Future Directions on Models of Architecture

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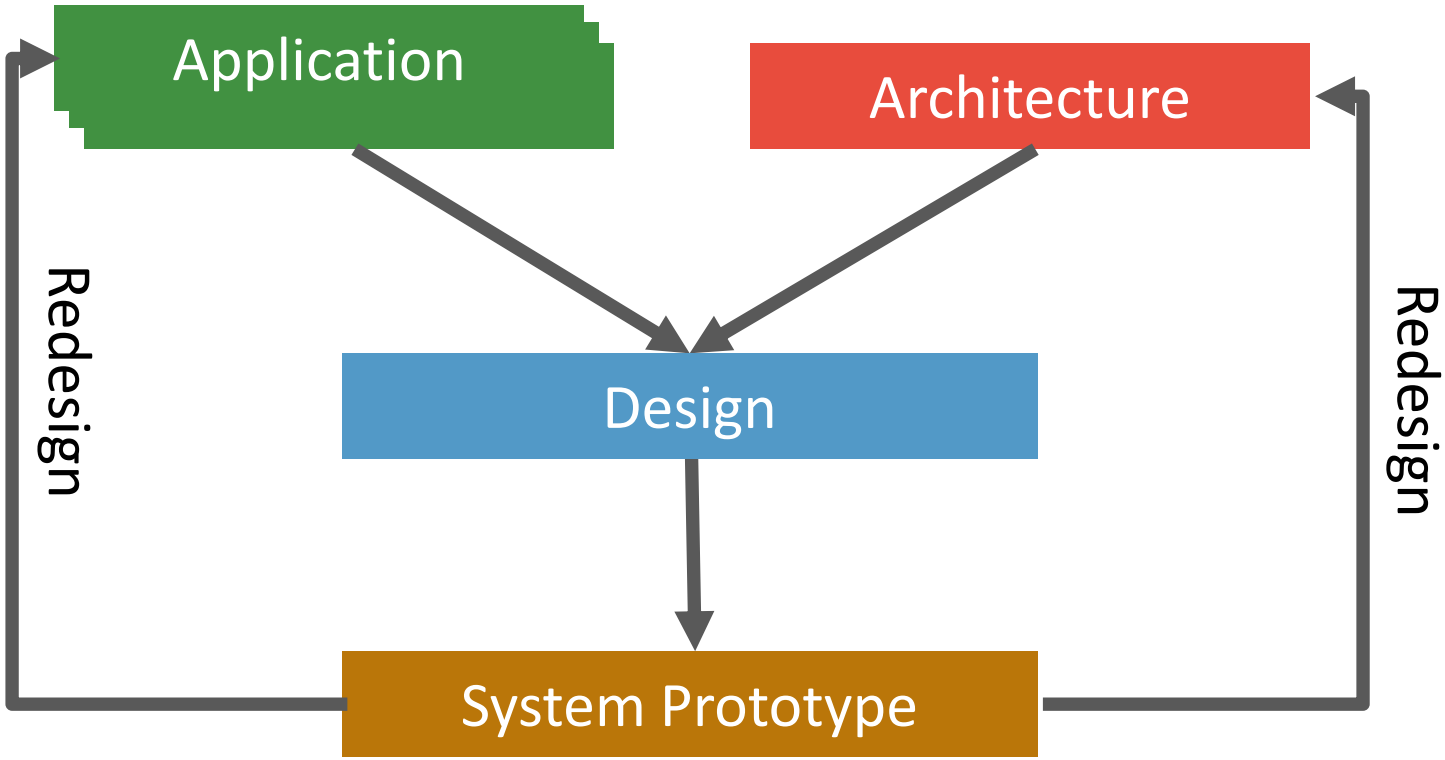
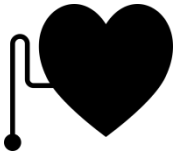
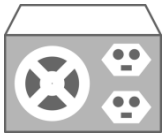
System Design: Y-Chart



System Objectives

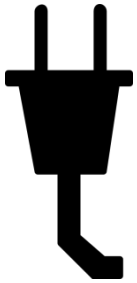


Reliability



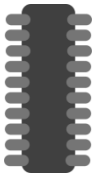
Peak Power

T°C



Energy

Performance



Memory

Security

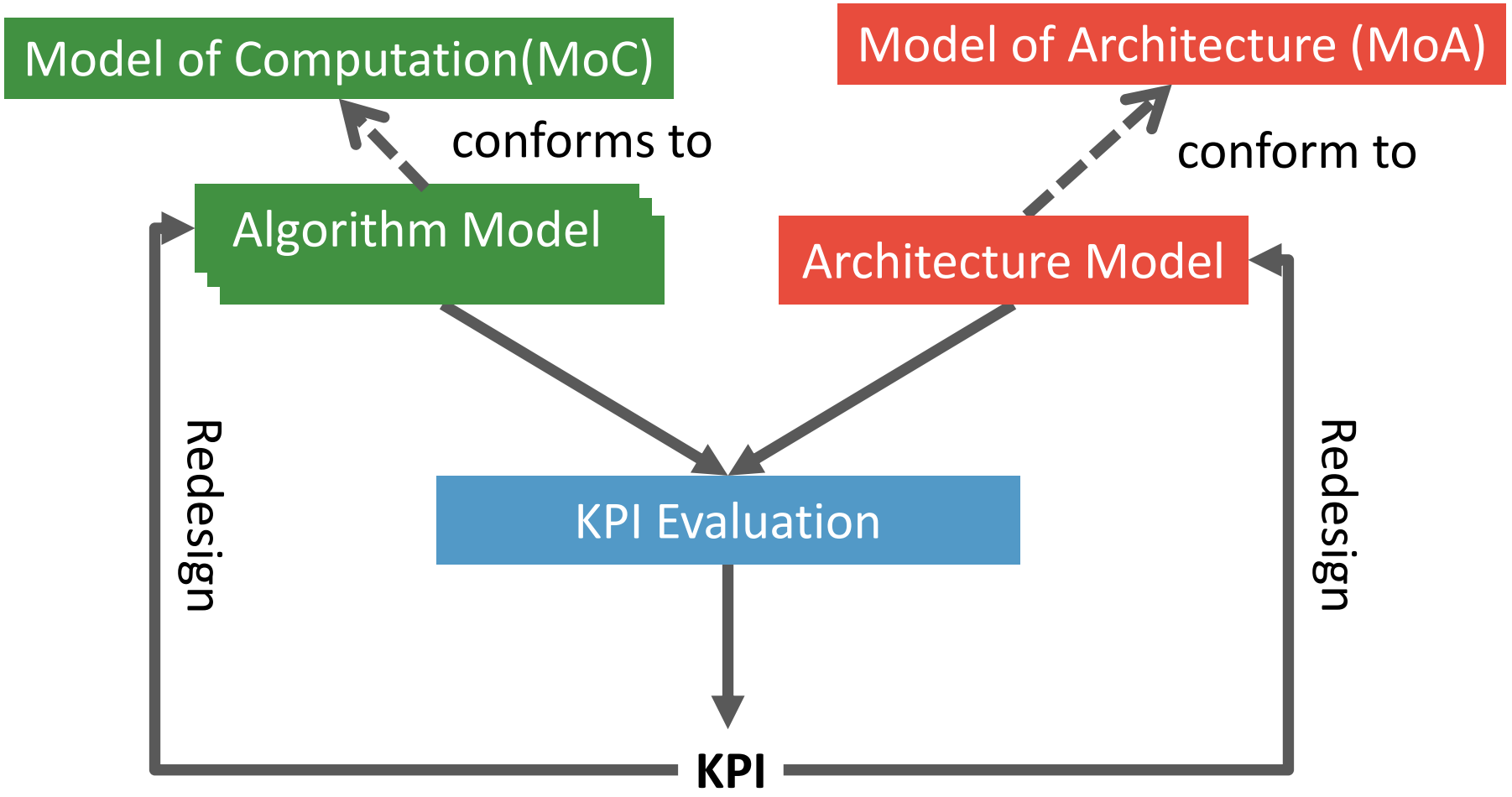
$

Unit Cost

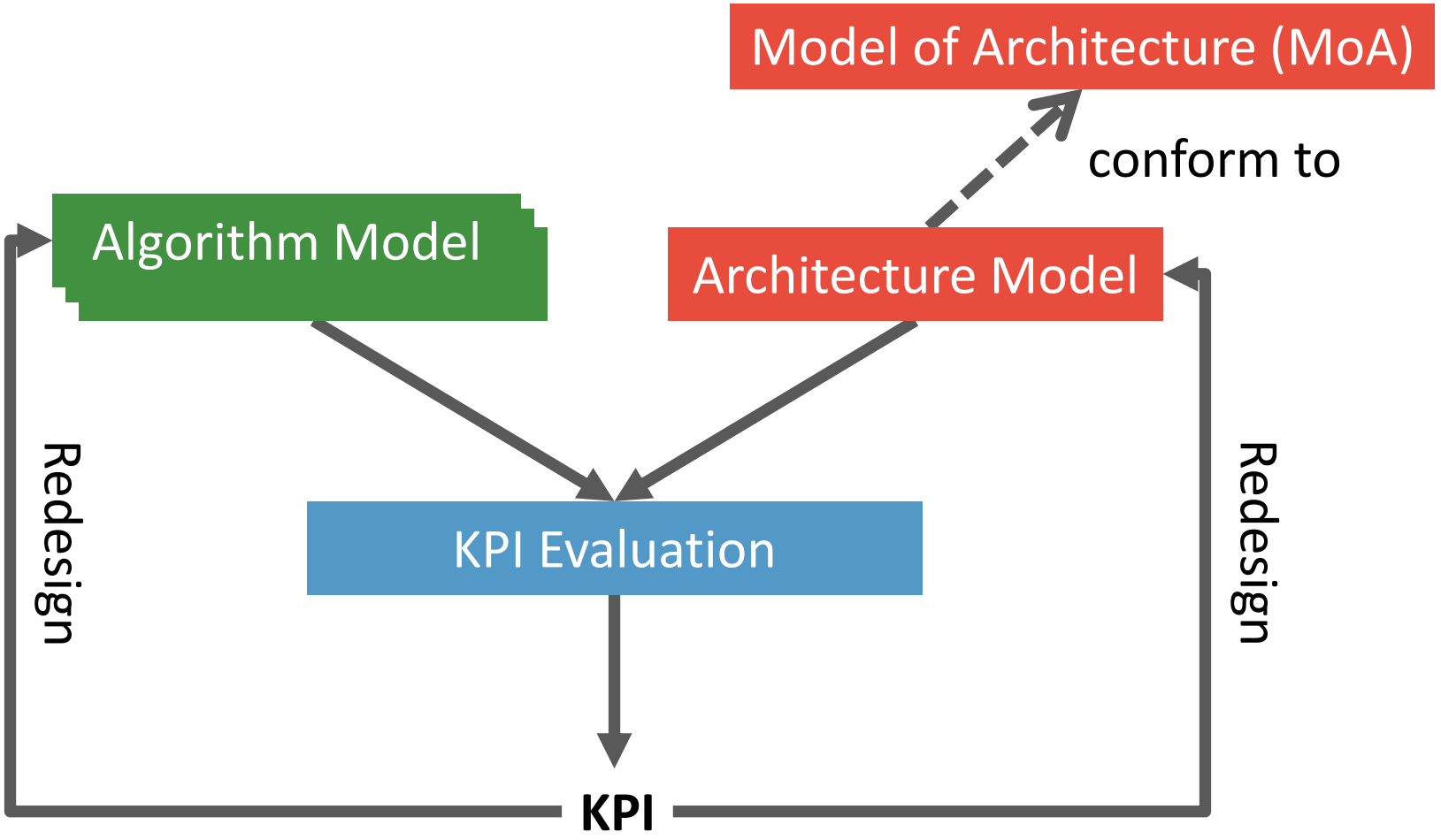
$

Maintenance Cost

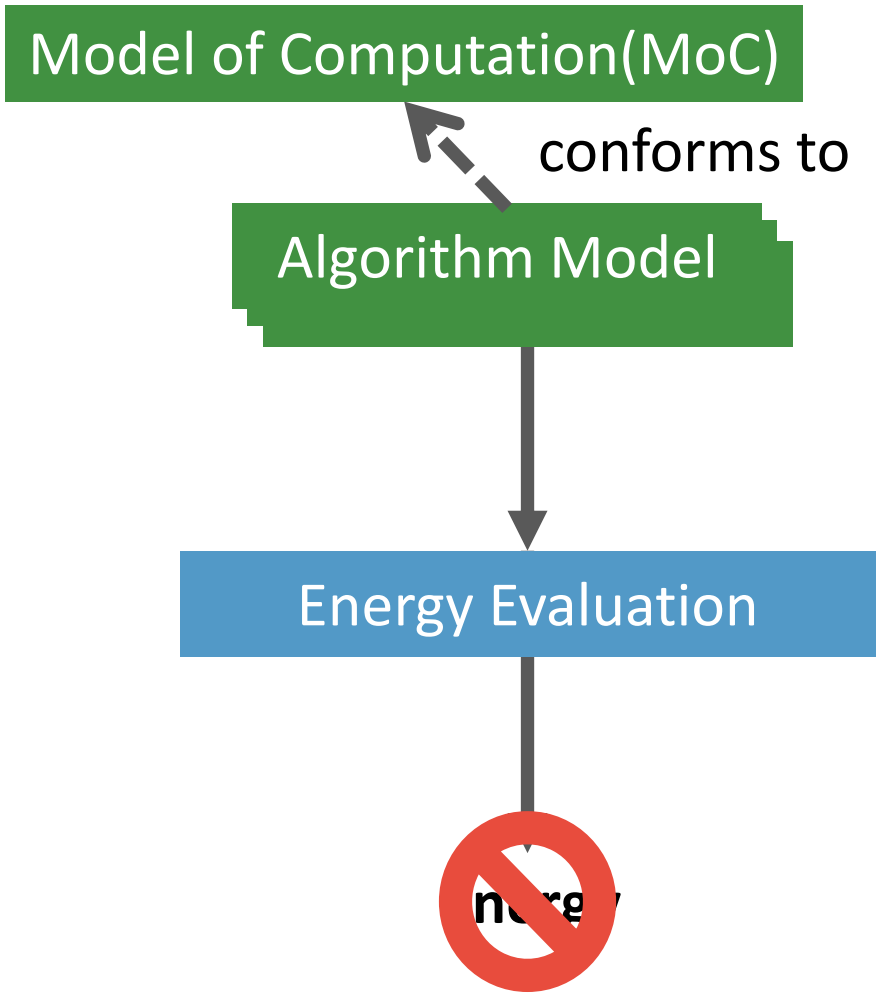
Model-Based Design



Models of Architecture



MoC is not sufficient



Problem: Predict System Quality

- How to predict a DSP system quality ?
  - **Efficiently (simple procedure)**
  - **Early (from abstract models)**
  - **Accurately (with a good fidelity)**
  - **With reproducibility (same models = same prediction)**

Model of Architecture

- Definition
  - **Model of a system Non-Functional Property**
  - **Application-independent**
  - **Abstract**
  - **Reproducible**

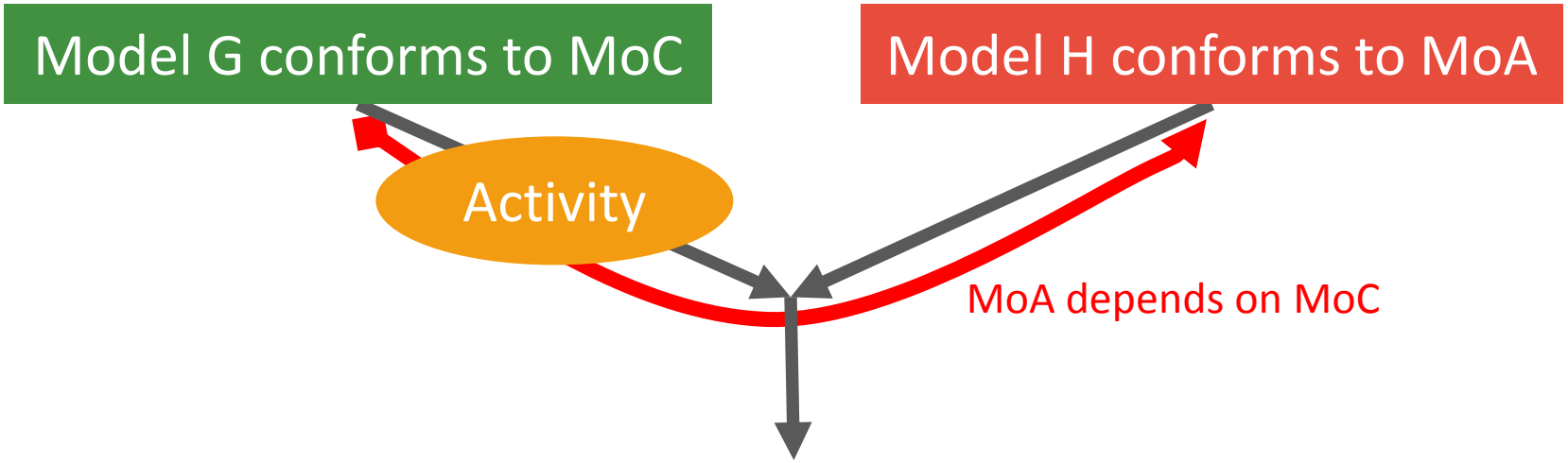
Pelcat, M; Mercat, A; Desnos, K; Maggiani, L; Liu, Y; Heulot, J; Nezan, J-F; Hamidouche, W; Ménard, D; Bhattacharyya, S (2017) "Reproducible Evaluation of System Efficiency with a Model of Architecture: From Theory to Practice", IEEE TCAD.

Pelcat, M (2018) "Models of Architecture for DSP Systems", Handbook of Signal Processing Systems, Third Edition, S. S. Bhattacharyya, E. F. Deprettere, R. Leupers , J. Takala, Springer.

Model of Architecture

Model	Reproducible	Application-independent	Abstract
AADL	☑	☒	☒
MCA SHIM	☒	☒	☒
UML MARTE	☒	☑ / ☒	☒
AAA	☒	☑	☒
CHARMED	☒	☑	☒
S-LAM	☒	☑	☒
MAPS	☒	☑	☒
LSLA	☑	☑	☑

Model of Architecture

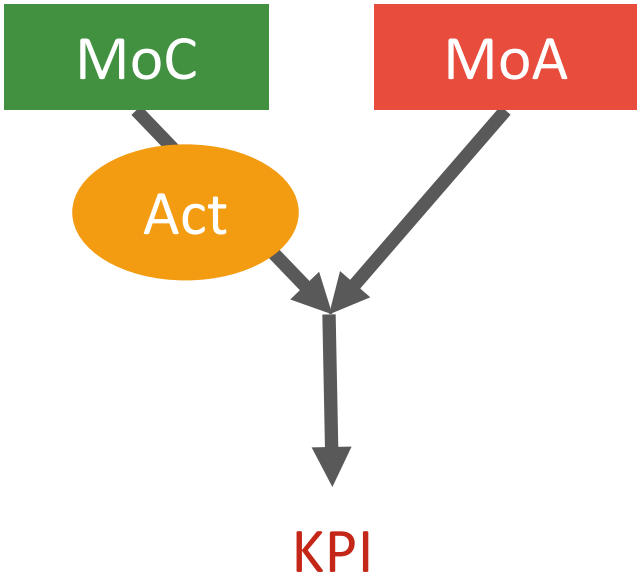


One and always the same quality evaluation

Reliability Power
Energy Performance Memory
Security T°C
Cost

= **MoA(activity(MoC(application)))**

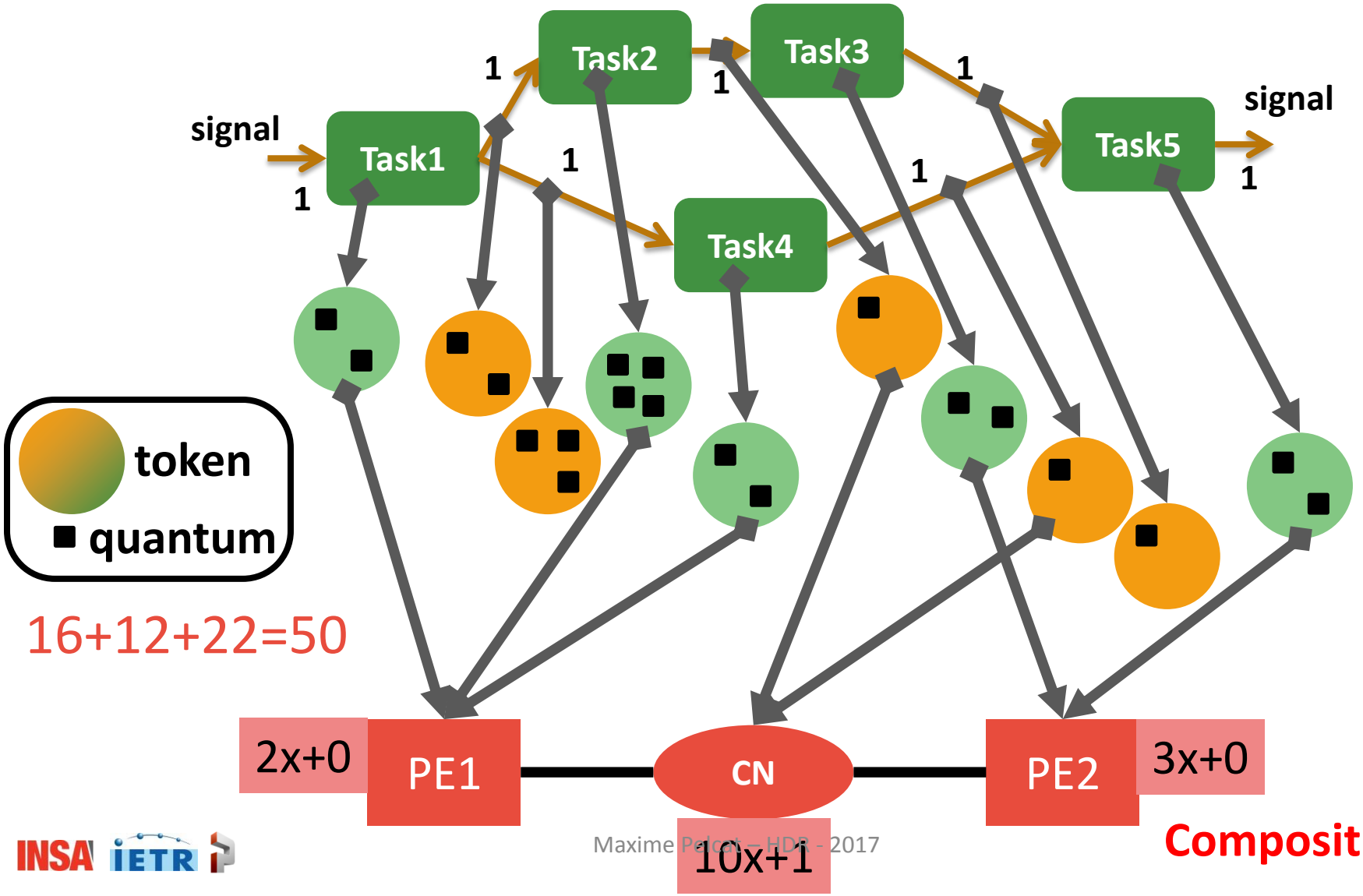
Model of Architecture



LSLA: First MoA

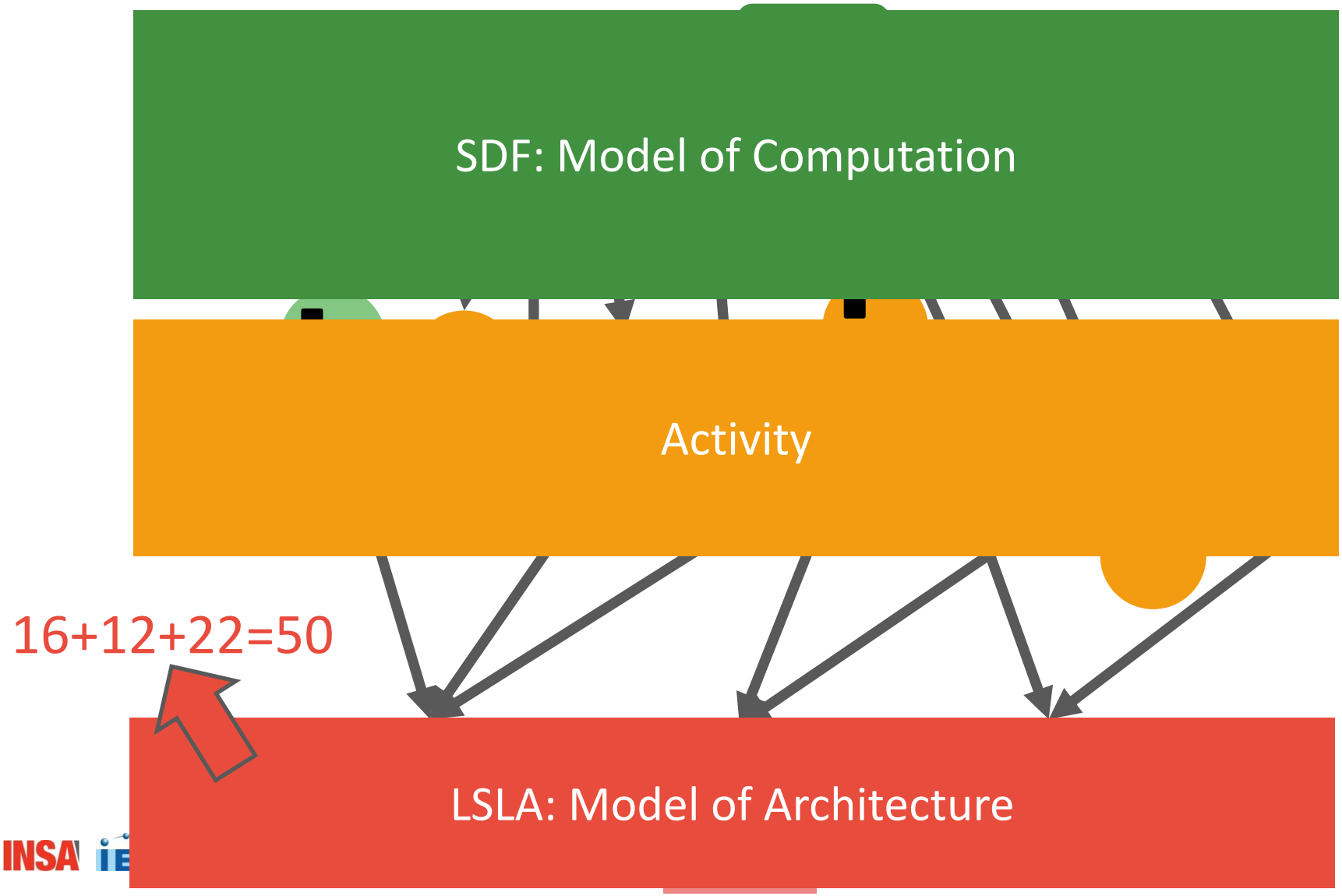
- LSLA = Linear System-Level Architecture Model
- Motivated by the additive nature of energy consumption

LSLA Model of Architecture



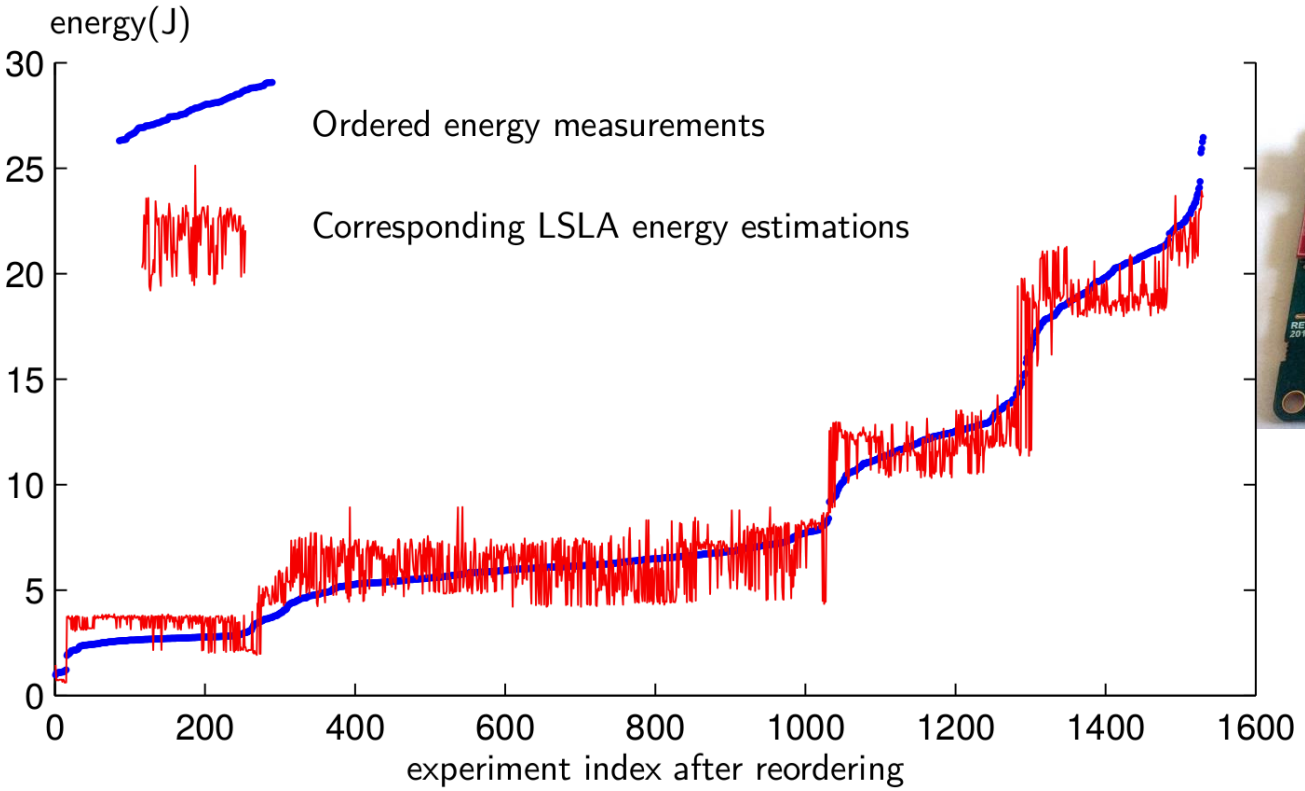
Compositional

LSLA Model of Architecture



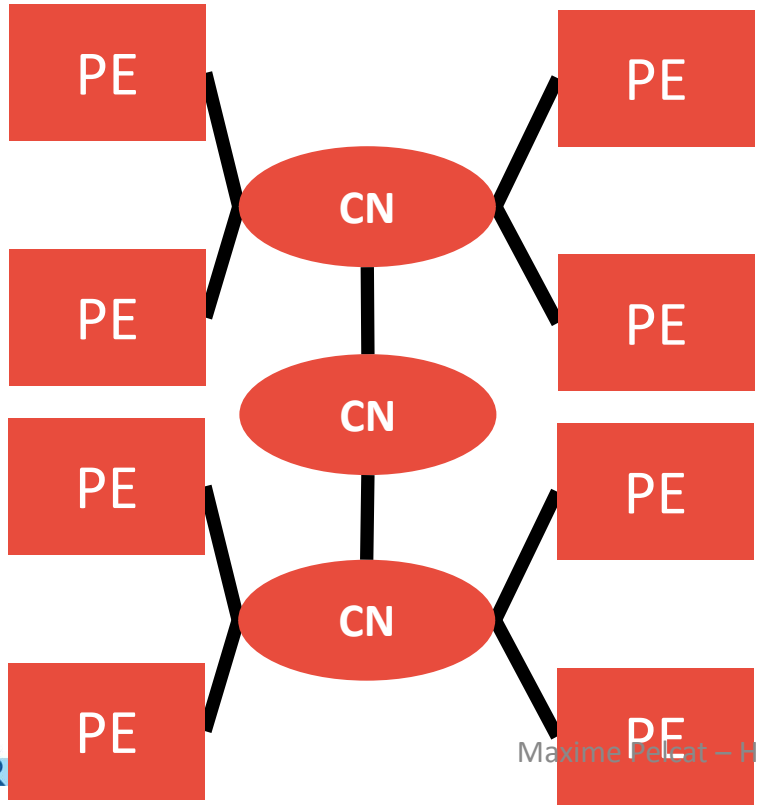
LSLA MoA for Energy Prediction

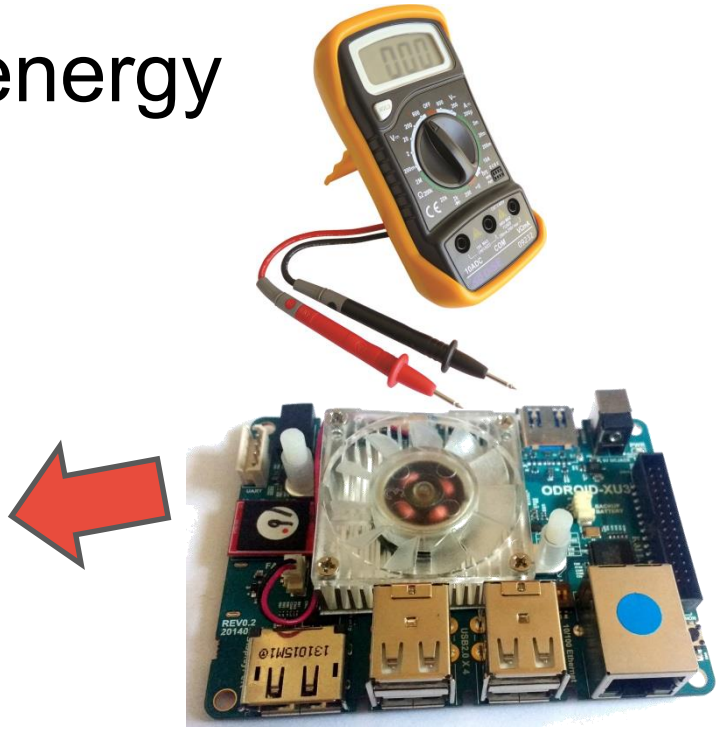
- 86% of fidelity on octo-core ARM ☺



LSLA MoA for Energy Prediction

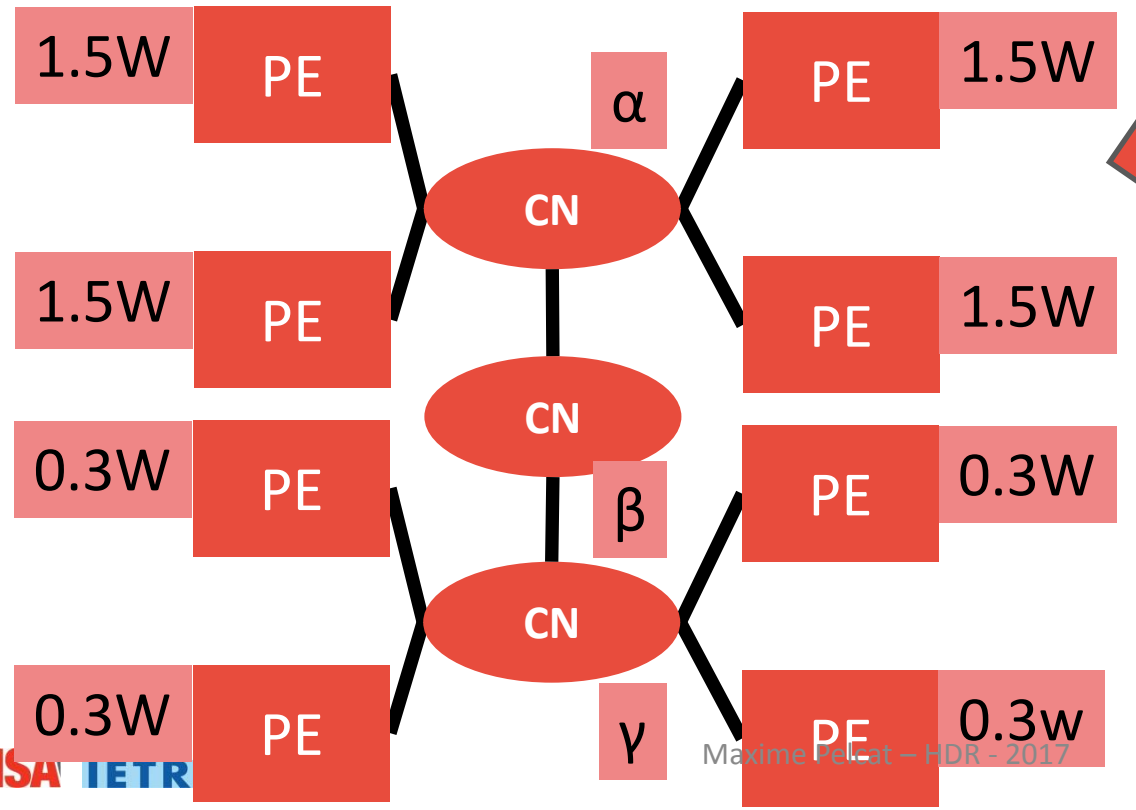
- The model is learnt from energy measurements

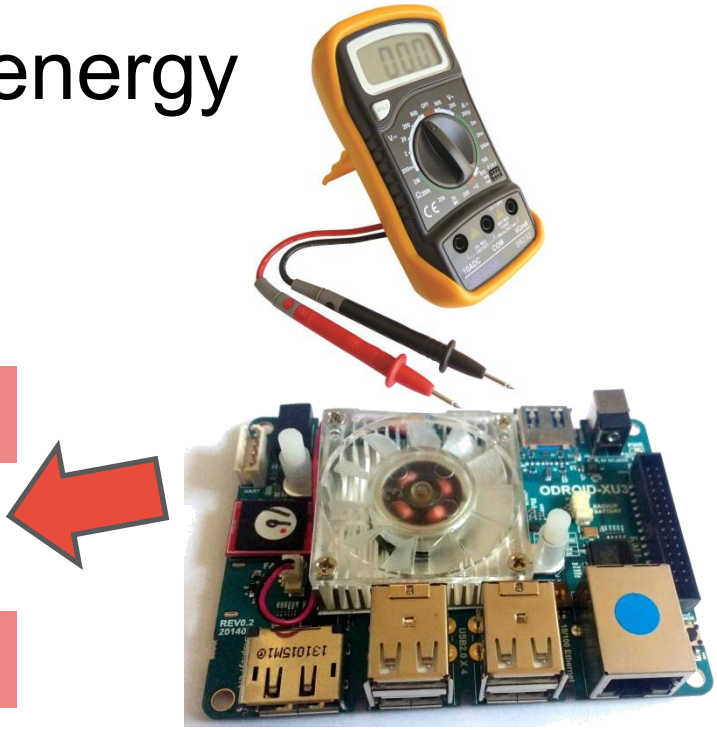




LSLA MoA for Energy Prediction

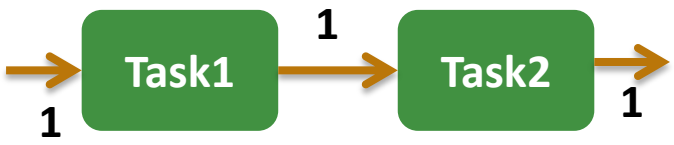
- The model is **learnt** from energy measurements



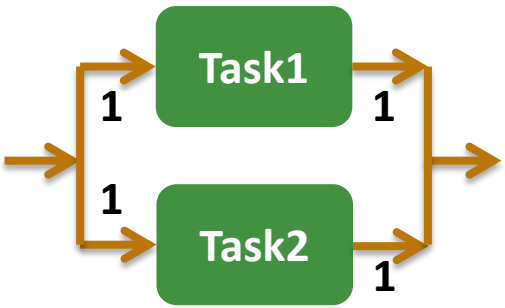


MoAs: Limits of LSLA

- Energy ☑ ← Linear model OK
- Latency ⚠
- Latency does not have an additive nature

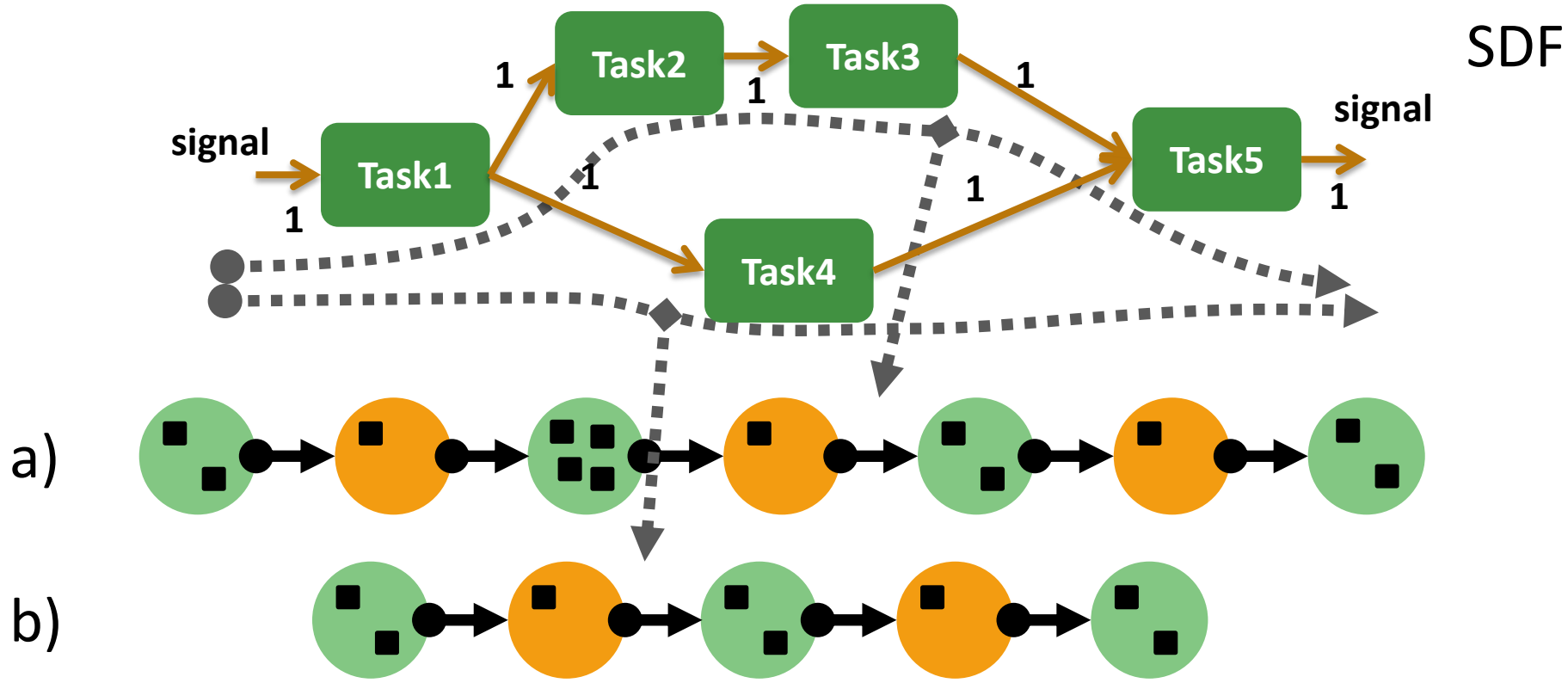


Latency = sum

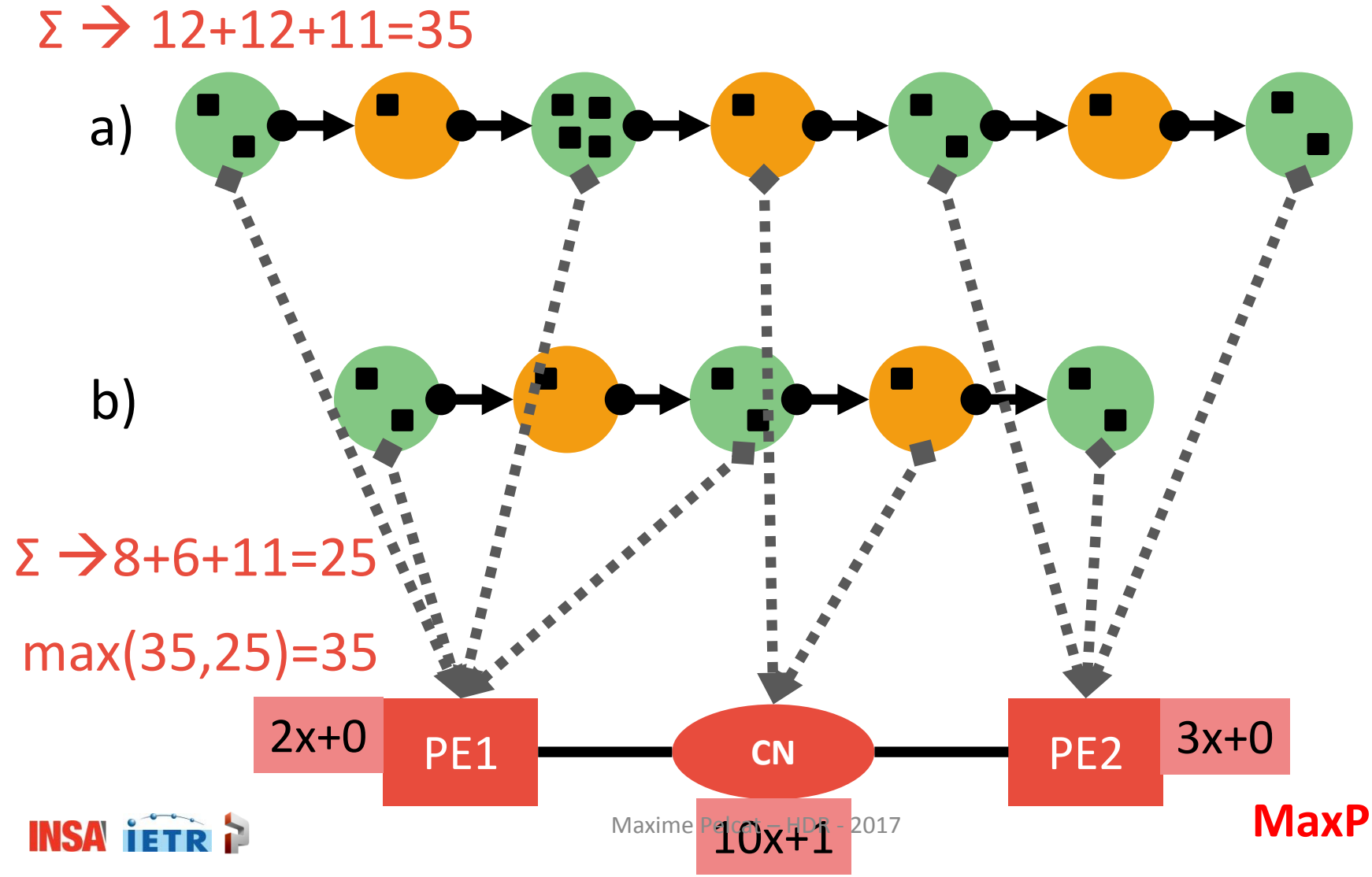


Latency = max

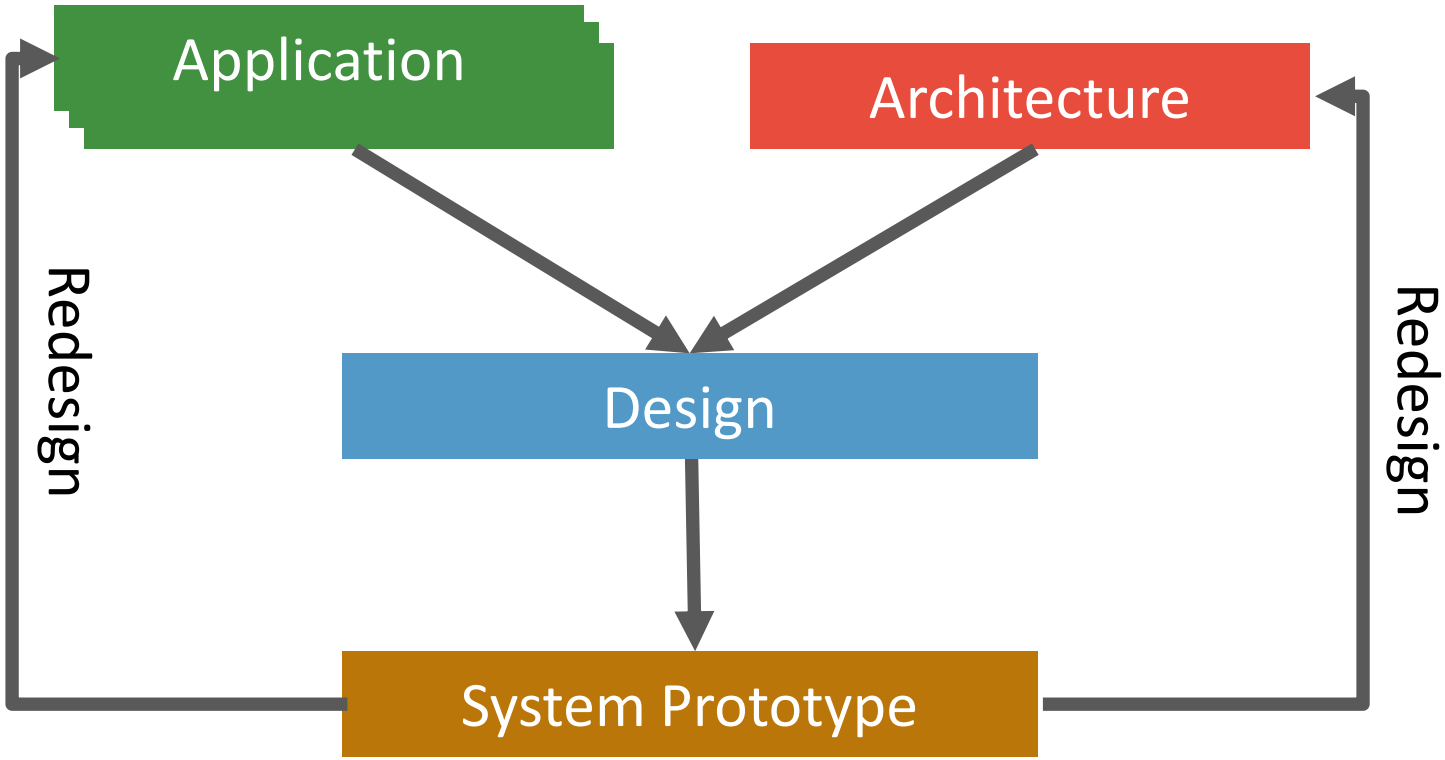
Activity & MoA for Latency



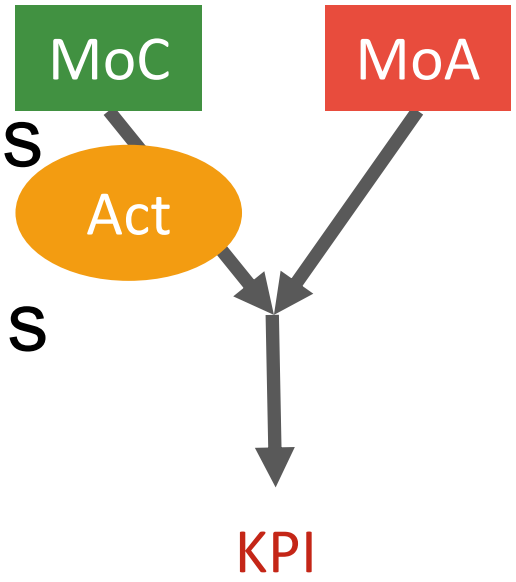
Activity & MoA for Latency



Accuracy?? No! Fidelity!!



Directions for Research on MoA



- Try existing models on new KPIs
- Create new models for new KPIs
  - **—When existing ones do not match**
- Co-explore MoAs - multi-objective optim.
- Learn more complex, non-linear models