Non-Interfering Composed Evaluation

How to Exchange Components without Re-Evaluation?

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Outline

- Industrial use cases have shown limitations of current compositional methodologies
- New Common Criteria **evaluation method** for evaluating one composed *target of evaluation* (TOE) based on two (or more) already certified TOEs
- Application cases

State of the Art and Motivation

ACO / CAP (Composed Assurance Package)

- Composed certification of already certified components
- Just conformance checks at component's boundaries without proof of execution boundaries (no non-interference proof)
- Up to CAP-C (attack potential: enhanced basic, i.e. EAL 4 like)
- No conformance claim to an EAL package possible
- Not widely applied in the real world

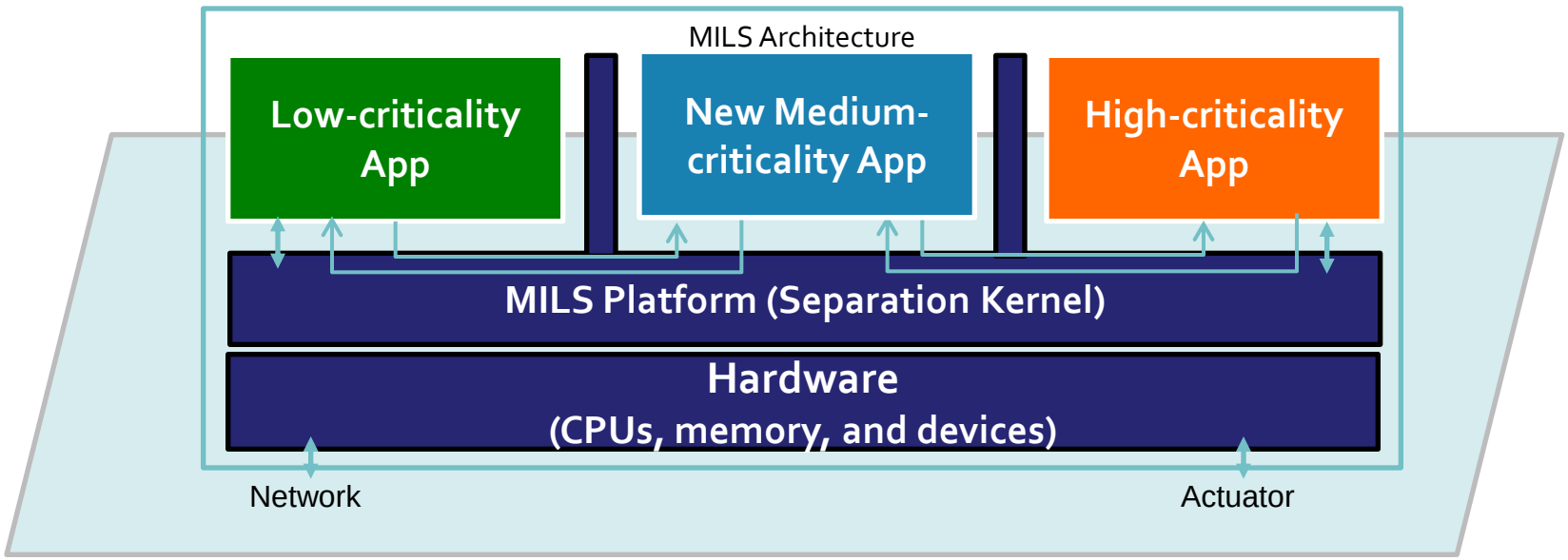
State of the Art and Motivation

CCDB Composition

- Composite certification of already certified platform and non-certified application using this platform
- Using the development documents and the vulnerability analysis of platform to ensure security properties of final Composite TOE
- EAL package claim is possible
- No limitation on assurance level, i.e. EAL 7 possible
- Drawbacks:
  - Re-usability of evaluation results for the application is difficult
  - Effort for re-certification may be quite high

Motivation

- Puzzle Composition
  - Exchange a system component with interface/function-compatible one
  - Use-cases
    - Product from Vendor-A is replaced by product from Vendor-B
    - Flexible in-the-field update



Definitions

a) *Component TOE*: **input** to the evaluation; two or more already certified products

b) *Composed TOE*: **output** of the evaluation; one certified final product based on the set of *Component TOEs*

c) *Interaction*: the allowed communication of two certified *Component TOEs* according to a given information flow policy inside the *Composed TOE*

d) *Interference*: any communication or influence on a *Component TOE* that is not explicitly authorized by the certified security policy for this Component TOE

Proposal

- New methodology based on *non-interfering* between Component TOEs
  - *Interaction* between Component TOEs possible only according to a given information flow policy inside the Composed TOE
  - *Interference* is not possible inside the Composed TOE

Idea and Principle of Non-Interference

- Execution of one Component TOE does not undermine the certified security policy of other Component TOE
- The complete internal state of each Component TOE is well-defined and -known at any time
- *Non-interference between the Component TOEs shall be evidently demonstrated*
  - *The non-interference property of the Component TOEs shall be verified during the dedicated evaluation processes of each Component TOE ➔ non-interference analysis by responsible Component TOE evaluator*

- This methodology is a *peer-to-peer* one: it treats Component TOEs in a symmetric way as equal entities from the point of view of their non-interference

Step 1: A priori analysis of the Component TOEs

- *A priori* evidence of fundamental non-interference between the Component TOEs
  - This *a priori* determination is one of the principal distinctions between the new methodology and the ACO and CCDB methodologies relying on an *a posteriori* determination of the level of non-interference between the Component TOEs
- Preparing non-interfering composed evaluation
- Analysis of all possible internal states of Component TOEs
- Analysis of non-bypassability and non-tampering
- Yielding a list of non-interference requirements

  → Single Components need to be made suitable for this approach

Step 2: Evaluation of the Non-Interfering Composed TOE

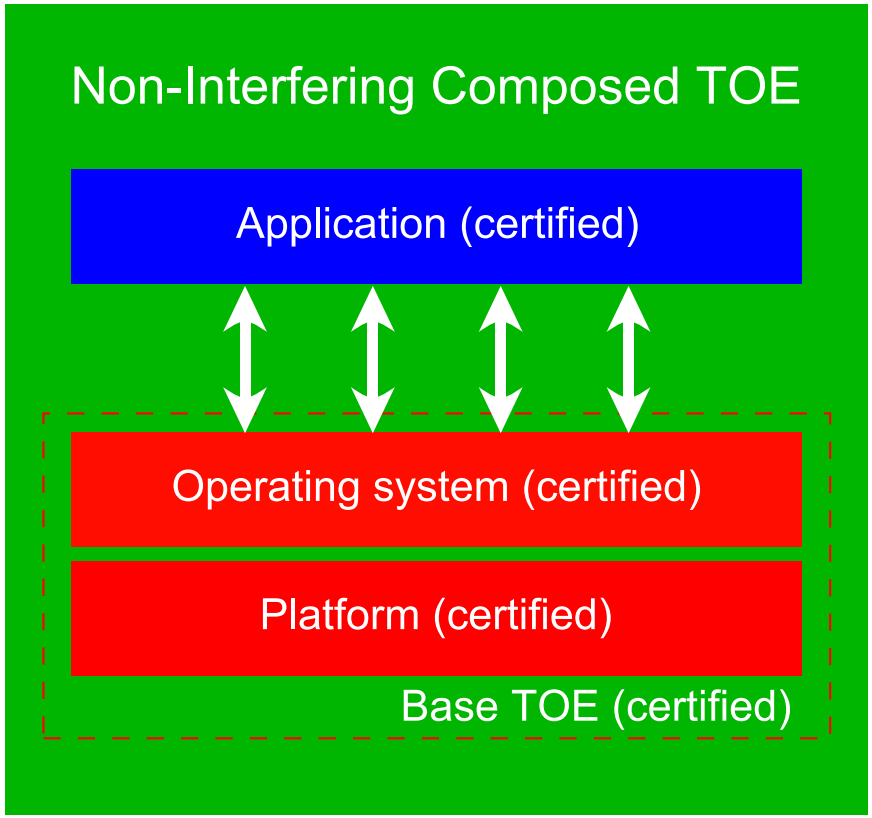
- Relies on the analysis of certified non-interfering properties of the Component TOEs (see Step #1)
- Analysis of mapping between the requirements of each Component TOE with the SFRs of the other Component TOEs
- Analysis of functional interactions between Component TOEs
- Verification of the fulfilment of non-interference requirements
- If necessary (incomplete requirement matching) perform reduced vulnerability assessment

Application Case 1

- Non-Interfering Composed TOE for Base and Dependent TOE

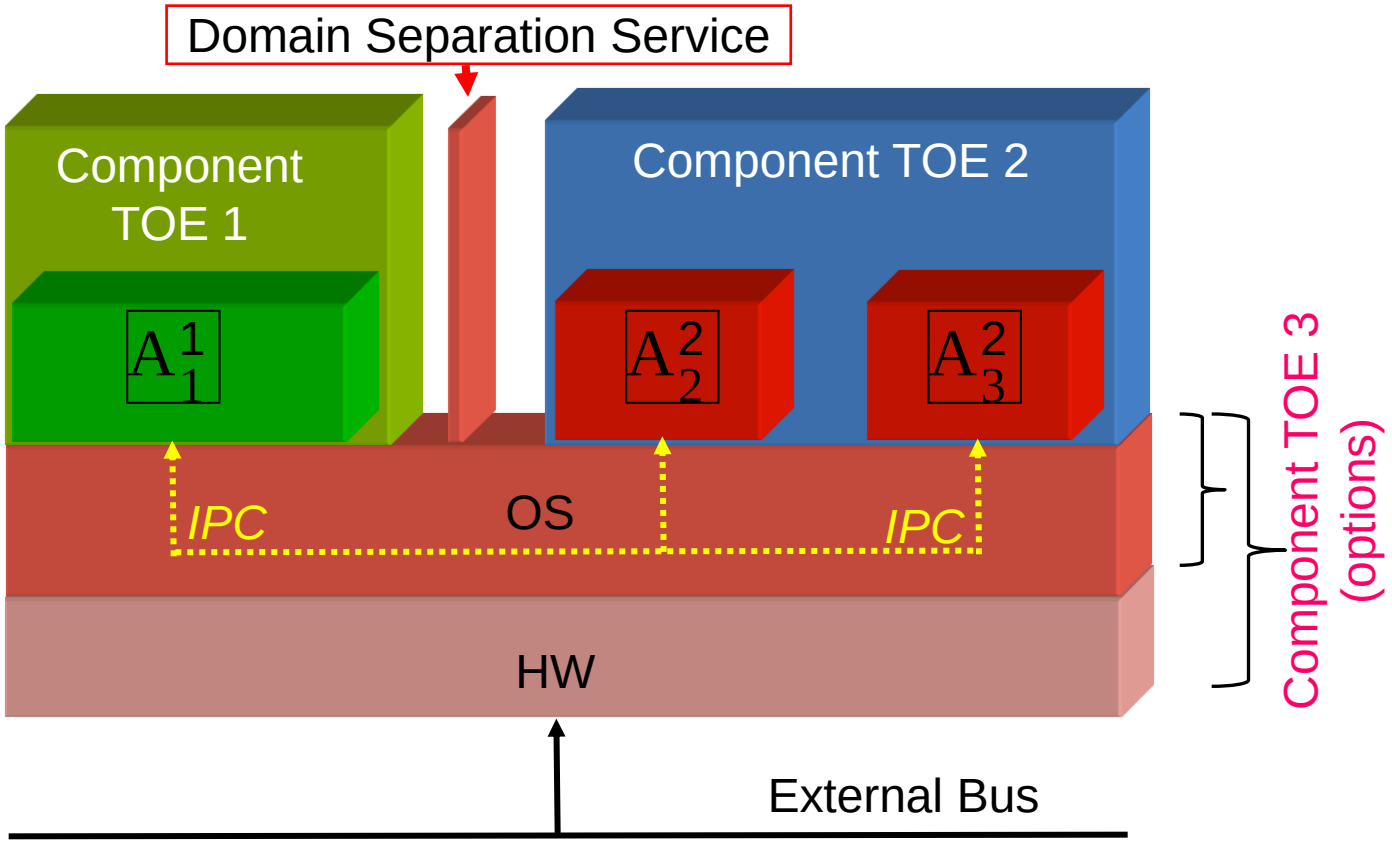
Non-interference is shown if:

1. The Base TOE strictly and evidently separates the application from the Base TOE
2. The fulfilment of all requirements for running the application in a non-interfered way (wrt. app-certificate) can be evidently guaranteed by the Base TOE
3. The fulfilment of all requirements for running the Base TOE in a non-interfered way (wrt. base-certificate) can be evidently guaranteed by the application



Application Case 2

- Non-Interfering Composed TOE:
  - Interaction via the underlying platform



Application Case 2 (cont.)

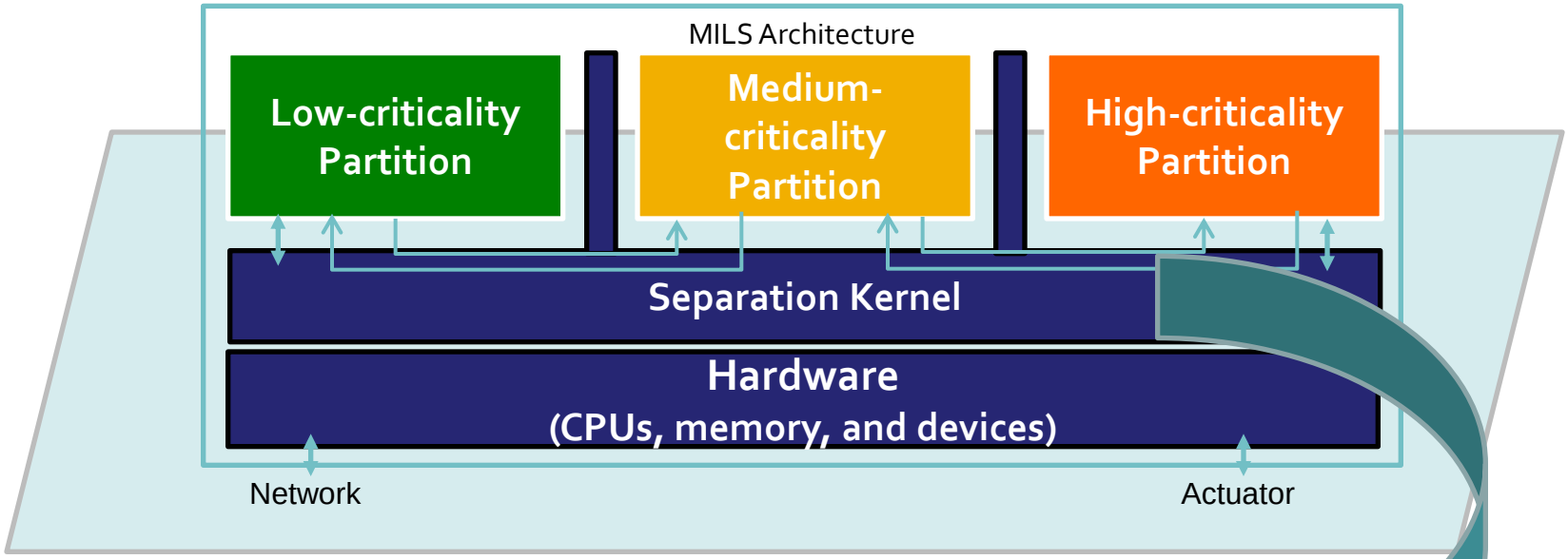
- Interaction via the underlying platform

Non-interference is shown if:

1. The fulfilment of all requirements for executing the Component TOE 1 and TOE 2 in a non-interfered way, as imposed by their certificates, can be evidently guaranteed by the Component TOE 3 (underlying platform) and by its *concrete configuration*.

2. The fulfilment of all requirements for executing the Component TOE 3 (underlying platform) in a non-interfered way, as imposed by its certificate, can be evidently guaranteed by the Component TOE 1, Component TOE 2 and given a *concrete configuration* of the Component TOE 3.

Separation Kernel as Base TOE



Separation Kernel

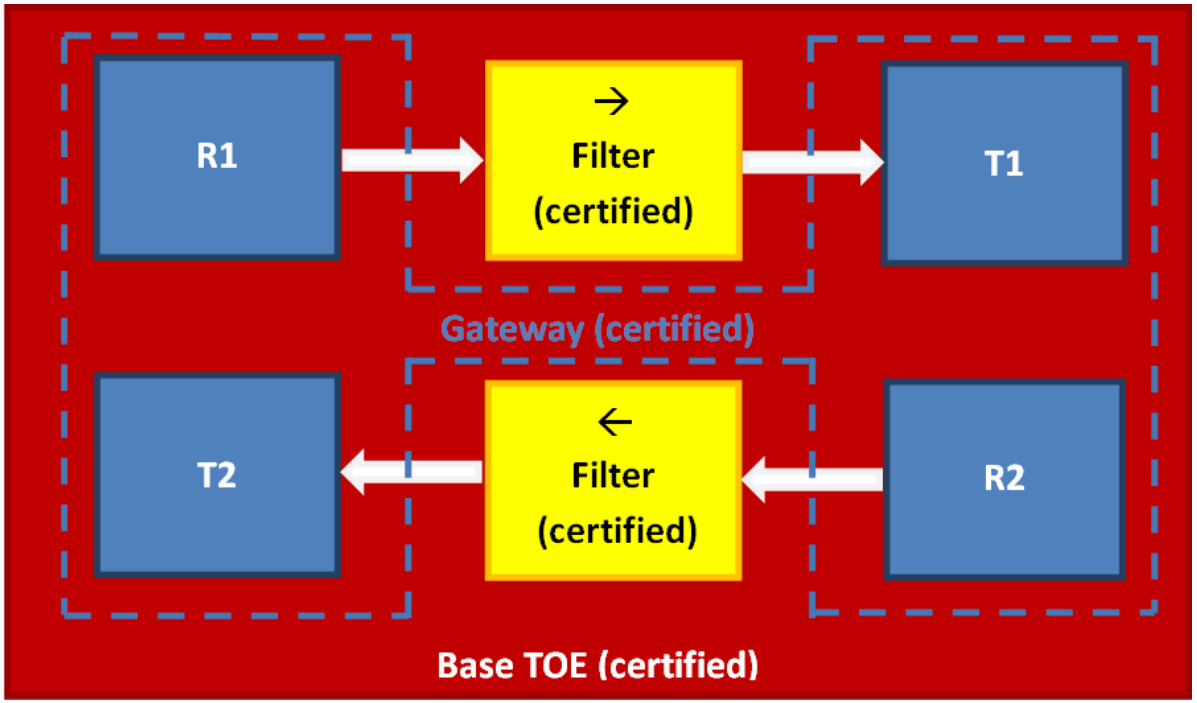
- Certifiable Operating System layer
- Separates system and processing resources
- Provides separated runtime environments to host applications
  → mandatory property to evidently proof non-interference
- Provide controlled communication between runtime environment
  → controls interactions and defines interfaces/access point to applications

Use Case: Non-Interfering Composed Firewall TOE

Base TOE:
Certified Separation Kernel (with HW)

Dependent TOE 1:
Generic Gateway (R, T)

Dependent TOE 2:
Specific Protocol Filters



Challenges:

1. Evidently secure (= certified) Composed Firewall using filter configuration A
2. Evolutionary Evaluation by enhancing filter configuration A (updates)
3. Incremental Improvement by adding filter configuration B (from the box of certified filters)

Back to the motivation

- Puzzle Composition
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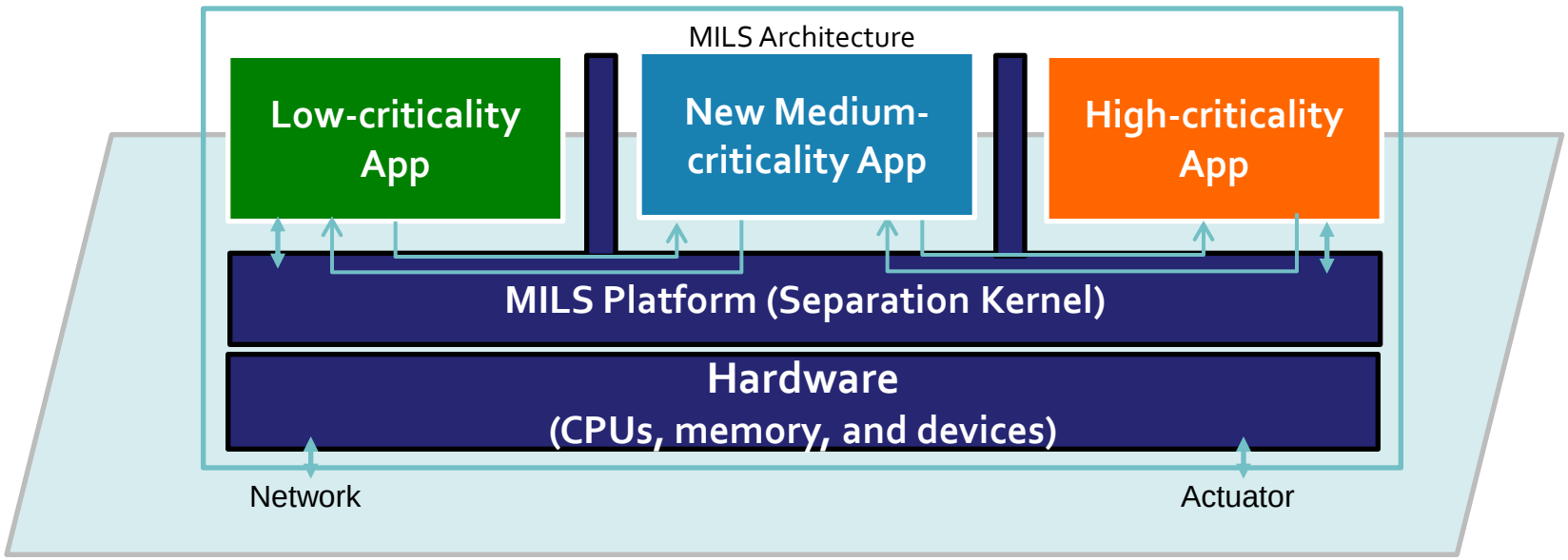

Summary and Benefits

- Common Criteria does not currently offer a highly flexible methodology for compositional evaluation regarding:
  - Reusability of single components
  - Independent evaluation of components
  - Compositional assurance of products from different vendors

- **Non-interfering** methodology shifts effort for vulnerability assessment to component evaluation to avoid duplication of effort during the compositional step when performing re-evaluations
  (however for initial certification, efforts likely similar to CCDB composite methodology)
- Evaluation effort for **Non-Interfering Composed TOE** can significantly be reduced due to the *non-interfering property of* and the related *evidence for* Component TOEs

Summary and Benefits (cont.)

- Targets certifications of dynamic high-assurance systems
- Conformance claim to each **EAL** package is possible
- Enables a verdict for the TOE resistance to attacks by an attacker with even ***high*** attack potential
- A Component TOE (e.g., an application) **can be replaced with less effort**
  - A supplemental application can be added to an already existing Composed TOE by only evaluating the new application Component TOE
- The new evaluation methodology for non-interfering Composed TOE enables **a higher business flexibility** for the vendors and operators of Composed TOEs

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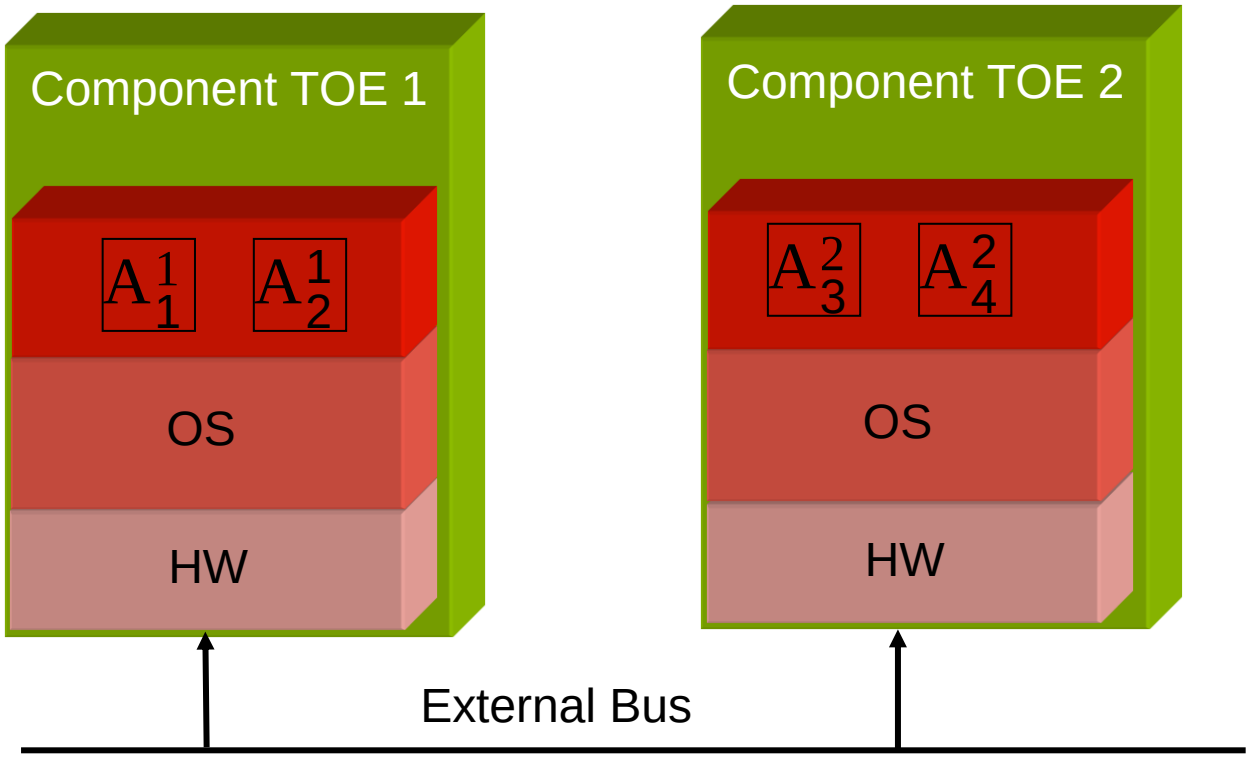
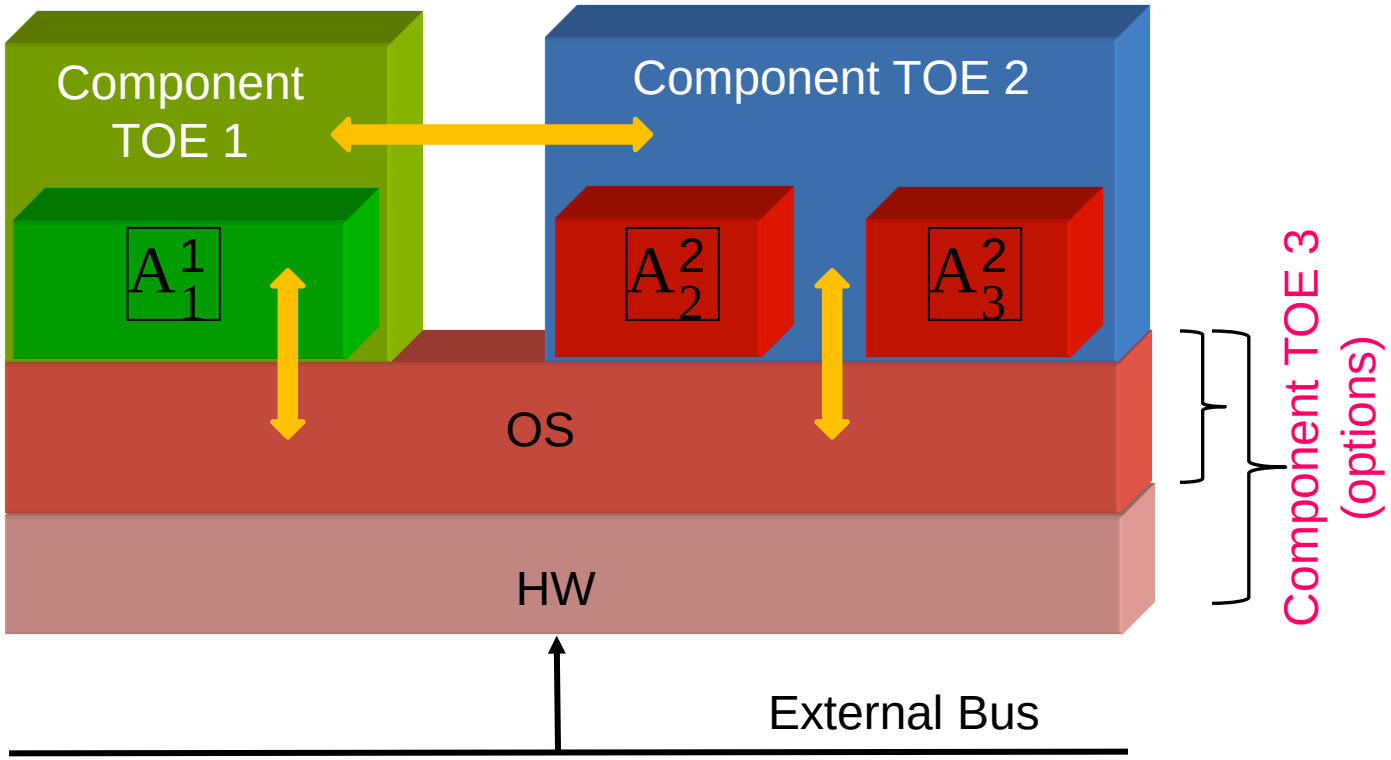
- BACKUP Slides or to be used



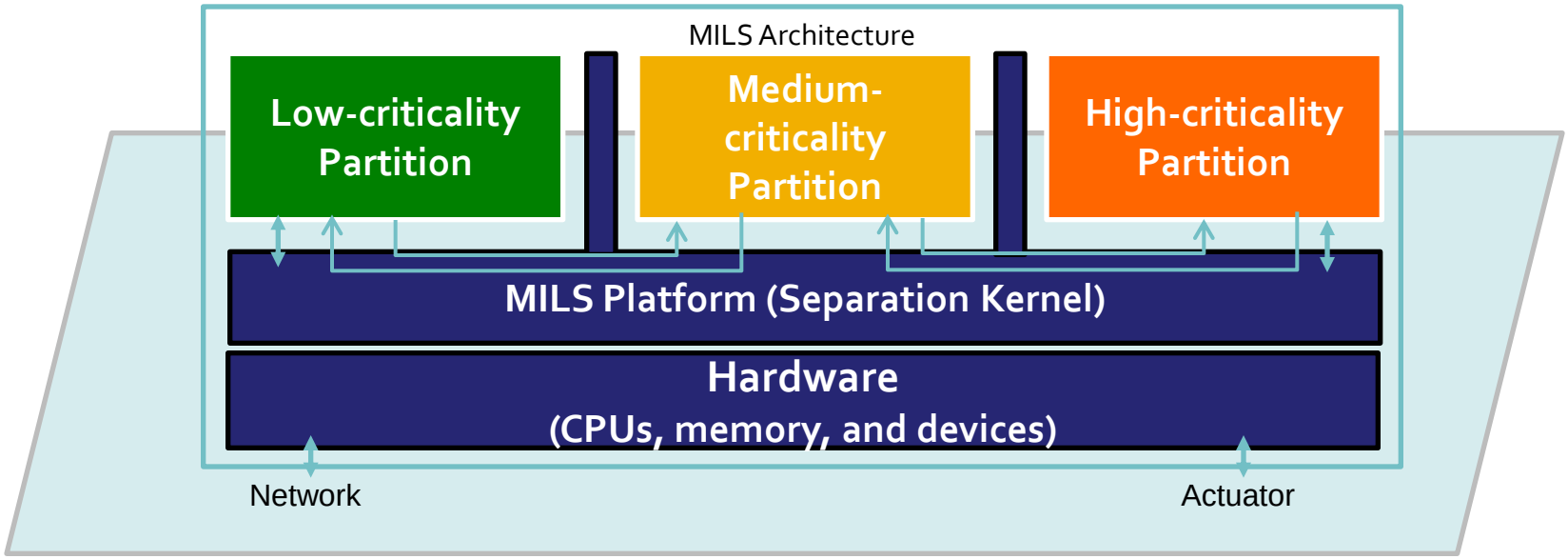
Sketch of a Non-Interfering Composed TOE: consisting of physically separated Component TOEs



Sketch of a Non-Interfering Composed TOE:
same execution environment and direct interaction
(N*(N-1)/2 evidences**)**

Compositional Certification: Scenario 1

- MILS architecture is the enabler for high-assurance compositional certification
- The core is Separation Kernel
- Components under certified composition
  - Hardware, Separation kernel, Applications



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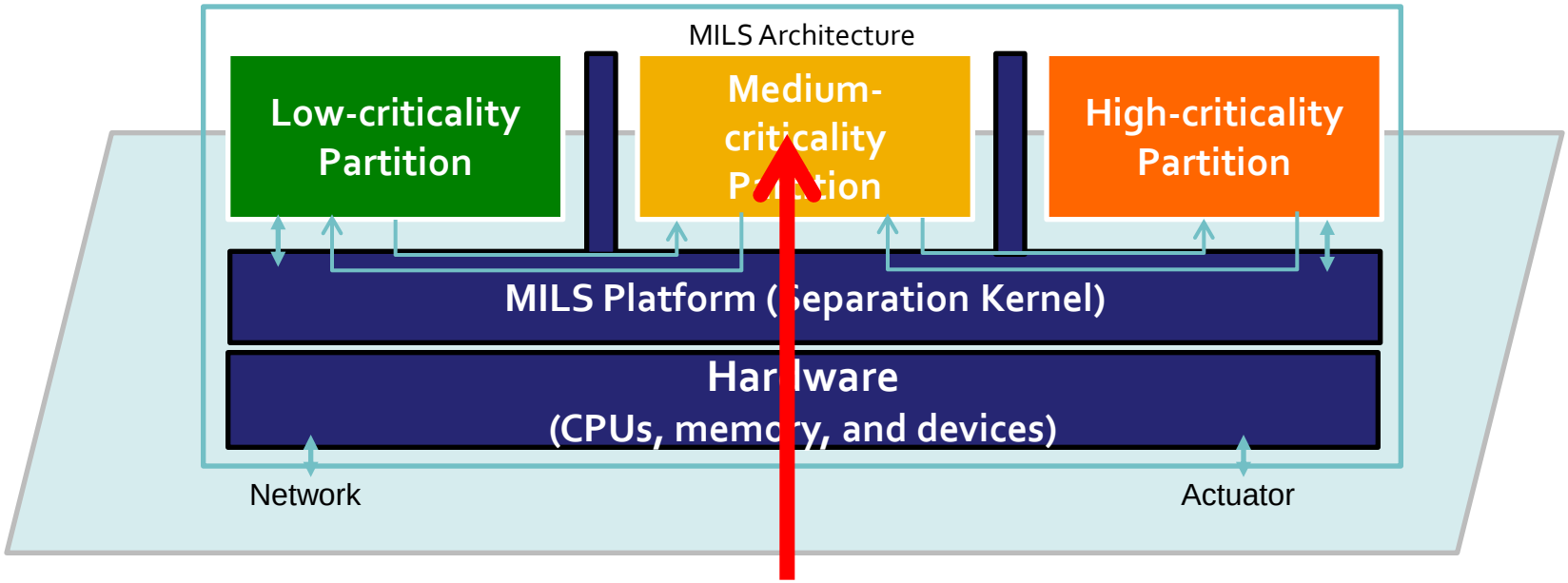

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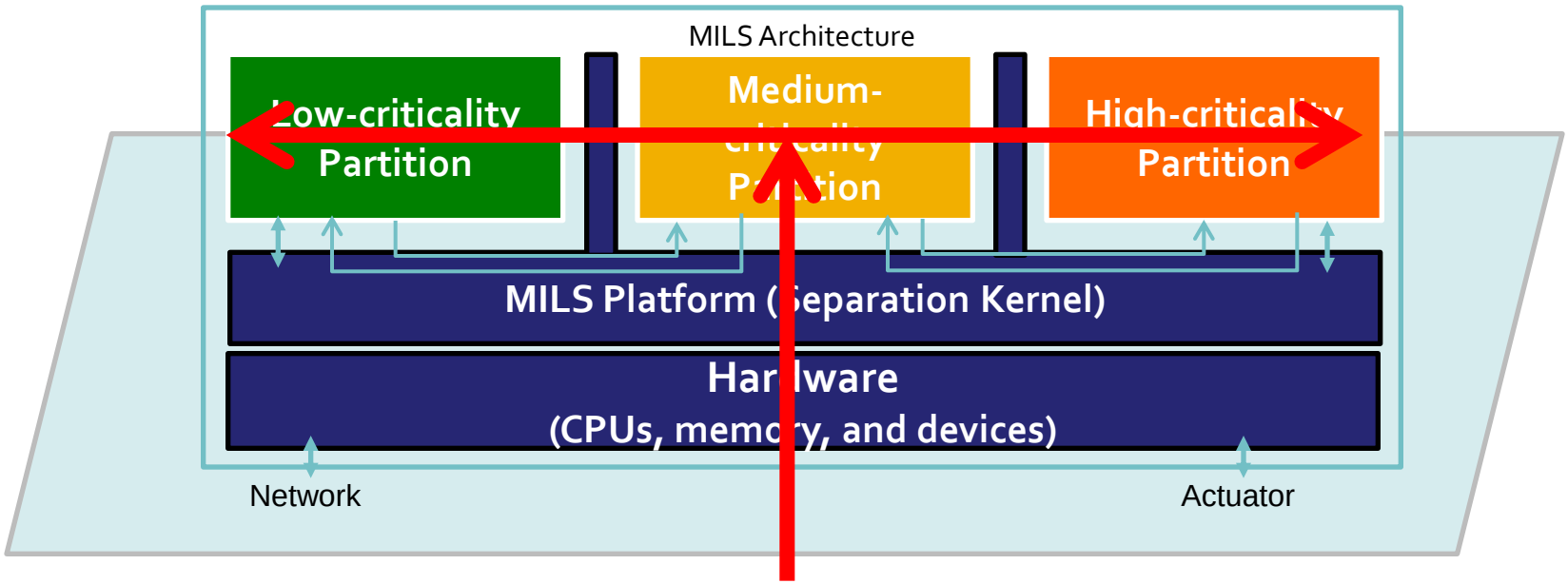
T - composition



Compositional Certification: Scenario-I

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