuelles

- Communication rapide et interoperable
- Support des protocoles sans adressage mémoire
- Applicabilité avec TLM-2.0
- Définir les protocoles d'une manière consistante



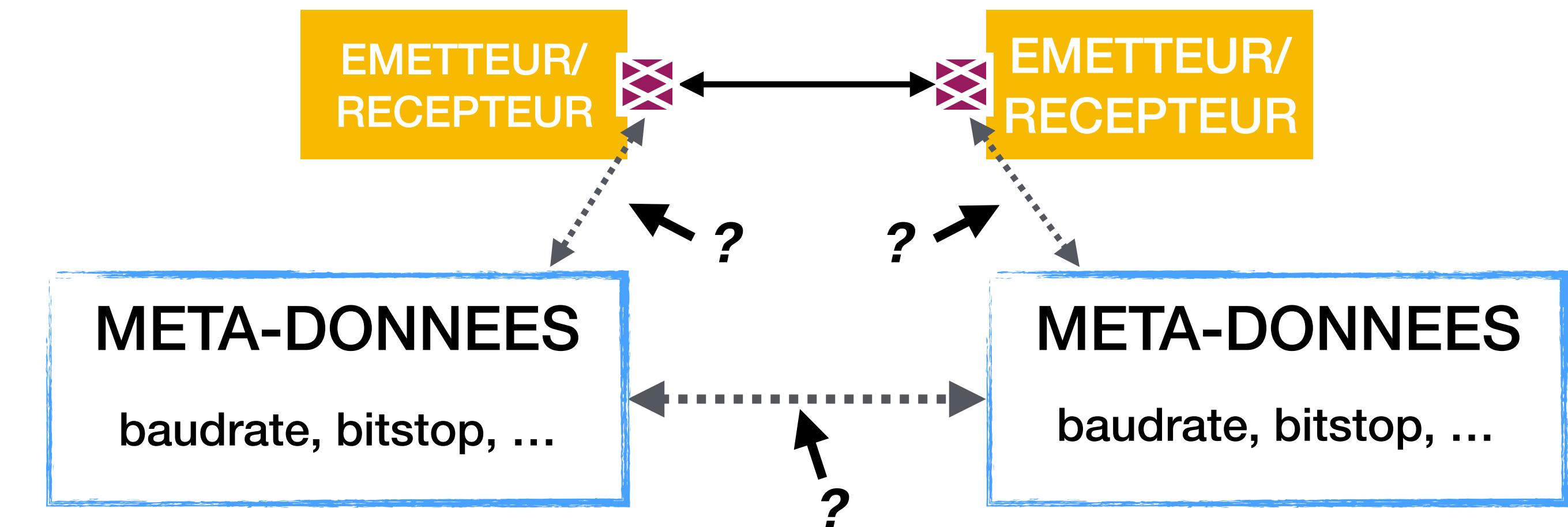
Proposition : une refonte de TLM rétro-compatibile

- ❯ Transport
- ❯ Socket
- ❯ Payload



Proposition : utilisation de CCI pour les communications

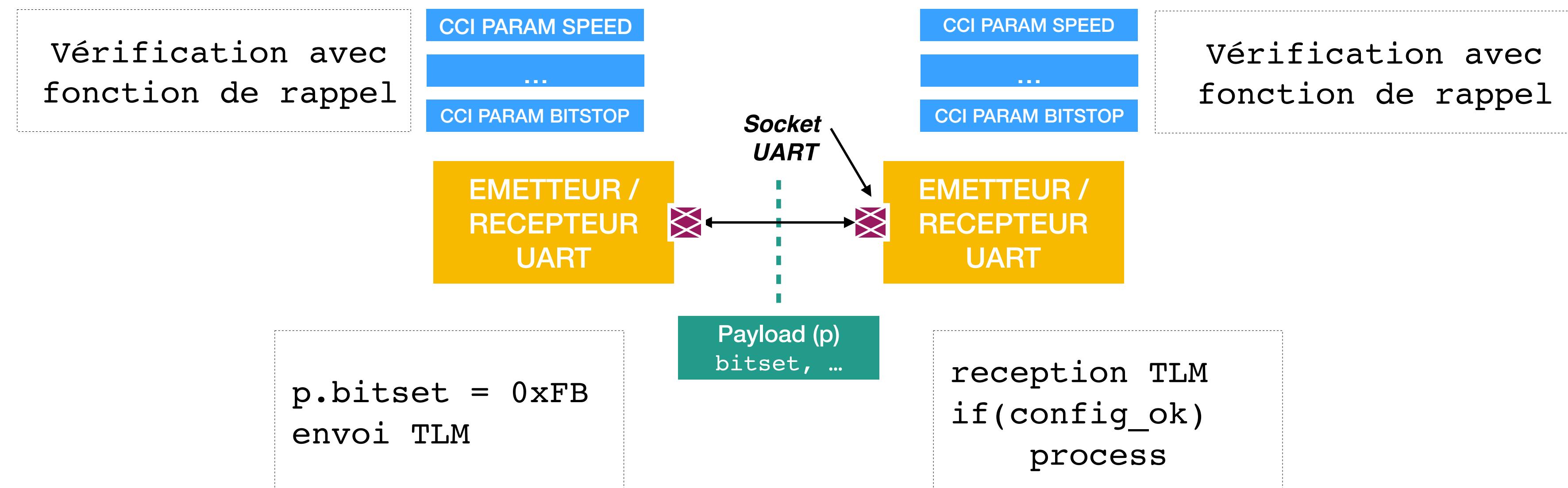
- ❯ Méta-données des protocoles
- ❯ Diminuer la taille du payload
- ❯ Utilisation de CCI
- ❯ Notification des changements par fonction de rappel



Analyse de la proposition : cas d'usage et résultats



Un cas d'usage : protocole UART



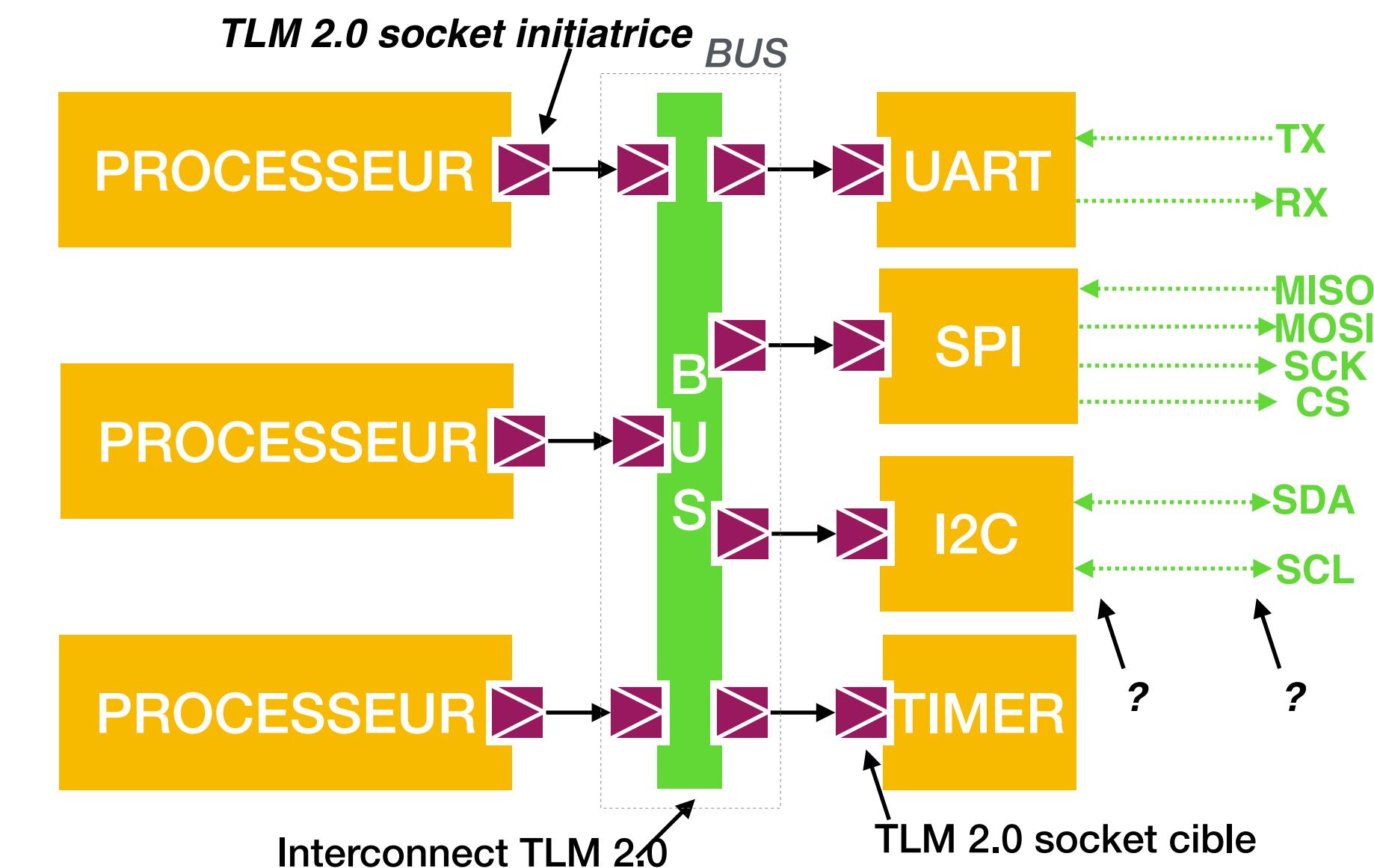
	Nombre de lignes de code	Duplication du code
TLM 2.0	830	●●●
Version améliorée de TLM-2.0	360 (~ rapport 2)	✓✓✓
Version améliorée de TLM-2.0 avec CCI	410	✓✓✓

Impact des contributions



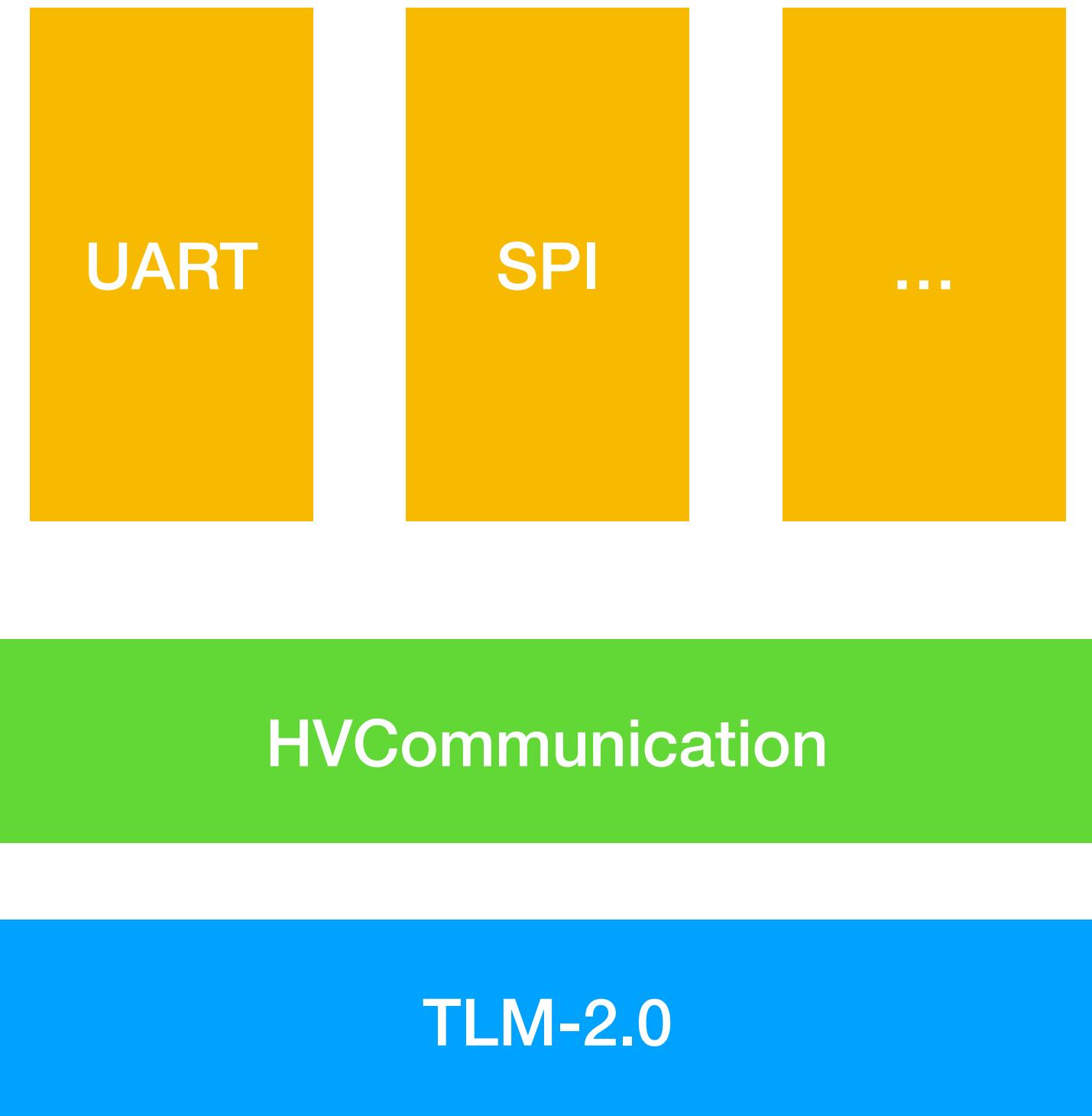
Atouts

- ✓ Pouvoir facilement ajouter de nouveaux protocoles à TLM
- ✓ Conserver les modèles existants
- ✓ Utiliser CCI pour la communication



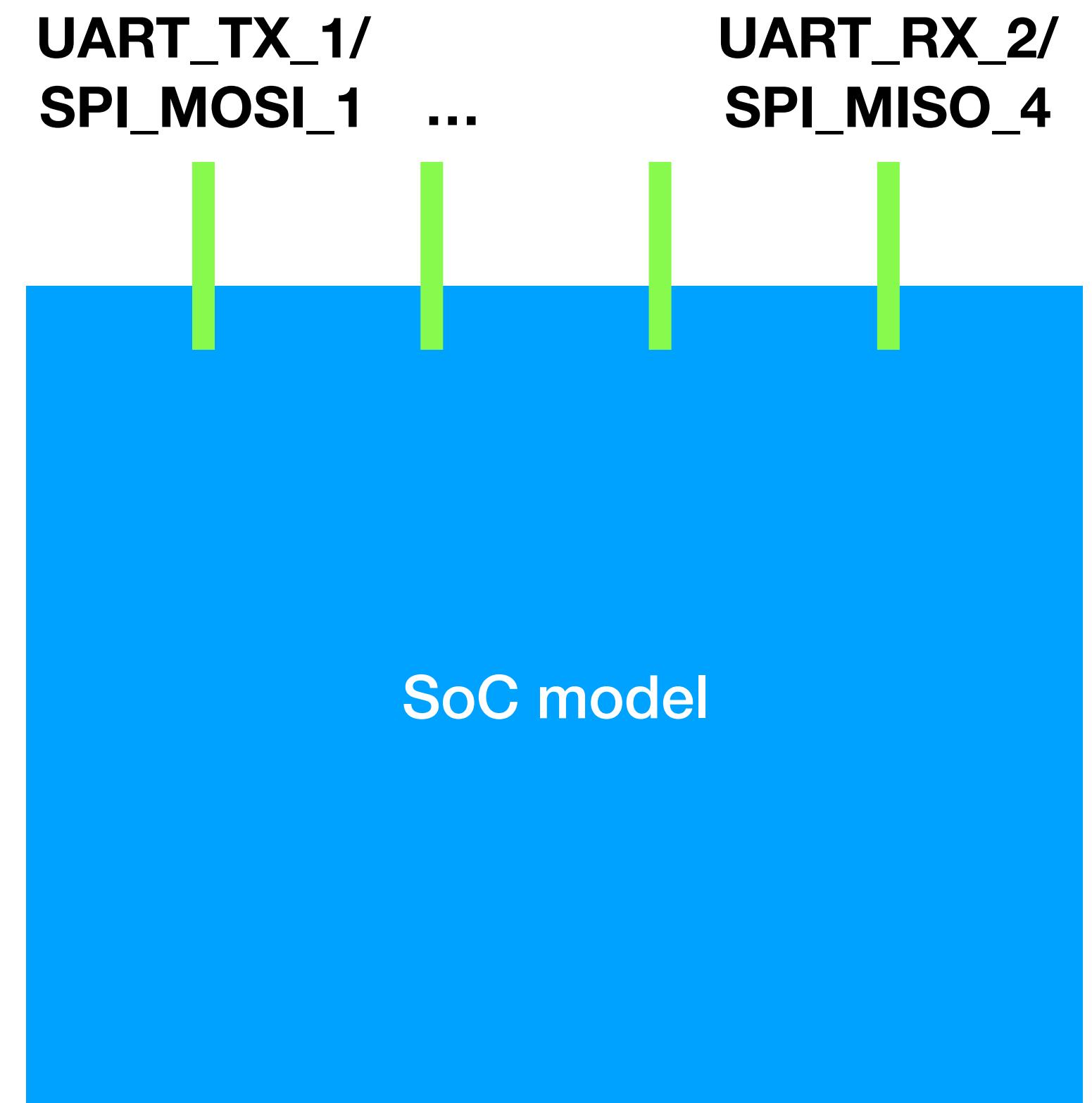
How we do TLM communications at Hiventive today

- All our work is based on TLM-2.0 and we've a complete compatibility with existing TLM-2.0 sockets
- We used some “C++ hacks” to do refactoring using the current standard.
- Many protocols supported and more coming:
UART, SPI, I2C, CAN, ...



“PINOUT” case

- Software is free to do whatever it wants as with the real hardware. PIO can be reconfigured during simulation
- A model should not fix statically the protocol if multiple solutions are available
- Solution we use: A socket supporting many protocols



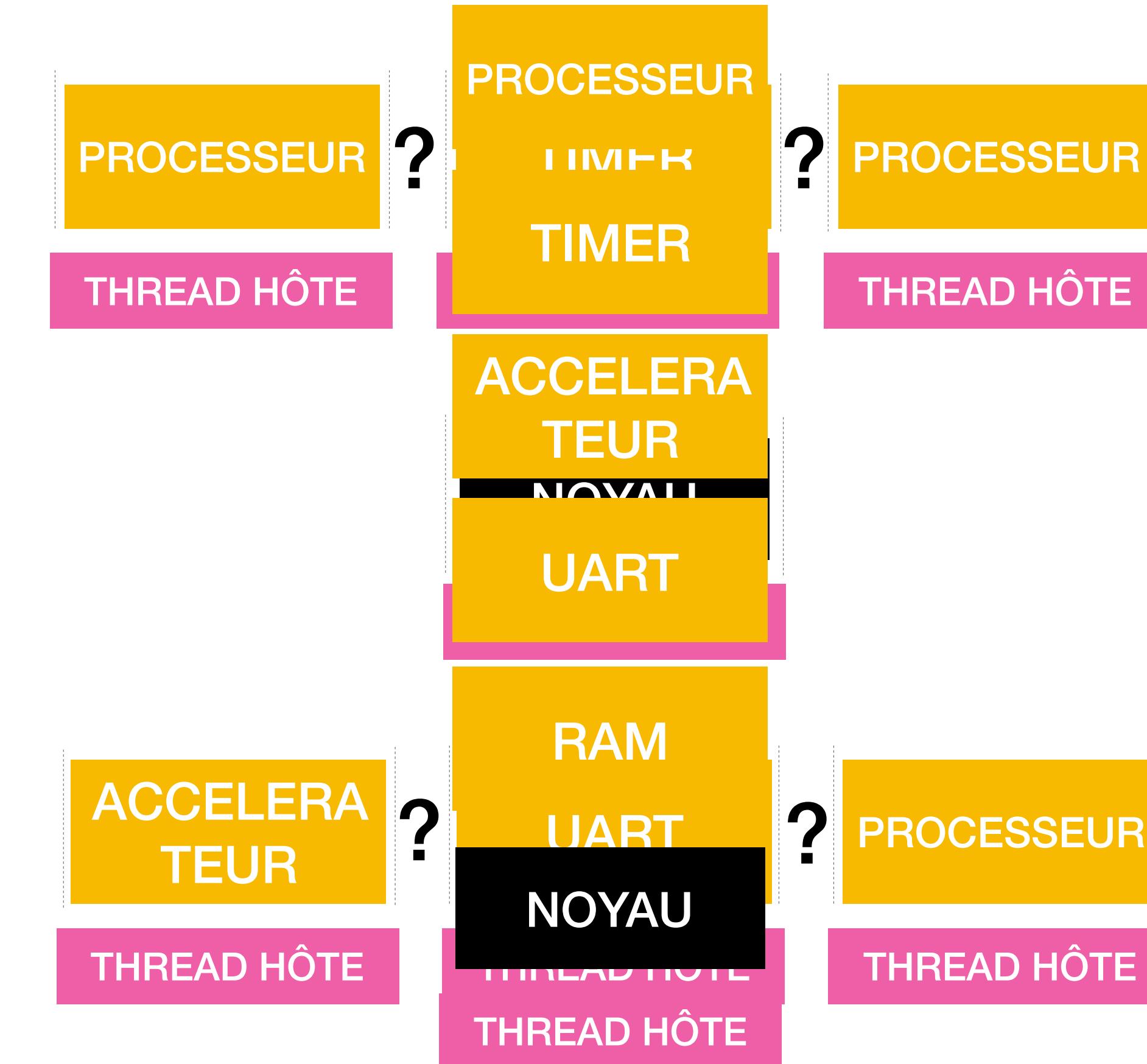
What we would like

- A new iteration of TLM-2.0 including refactoring
- Official protocols provided by standards owner
- An open discussion for improvements
- A robust solution for “variant” protocols



Les besoins en vitesse dans les plateformes virtuelles

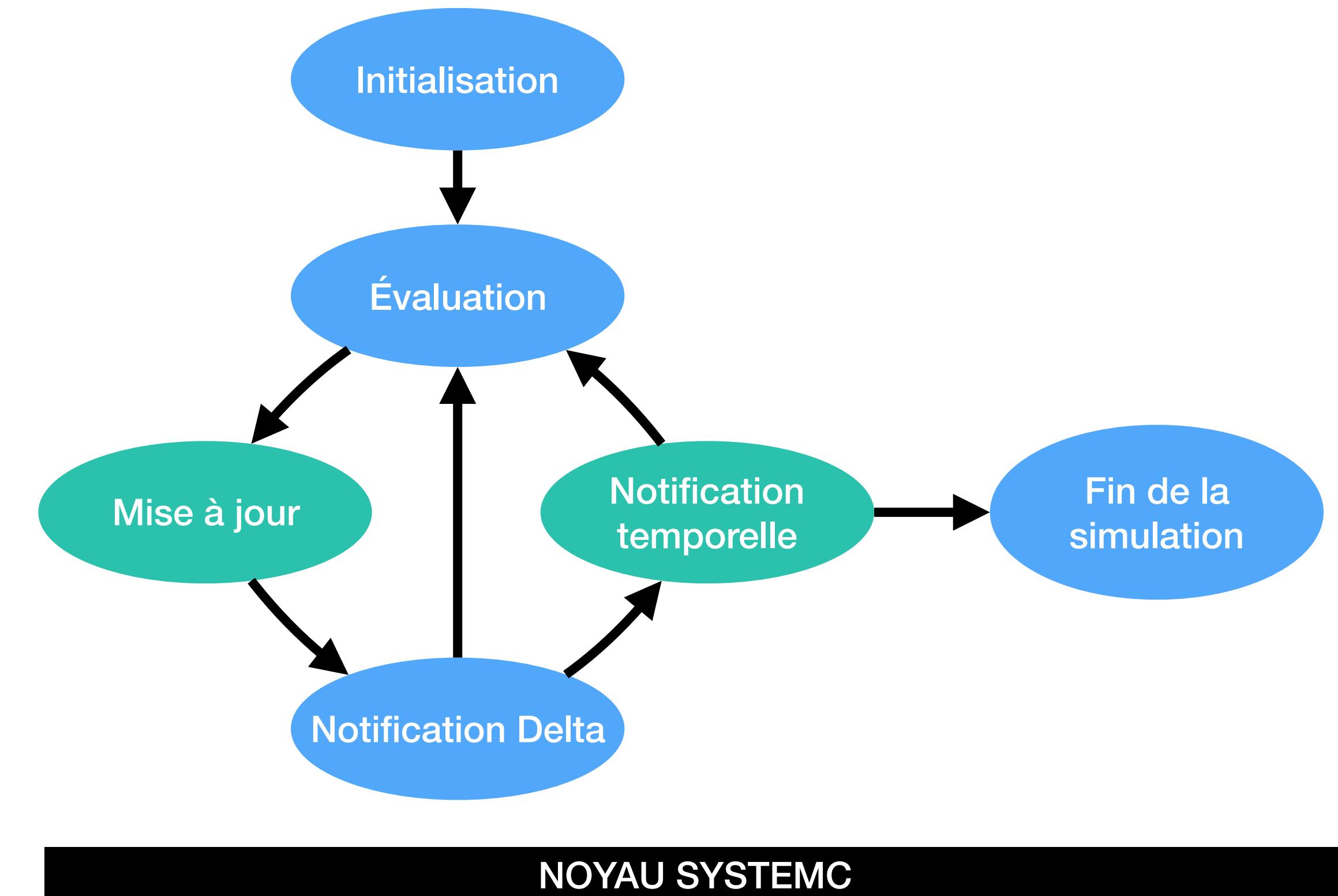
- Exécution séquentielle
- Pouvoir simuler un ensemble de plateformes virtuelles
- Eviter les situations de compétition entre les différents modèles
- Ne pas avoir à réécrire les modèles et éviter au maximum d'imposer du thread safe dans les modèles



Proposition : attente standard asynchrone

- Deux solutions proposées au groupe de travail SystemC
- Modification du noyau SystemC
- Solution retenue :
- Modification de l'ordonnanceur
- Deux nouvelles sémantiques : notification et fin d'attente d'événements asynchrones sur un canal SystemC

Plusieurs instances de SystemC avec / sans quantum



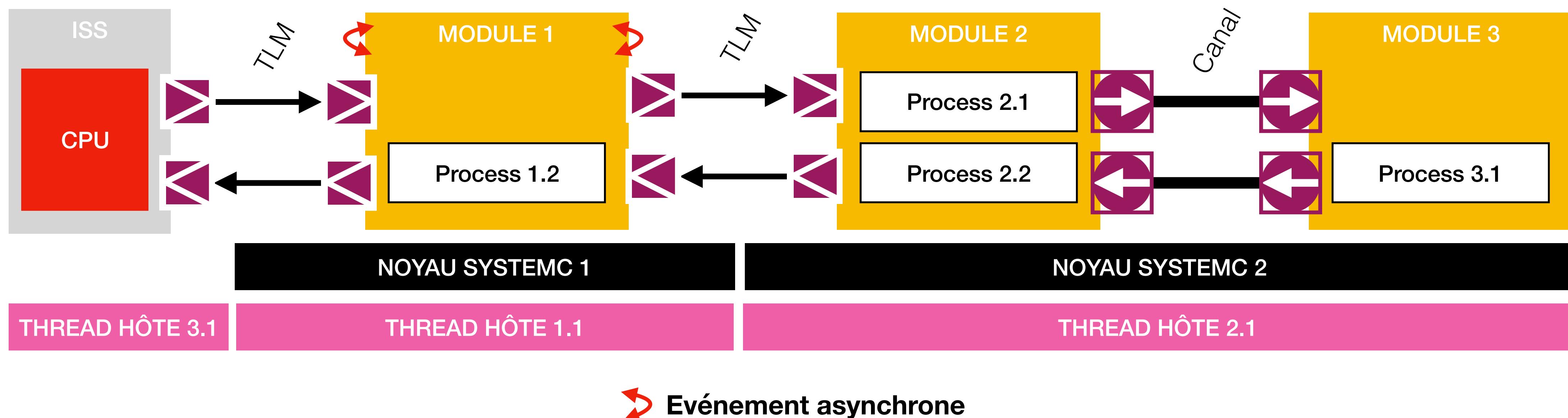
Impact des contributions

Atouts

- ✓ Exécuter des modèles dans des threads différents
- ✓ Connecter d'autres simulateurs
- ✓ Eviter les inter blocages

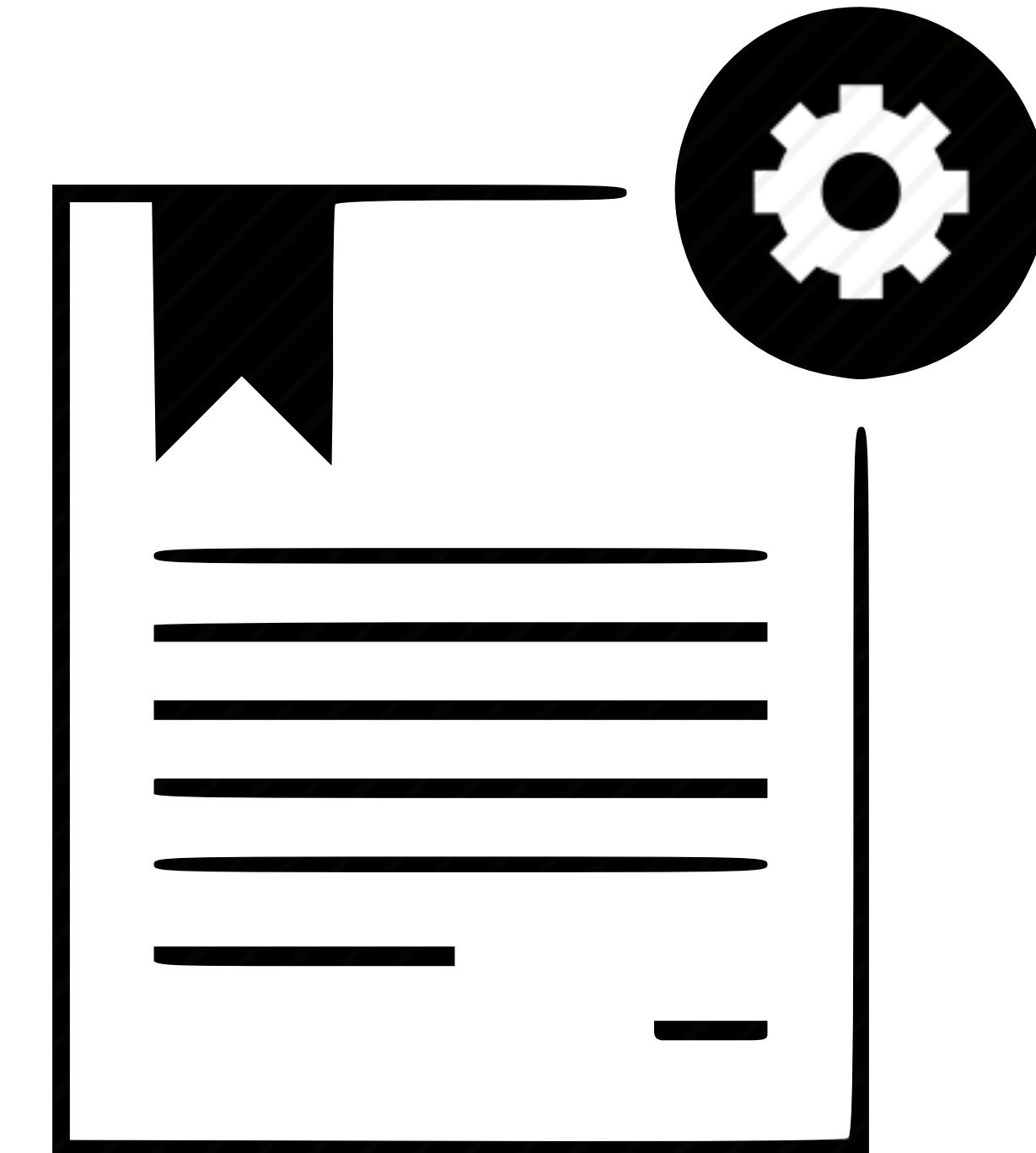
Limitations

- ✗ Parallélisation manuelle
- ✗ Besoin de mise en place du mécanisme de synchro

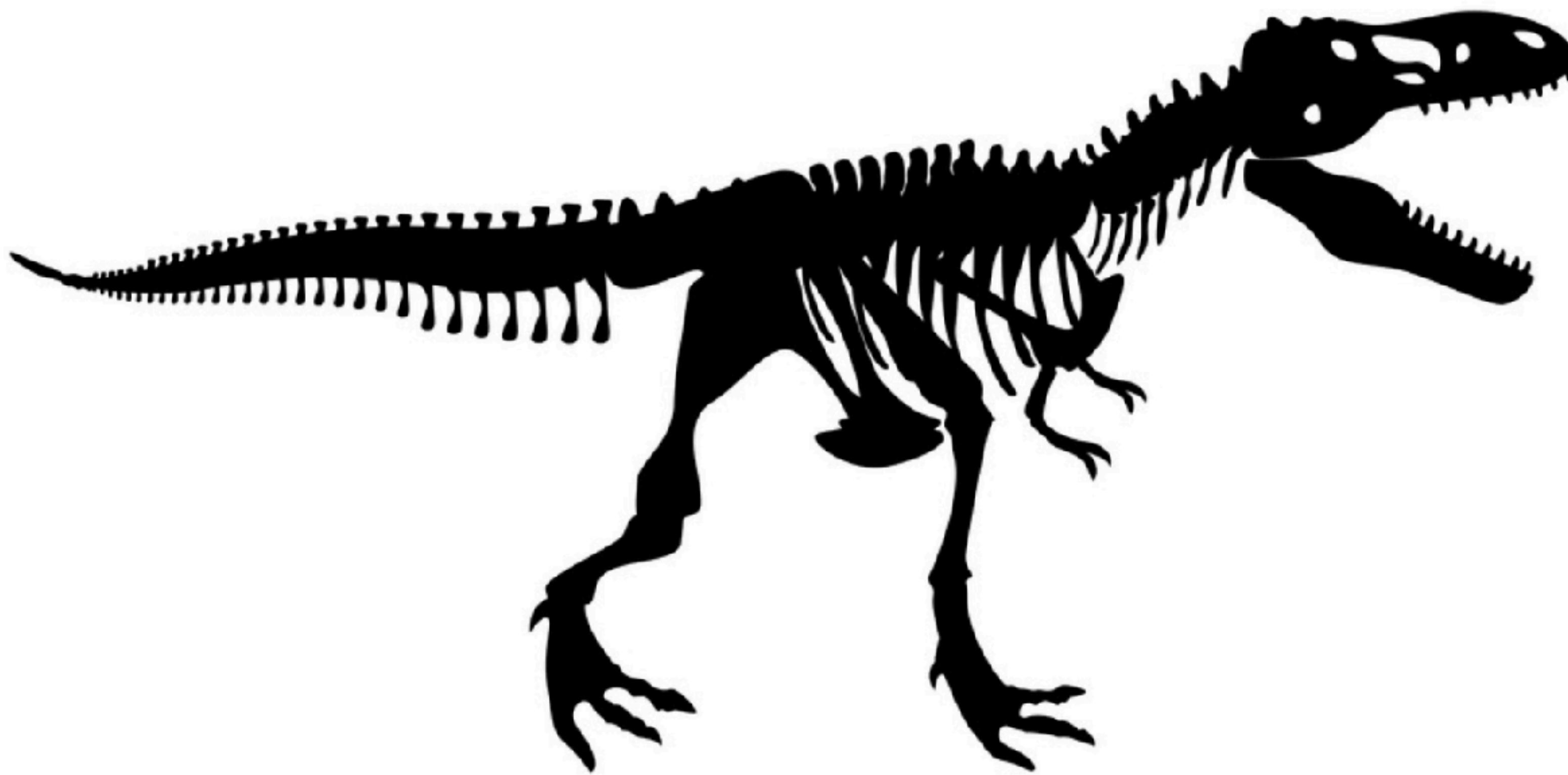


SystemC standardisation process

- SystemC is part of Accellera
- **SLOW update process** : completely open-source projects are moving faster
- An update every year or 2 years : this is not enough. Many bugs (we provide patches)



The future of SystemC



The future of SystemC

- An **open community**. Discussions should be done considering users, not only company parts of Accellera.
- SystemC, CCI, ... should have an **open repository**. GitHub, GitLab, to allow users to submit contributions.
- A **really parallel approach** : needs to break existing API ? Maybe. (eg: Thread safety issue)



Cf: Seven Obstacles in the Way of Parallel SystemC Simulation from R. Doemer

Great, but we don't want to wait for 10 years



Virtual prototypes are composed of many solutions



We need to find a way to manage this complexity. What about a collaborative project now ?

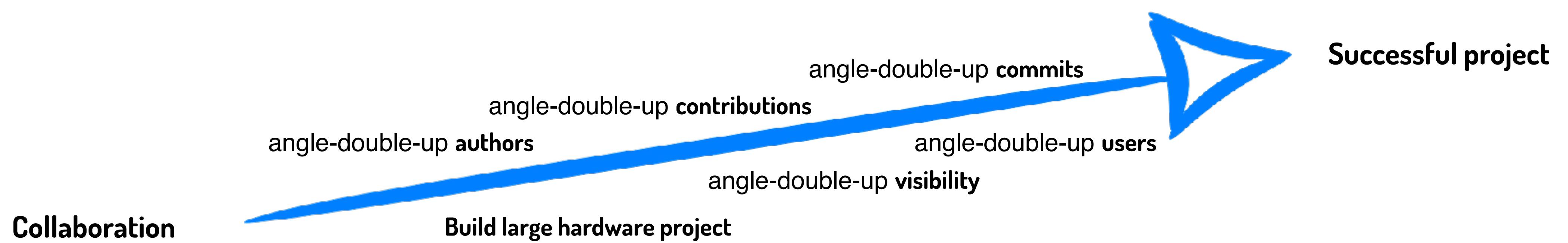
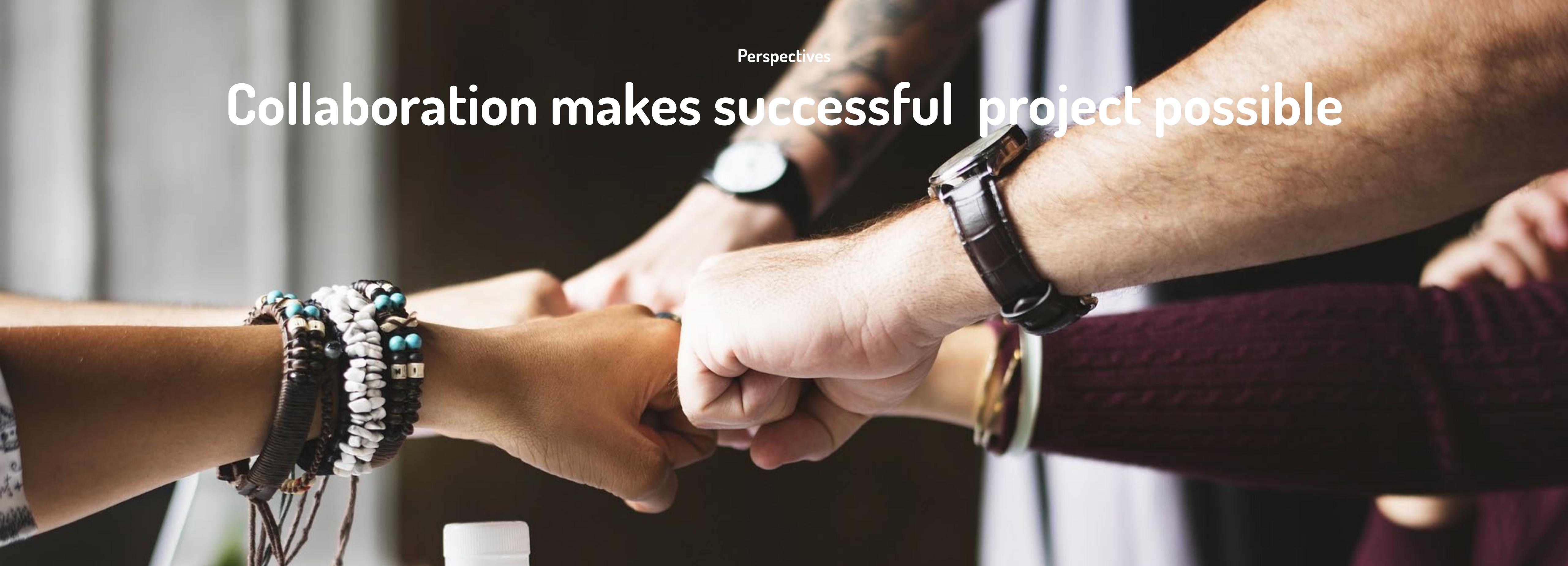


QMG : QEMU Machine Generator

- **Dynamically generates a QEMU** machine from user-provided info with a high level API.
- Use **upstream QEMU**. (no need to maintain a fork)
- Enable an easy export of existing models with other solutions (and so others simulators).
- **QMG2SC** project also available with native SystemC integration.
- Open Source. Refactoring in progress (new iteration expected in 2 months).



Collaboration makes successful project possible



Tools are great, communities are numerous

- Difficulties to interconnect tools
- Difficulties to re-use existing solutions
- Hard to ensure compatibility
- Bridge both of best worlds



Easy to search, easy to explore

The image shows a screenshot of the Hiventive website's search interface. At the top, there is a dark blue header with the Hiventive logo, navigation links for 'Explore', 'Catalog', and 'Learn', and a search bar containing a magnifying glass icon. To the right of the search bar are icons for a globe and a user profile.

Filter

Certified

HUB Certified

Categories

Arithmetic core

Communication controller

Prototype board

Coprocessor

Crypto core

Processor

Library

System on module

System on chip

Memory core

System controller

Video Controller

Uncategorized

Testing/Verification

ECC Core

DSP Core

Other

Operating Systems

567K Download



HDJBJS 259

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Solar 269



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Upload: 21h Ago

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Model page

The screenshot shows a web-based application interface for managing software components. At the top, there's a dark blue header bar with the Hiventive logo, navigation links for 'Explore', 'Catalogue', and 'Learn', a search bar, and user profile icons. Below the header, the main content area displays a component card for 'BJS 2.6.9'. The card includes a small icon of a cube, the component name, its version '2.6.9', a rating of four stars, the developer 'Amazone', and a brief description: 'Info: Lorem ipsum dolor sit amet, consectetur adipiscing elit.' A 'Certified HIVENTIVE' badge with a checkmark is also present. Below the card, there are tabs for 'README', 'Compatibility', 'Licence', 'Similar', and 'Comment'. The 'README' tab is active, showing a large text area with placeholder text: 'Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis et leo sit amet odio aliquet pellentesque eget vitae urna. Maecenas viverra congue urna at congue. Nulla non felis et ligula rhoncus volutpat. Vestibulum eu purus est. Aliquam nibh justo, ornare et neque eget, pharetra rutrum nisl. Vestibulum tincidunt viverra interdum. Aliquam quis aliquam metus. Suspendisse placerat, neque in sollicitudin luctus, mi sapien commodo mauris, in vehicula nibh velit id eros. Vestibulum eget scelerisque justo, fermentum dignissim nulla.' The footer of the page contains links to the Hiventive website and social media, along with a copyright notice and the Hiventive logo.

BJS 2.6.9 | • • • •
By Amazone
Info:
Lorem ipsum dolor sit amet, consectetur adipiscing elit.
Tag: Lorem ipsum dolor sit amet, consectetur adipiscing elit.

README Compatibility Licence Similar Comment

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Similar models



[« Return to Component](#)

Home > Search > Composant > Model



BJS 2.6.9 | ● ● ● ●

By Amazone

Info:

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Certified HIVENTIVE

Tag: Lorem ipsum dolor sit amet, consectetur adipiscing elit.

README

Compatibility

Licence

Similar

Comment

The grid displays eight cards, each representing a similar model:

- HDJBJS**: 2.5K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- Solar**: 2.6K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- Pixou**: 2.6K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- PPNKS?**: 2.6K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- HDJBJS**: 2.5K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- Solar**: 2.6K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- Pixou**: 2.6K Downloads, Certified, by Solar, uploaded 21h Ago. Description: Lorem ipsum dolor sit amet, consectetur adipiscing elit.
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Hiventive

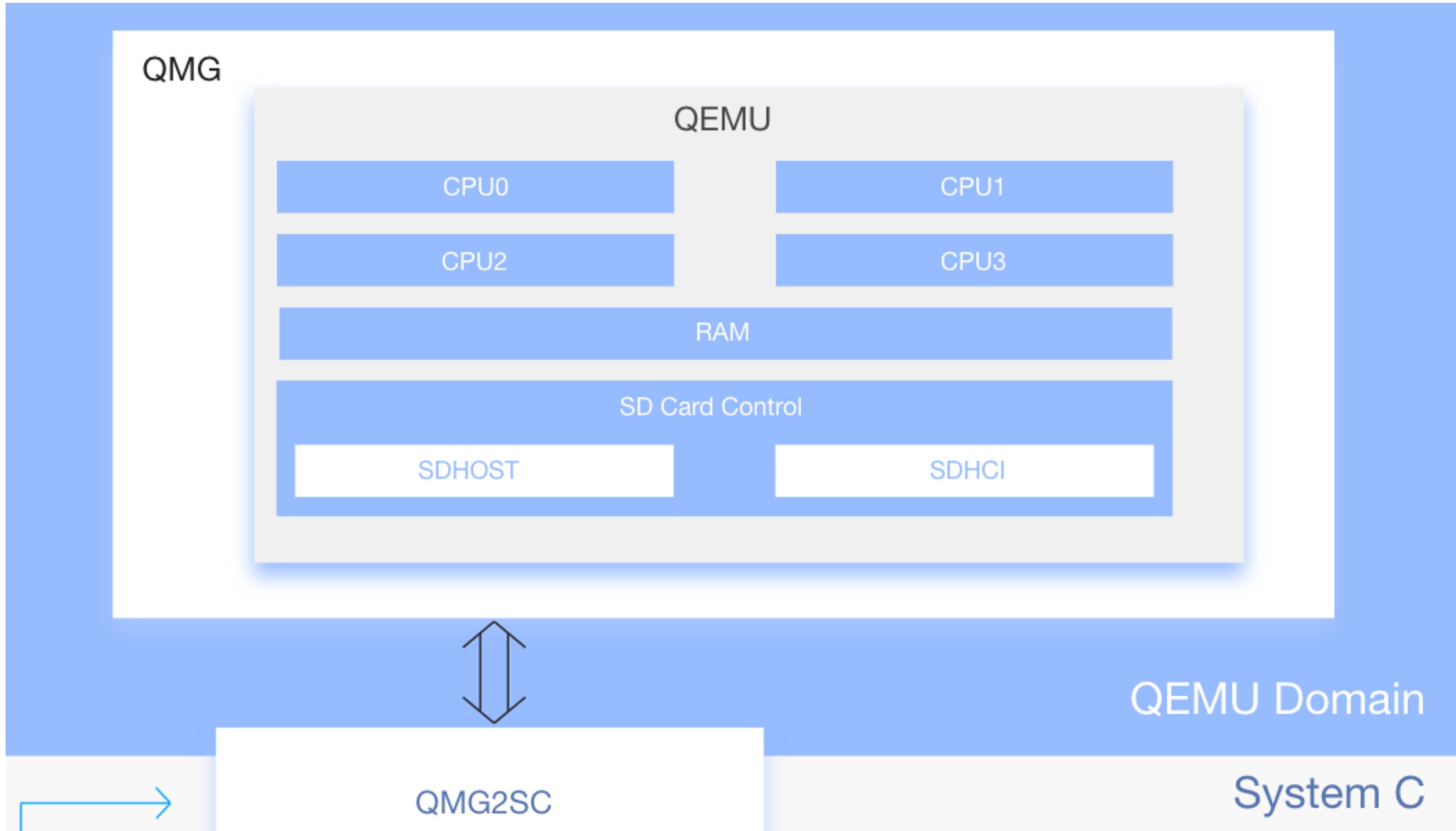
Add a model to index

The screenshot shows the Hiventive platform interface for adding a new model. The top navigation bar includes links for 'Explore', 'Catalogue', 'Learn', and a search bar. The main form is titled 'Model' and contains the following fields:

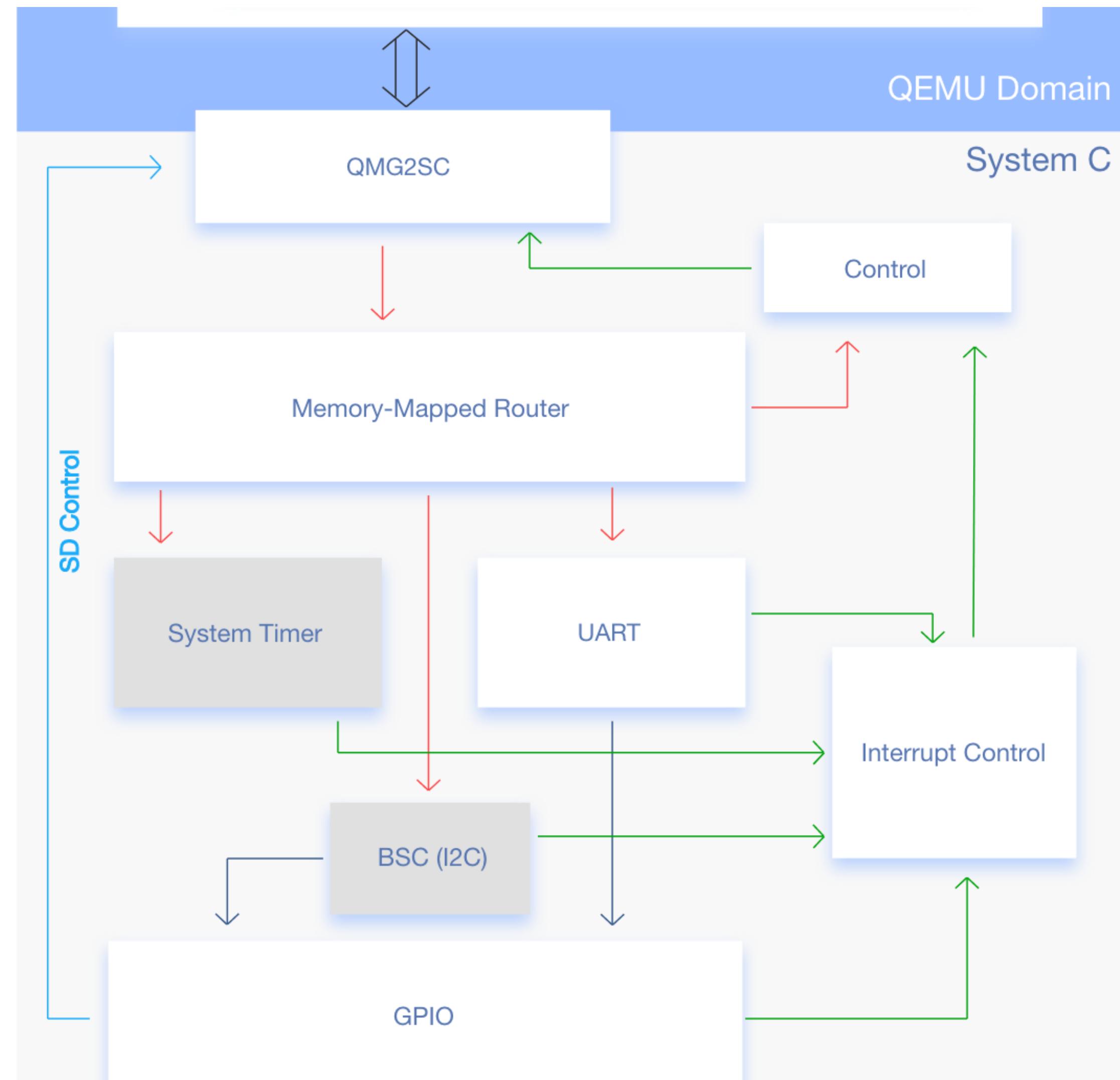
- Name your Model**: A text input field labeled 'Name' with a placeholder 'Lorem ipsum dolor sit amet, consectetur adipiscing elit.' and a note '* Required'.
- Complementary information**: A text input field labeled 'Tags' with a placeholder 'Add your tags here and press enter to confirm' and a note '* Required'. Below it is a file upload section with a cloud icon, a 'Drag and drop your files here' prompt, an 'Or' separator, and a 'Browse files' button.
- Description**: A text input field containing the text 'This is a description for my model'.
- Repository URL**: A text input field with a note '* Required'.
- Publish**: A section with two checkboxes:
 - Don't display activity-related personal information on your profiles
Private contributions
 - Include private contributions on my profile
Choose to show contributions of private projects on your public profile without any project, repository or organization information

A blue 'Save' button is located at the bottom of the form.

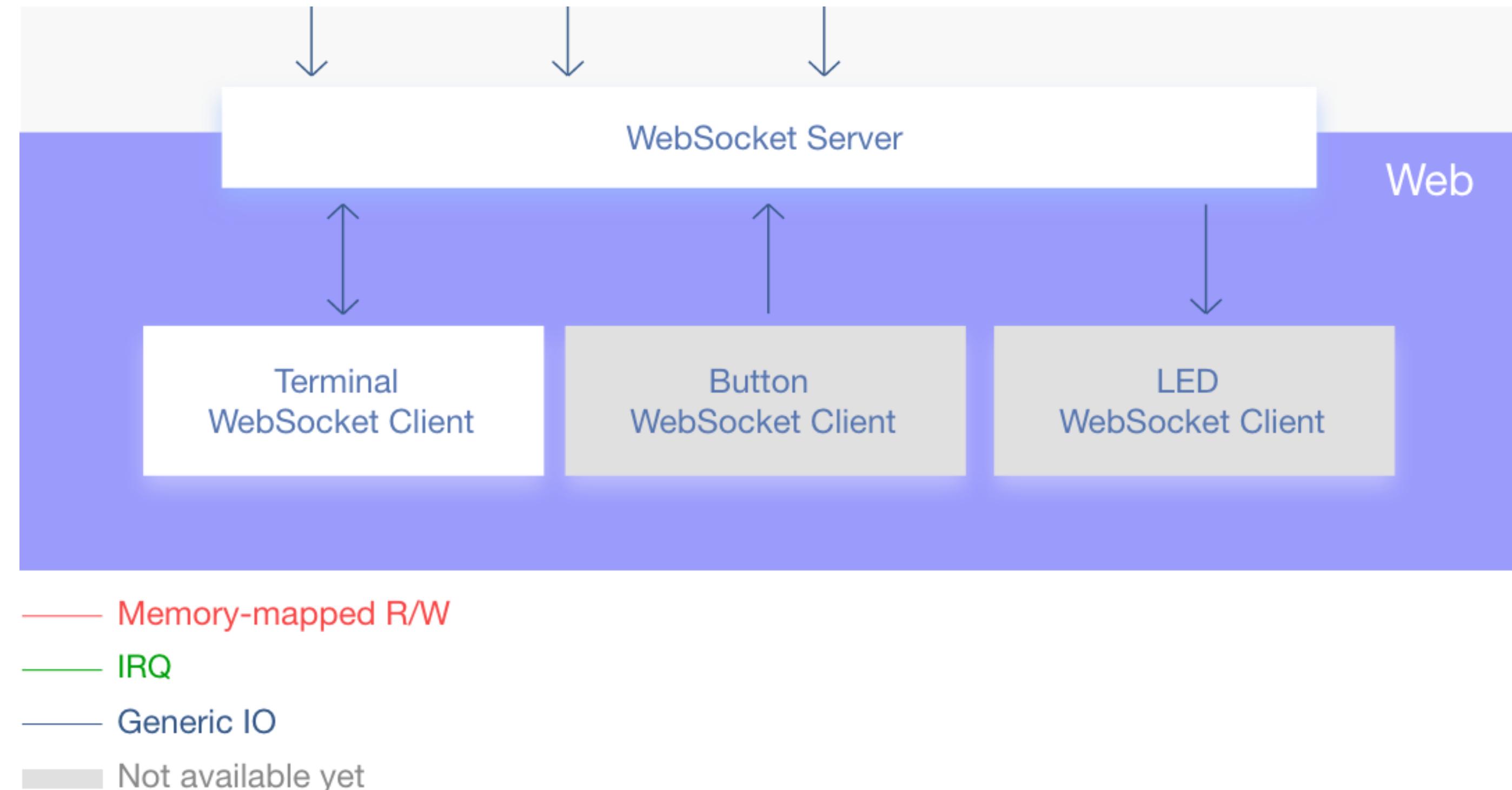
The Hiventive Way - QEMU (GEM5,...)



The Hiventive Way - SystemC part



The Hiventive Way - Backends



Is it complex to start a virtual prototype ?

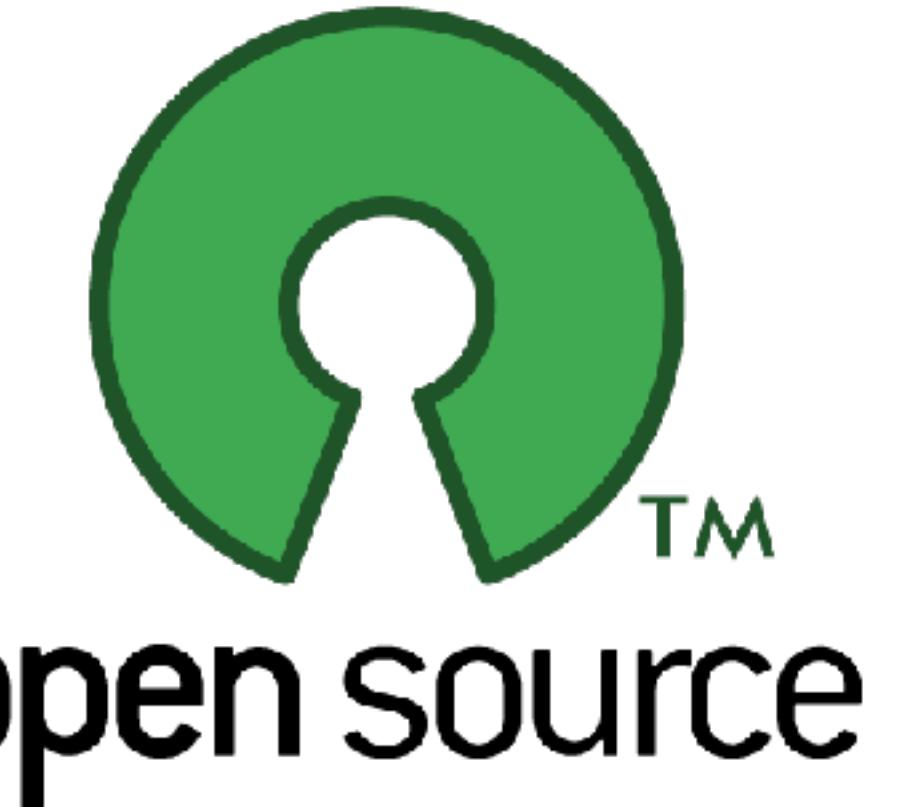
You don't need to read tons of books or tutorials. It's just easy as 1 2 3.



1 : Clone the project

2 : Install model dependencies

3 : Run the virtual prototype with your software



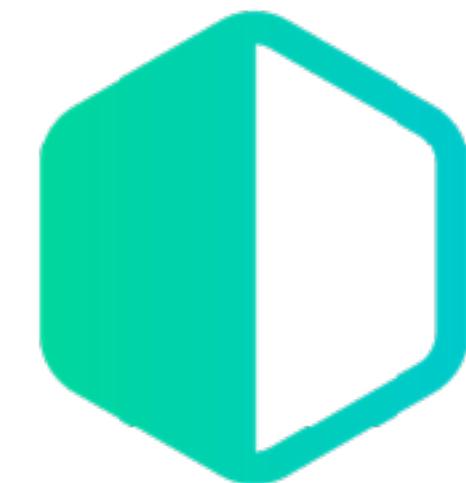
All details are available on our Beta Documentation : <https://www.hiventive.com>

Onemorething



**ORCONF 19 : The open
source digital design
conference**
**September 27th to 29th in
Bordeaux, France.**

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