WP1

Interoperability automation considered as machine learning tasks

LEADERS

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INTERACTION WITH OTHER WPs, Tasks, UCs

Complementary to the interoperability methods and tools developed by FCT/UNL and HIO in WP1.

OBJECTIVES

Automated on-demand interoperability between services in Industry4.0 and the IIoT based on machine learning.

Complement to information-model standardisation in applications where standard diversification, complexity, latency and human resources are limiting factors.

Engineers should focus on system of systems goals and constraints in terms of cost or reward function. Generate translators between information models by optimization.

Mapping of the semantic interoperability problem to formal machine learning tasks

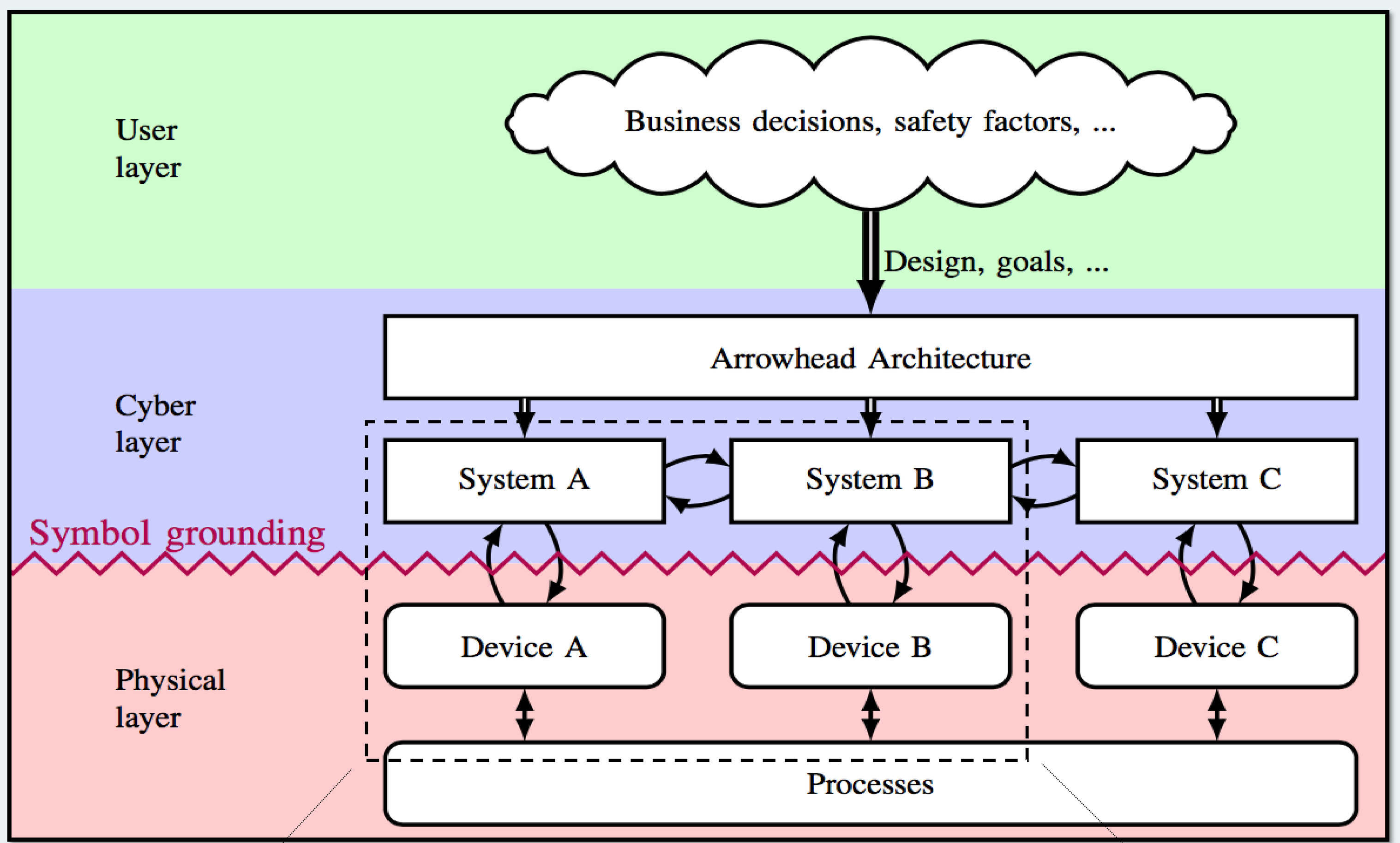
INTEROPERABILITY CHALLENGES

Modern large-scale automation systems integrate thousands to hundreds of thousands of physical sensors and actuators.

Heterogeneous data-scape formed because manufacturers use different standards and information models, which makes flexible on-demand reconfiguration and optimization difficult.

Symbolic reasoners do not generalise reliably. Integration of metadata with subsymbolic representations grounded in data streams or big auxiliary datasets required.

An interoperability solution also needs to be interpretable by engineers in some particular domain, where system goals, parameters and constraints are defined and verified.



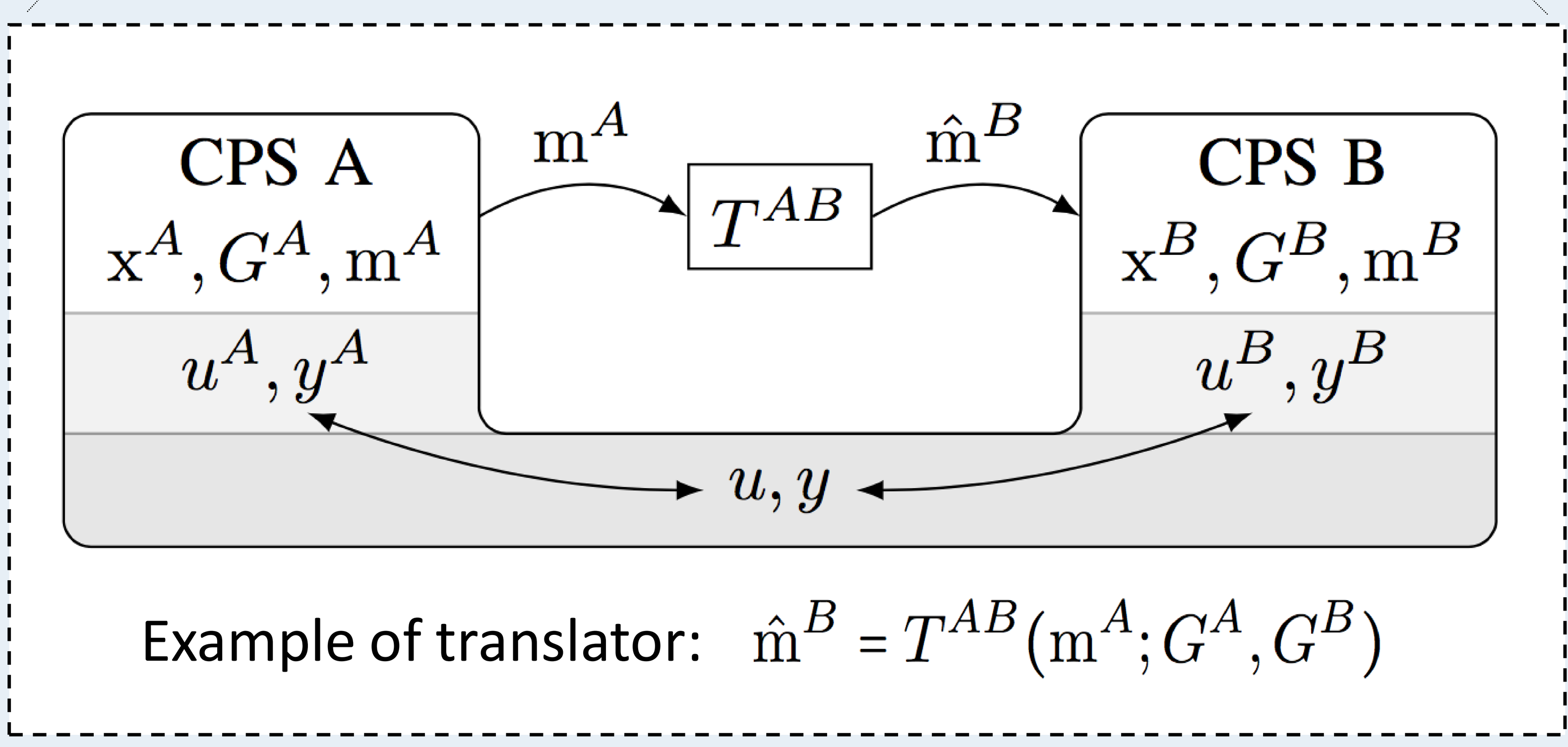
TRANSLATOR-BASED INTEROPERABILITY MODEL

Environment with inputs u and outputs y defines the context (physical, digital twin, or cyber artefact in ISA-95 triangle).

A cyber-physical system (CPS A) affects a subset of u via actuators u^A and senses a subset of y via sensors y^A. Similarly for CPS B.

CPS A also has internal states x^A, metainformation G^A in RDF format and an encoder for messages m^A. Similarly for CPS B.

Translator T^{AB} learned by optimizing auxiliary function $J(y^A, y^B)$.



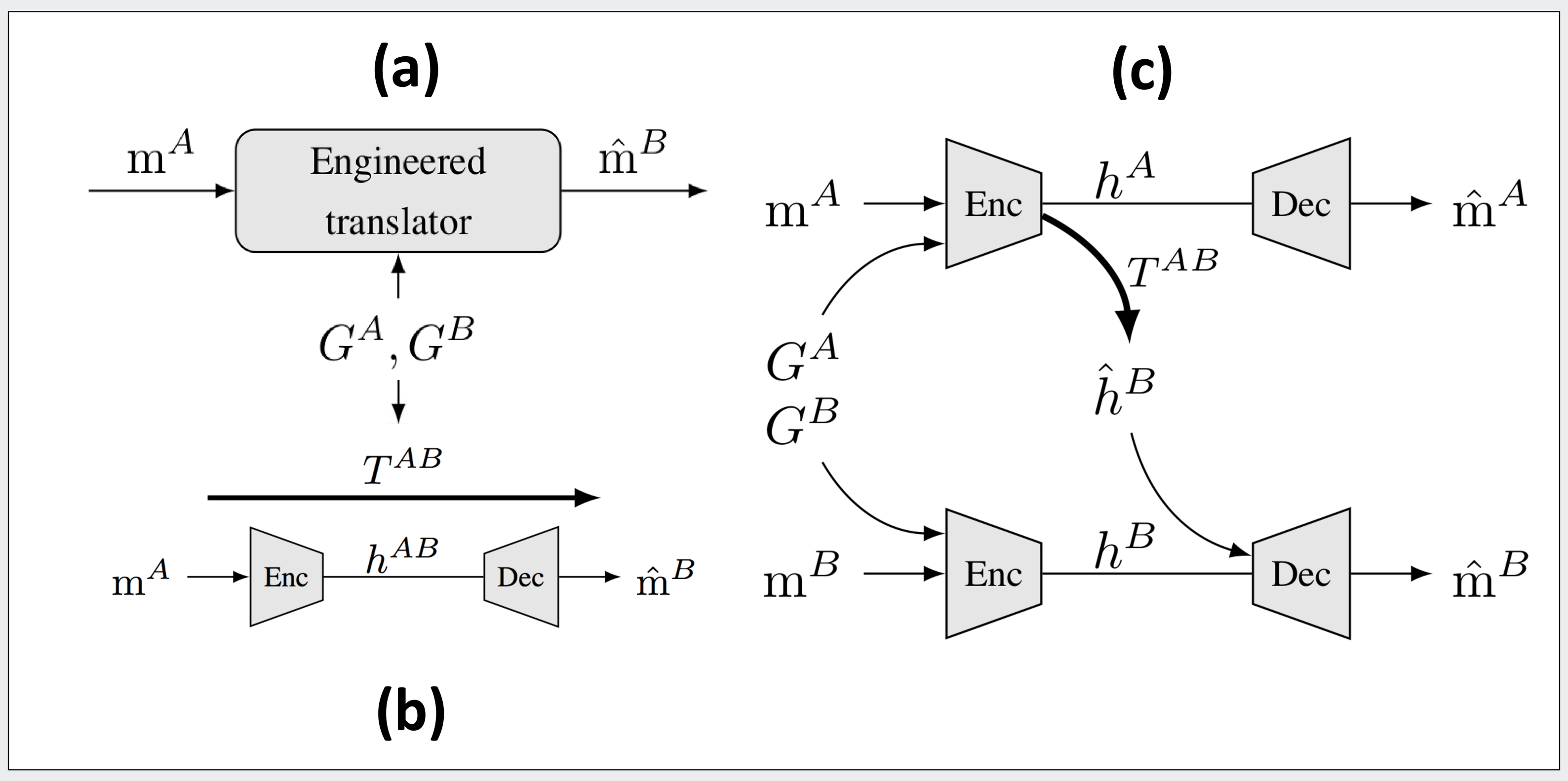
SEMANTIC INTEROPERABILITY

a) Engineers map symbolic metainformation to generate translator. Limited scalability and generalisation: Costly. Deployment delay.

DYNAMIC / OPERATIONAL INTEROPERABILITY

b) Subsymbolic mapping of metainformation using auxilliary data for online ontology alignment, or end-to-end translator learning.

c) Unsupervised learning of autoencoders with correlation/goal-based translator learning across representational systems.



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