Cyber Physical Systems
enabling technologies perspective and more…

CPS Summer School – Creative Lab

19 September 2022

POLITECNICO MILANO 1863
NECST laboratory

Marco D. Santambrogio
<marco.santambrogio@polimi.it>
Politecnico di Milano

POLITECNICO
MILANO 1863

Who am I?

Marco Santambrogio
marco.santambrogio@polimi.it
aka Santa

CYBER PHYSICAL SYSTEMS ARE…

LITTLE…

CYBER PHYSICAL SYSTEMS ARE…

LITTLE…

LITTLE+big

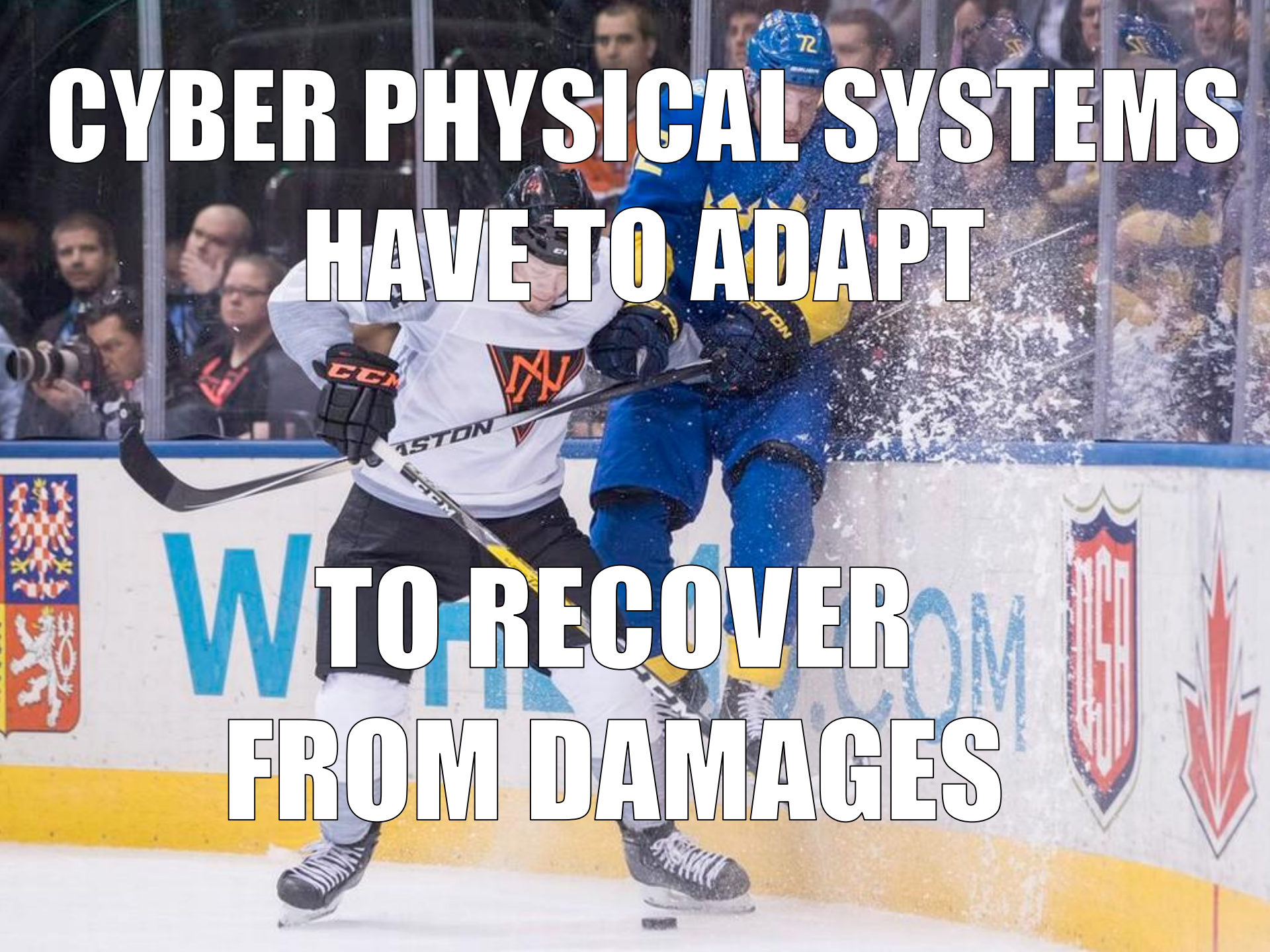
CYBER PHYSICAL SYSTEMS ARE…

LITTLE…

LITTLE+big

LITTLE+big and heterogeneous

Things they have in common?


CYBER PHYSICAL SYSTEMS
HAVE TO ADAPT
TO RECOVER
FROM DAMAGES

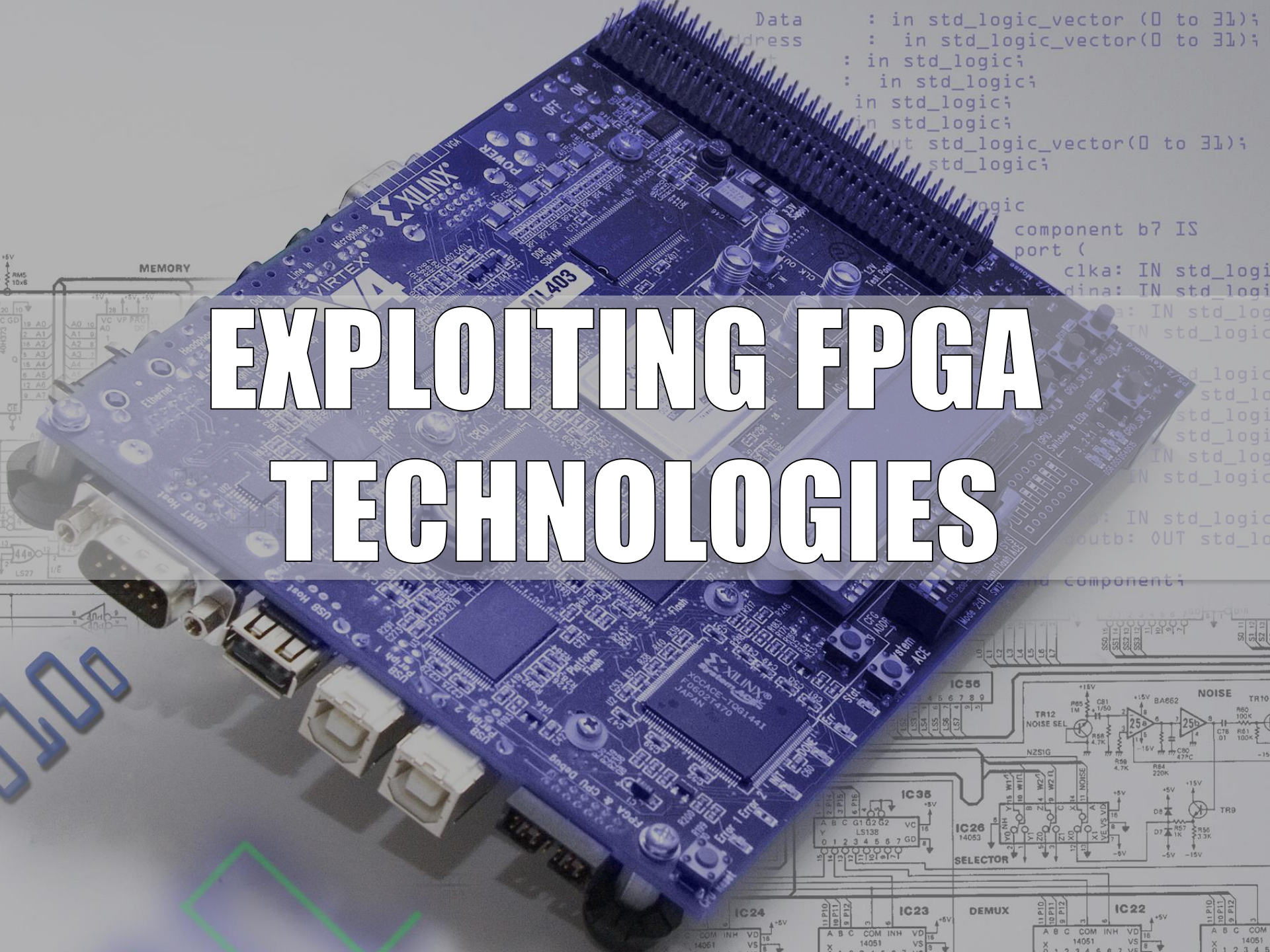
CYBER PHYSICAL SYSTEMS HAVE TO ADAPT

TO GUARANTEE SERVICES OVER POWER CAP AND ENERGY SAVINGS


CYBER PHYSICAL SYSTEMS
HAVE TO ADAPT
TO DEAL WITH...

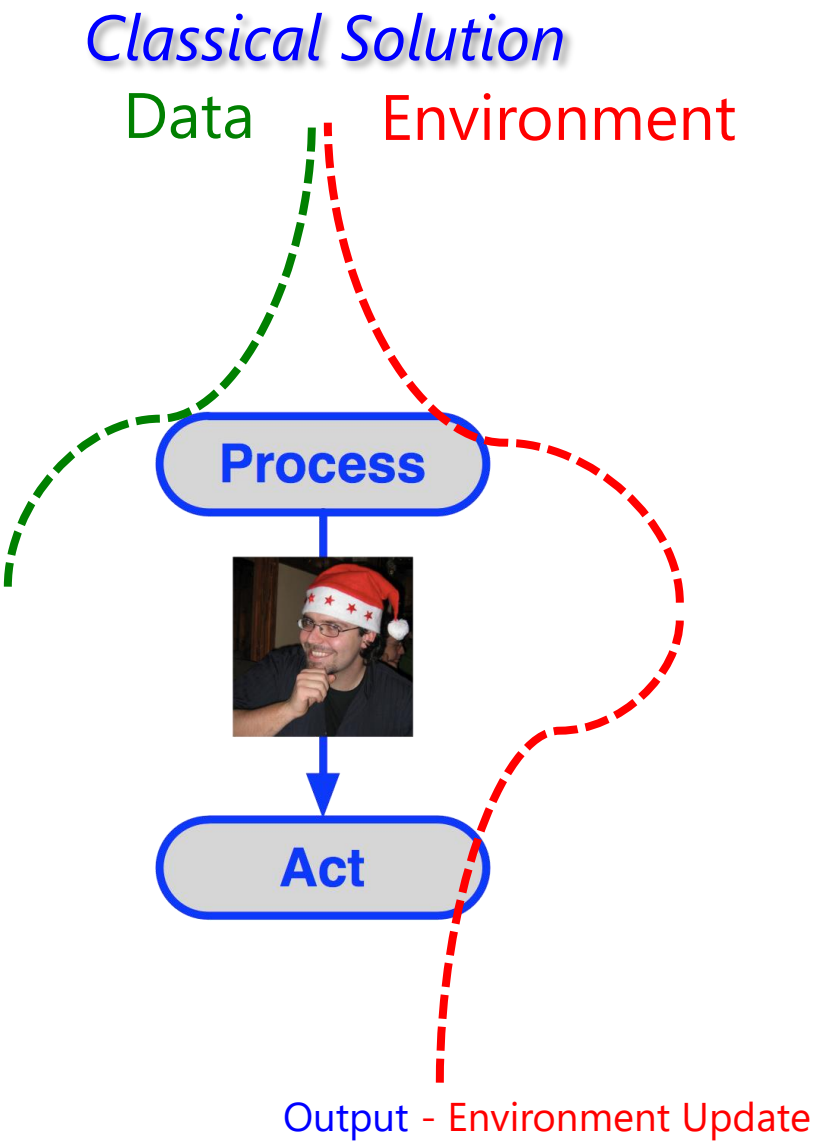

CYBER PHYSICAL SYSTEMS
HAVE TO ADAPT
TO DEAL WITH...
UKNOWN CONDITIONS

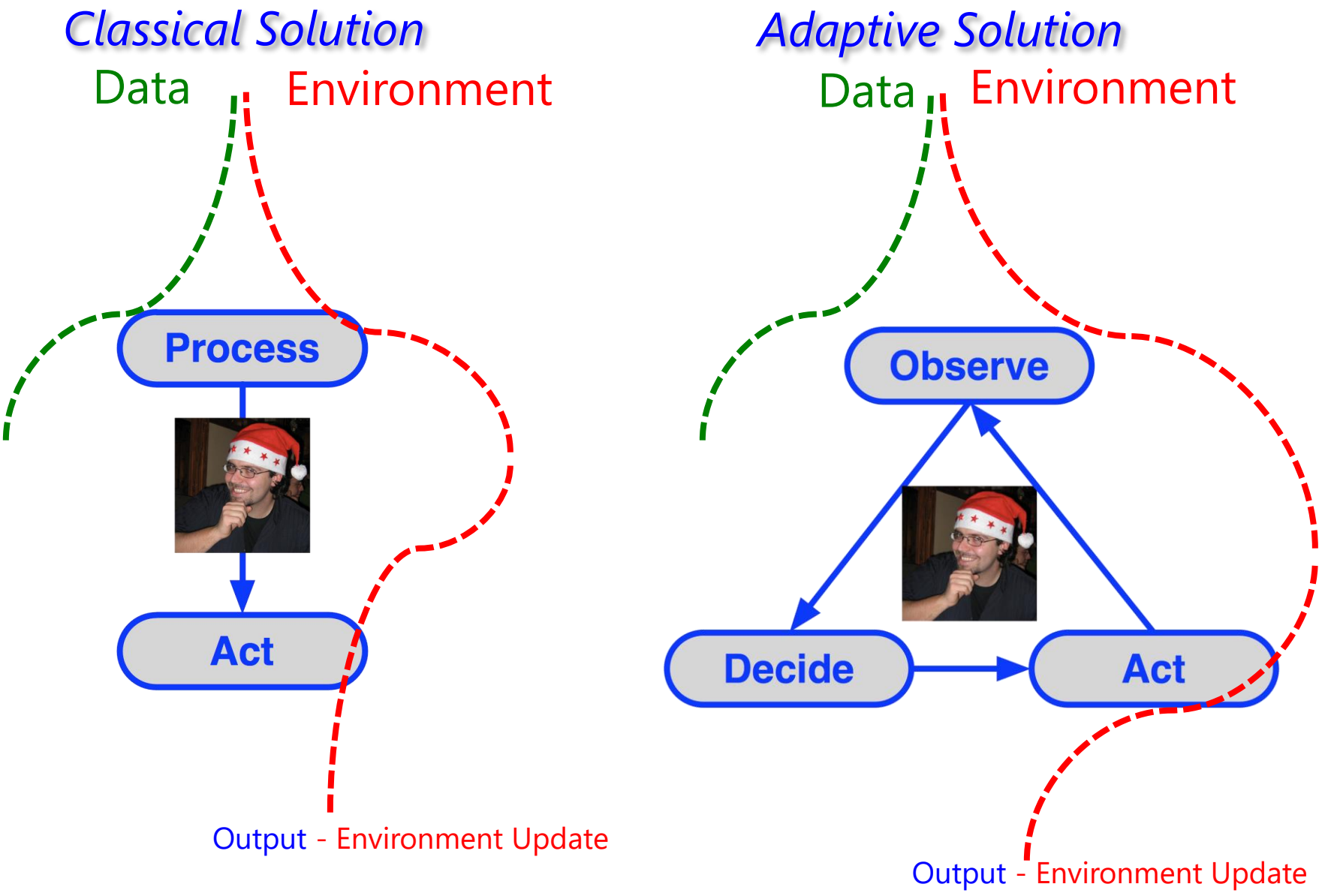

A VIABLE SOLUTION
TO REALIZE THIS CPS VISION

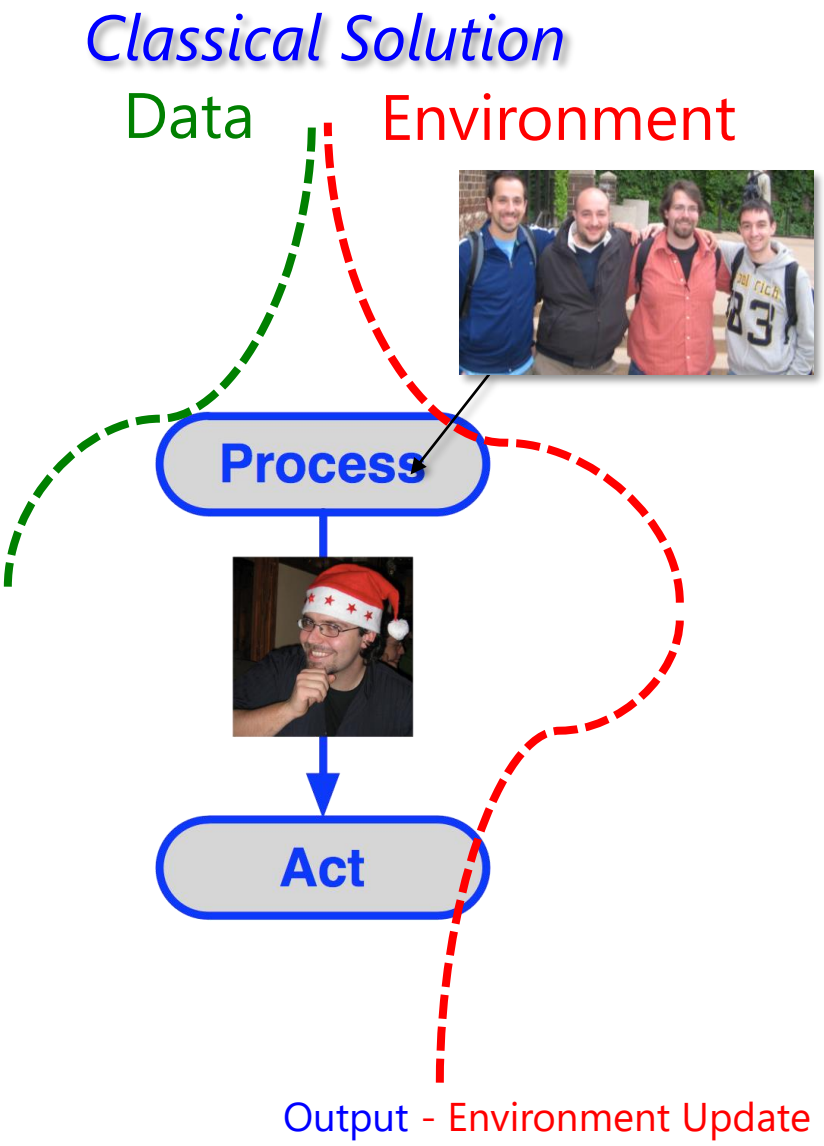

EXPLOITING FPGA
TECHNOLOGIES

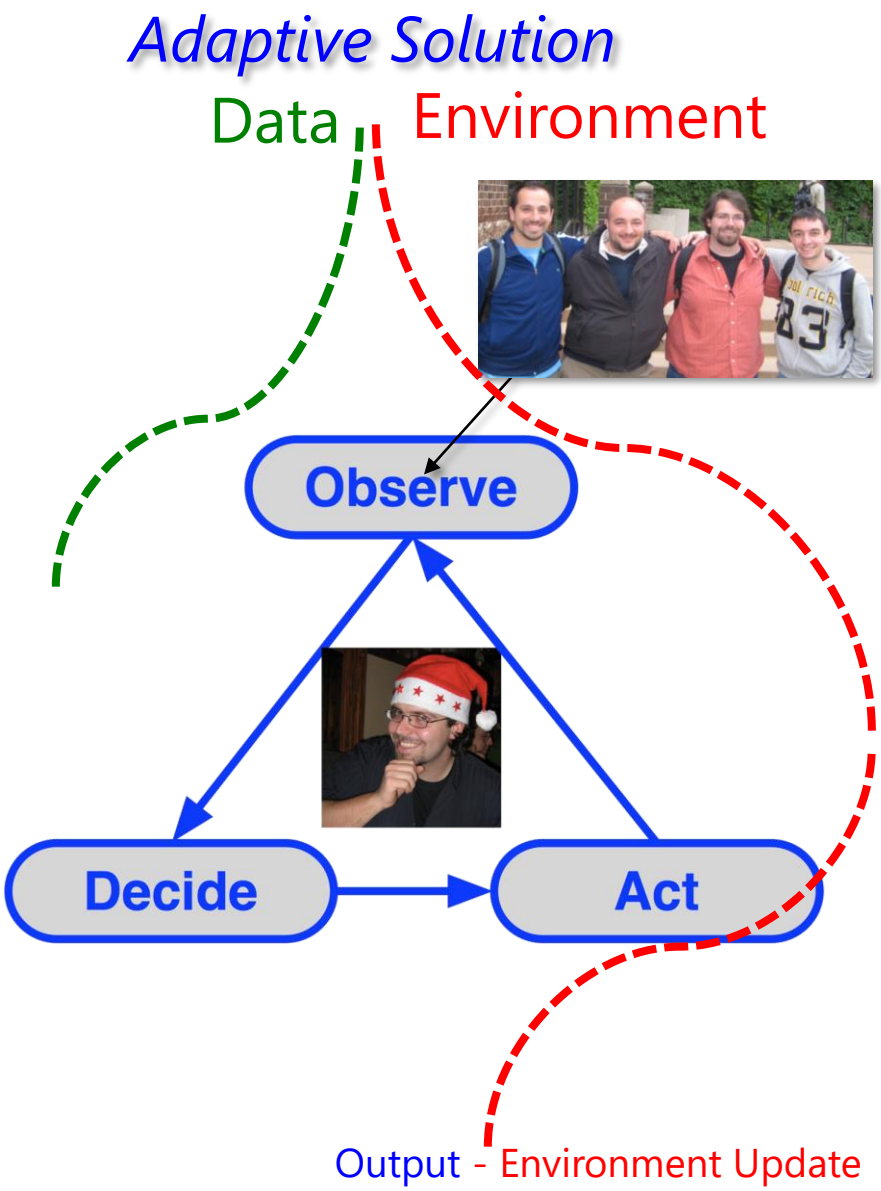

AN ADAPTIVE-FRIENDLY
ECOSYSTEM IS NEEDED

How to adapt?


Classical Solution
Data
Environment
Process
Act
Output - Environment Update


Classical Solution
Data
Environment
Process
Act
Output - Environment Update
Adaptive Solution
Data
Environment
Observe
Decide
Act
Output - Environment Update


Classical Solution
Data
Environment
Process
Act
Output - Environment Update


Adaptive Solution
Data
Environment
Observe
Decide
Act
Output - Environment Update

Classical Solution

Data

Environment

Process

Act

Output - Environment Update

Adaptive Solution

Data

Environment

Observe

Decide

Act

Output - Environment Update

Classical Solution

Data

Environment

Process

Act

Output - Environment Update

Adaptive Solution

Data

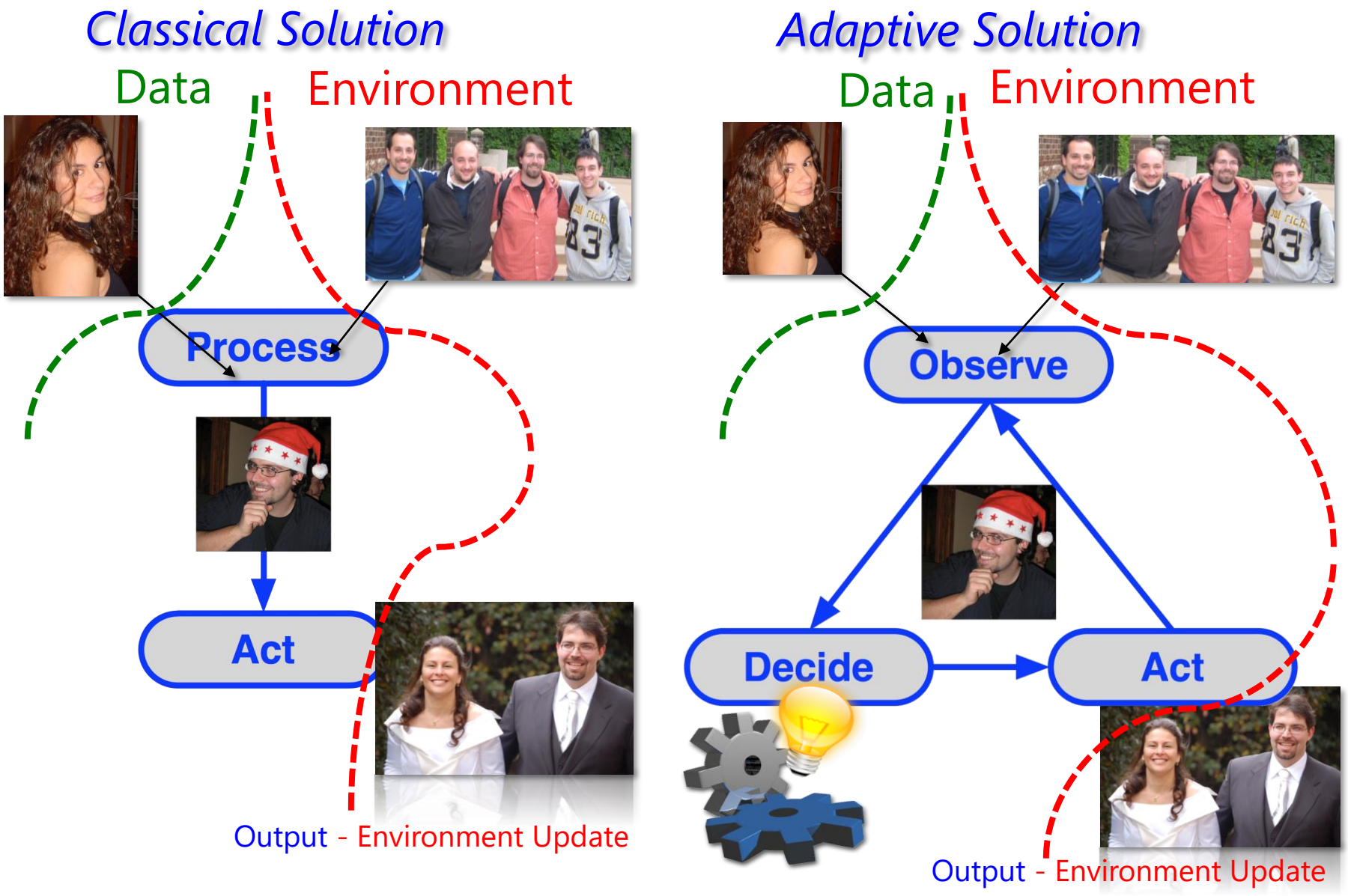
Environment

Observe

Decide

Act

Output - Environment Update


Classical Solution
Data
Environment
Process
Act
Output - Environment Update
Adaptive Solution
Data
Environment
Observe
Decide
Act
Output - Environment Update

Classical Solution

Data

Environment

Process

Act

Output - Environment Update

Adaptive Solution

Data

Environment

Observe

Decide

Act

Output - Environment Update

Classical Solution

Data

Environment

Process

Act

Output - Environment Update

Adaptive Solution

Data

Environment

Observe

Decide

Act

Output - Environment Update

Classical Solution

Data

Environment

Process

Act

Output - Environment Update

Adaptive Solution

Data

Environment

Observe

Decide

Act

Output - Environment Update

Classical Solution

Data

Environment

Process

Act

Output - Environment Update

Adaptive Solution

Data

Environment

Observe

Decide

Act

Output - Environment Update

Adaptive Solutions

Adaptive Solutions

Goal-Oriented

Adaptive Solutions

Goal-Oriented

Approximate

Adaptive Solutions

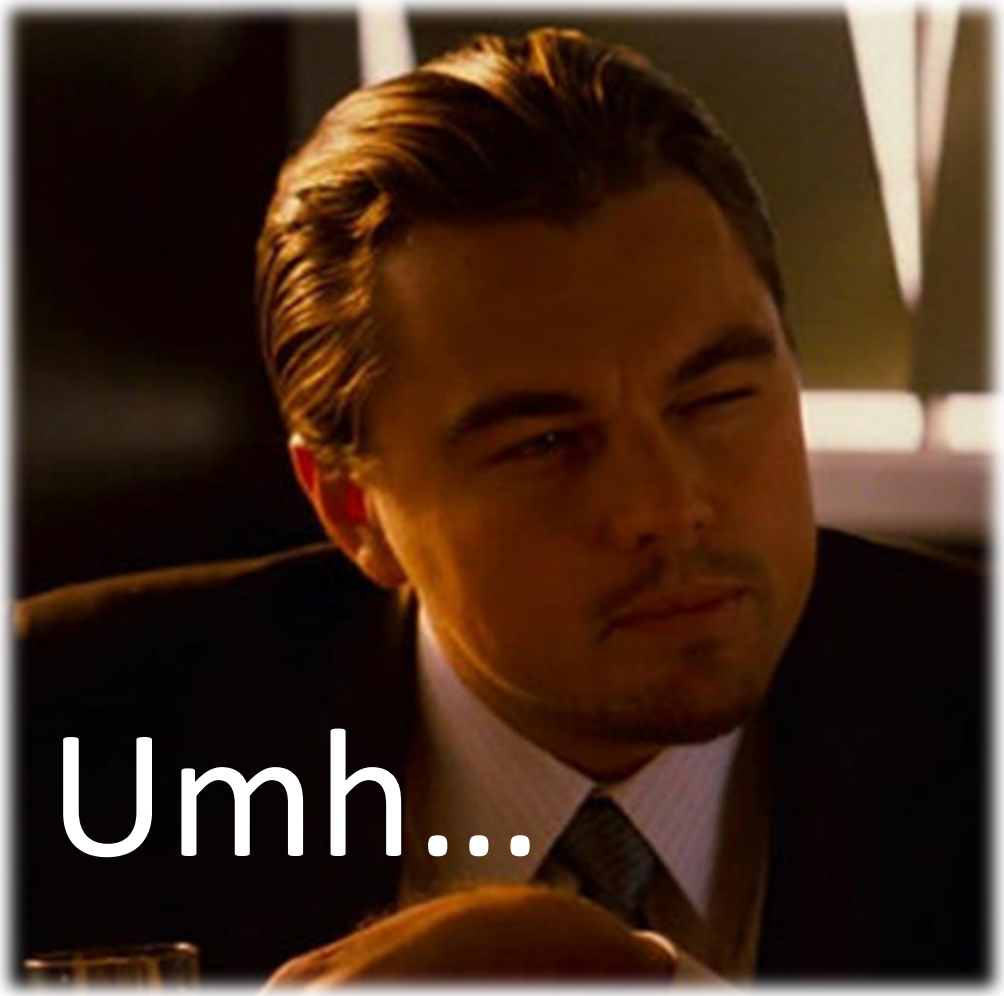
Goal-Oriented

Approximate

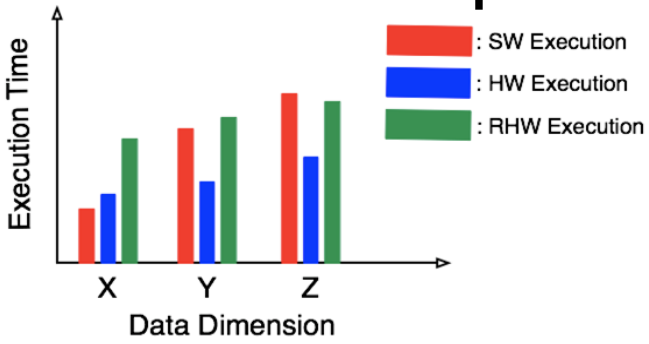
Fast

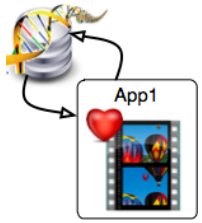
Nice idea, but

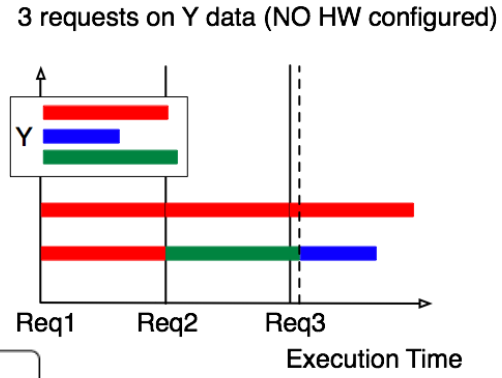
Nice idea, but how to use it!

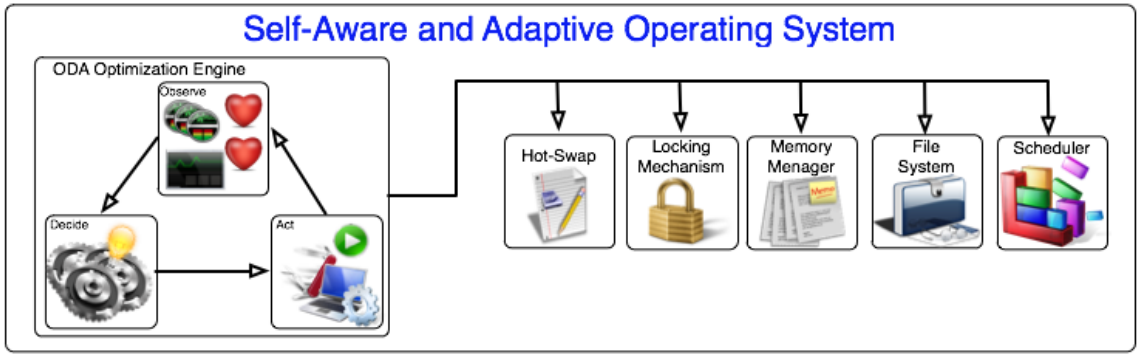


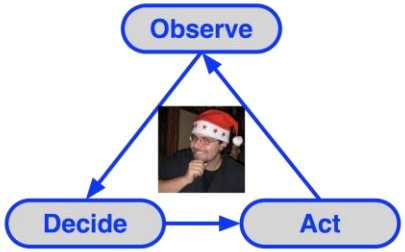
Adaptive Self-Aware CPS

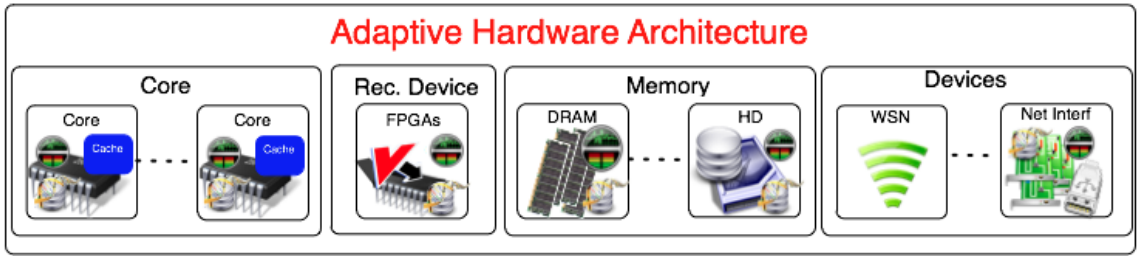


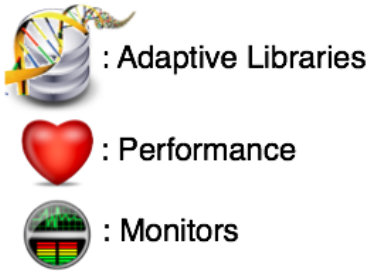




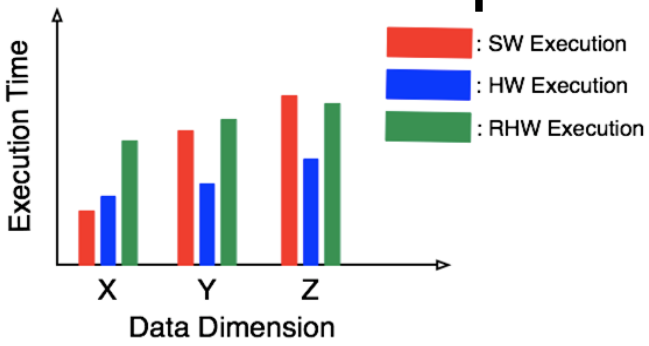


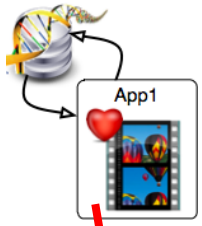


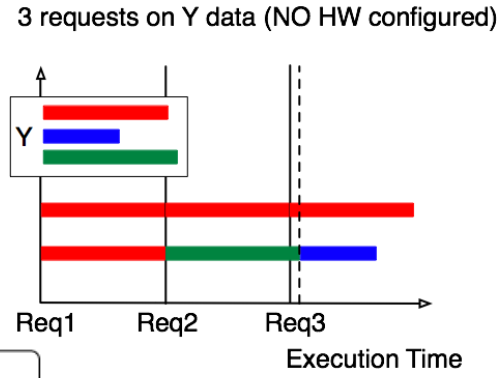


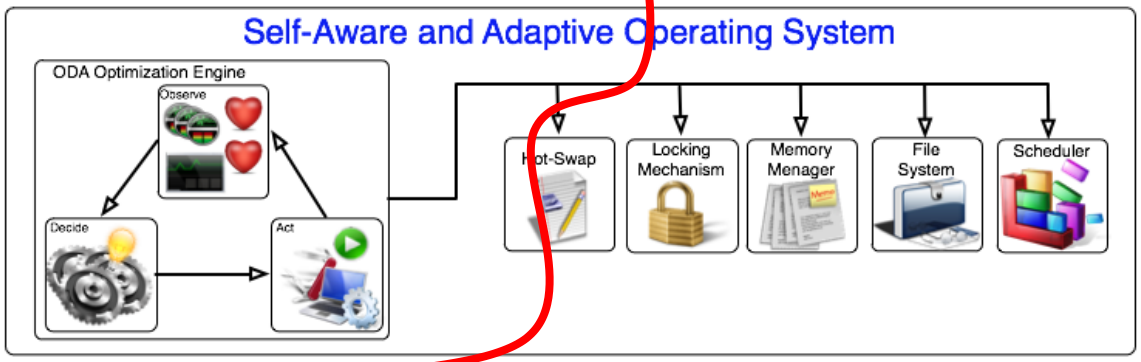


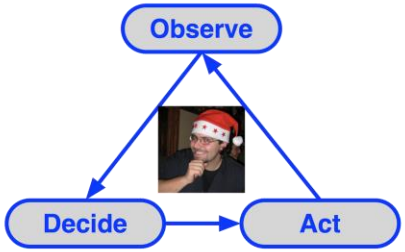
Adaptive Self-Aware CPS

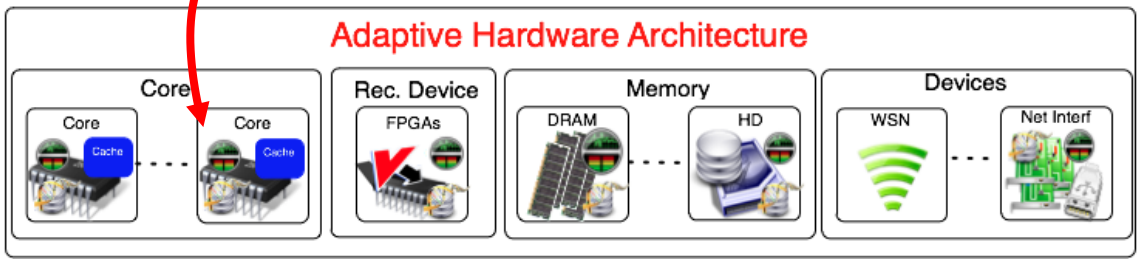


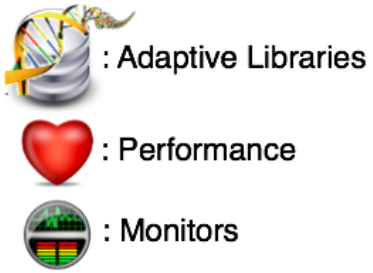




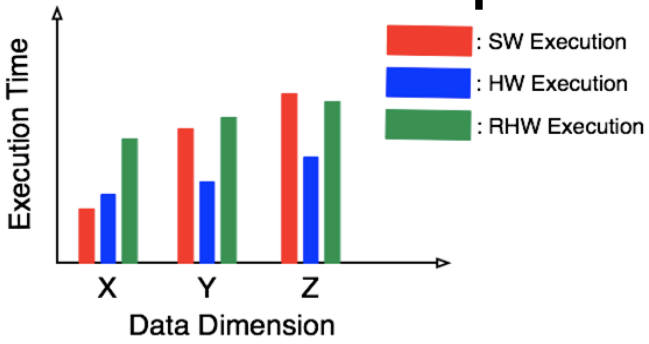


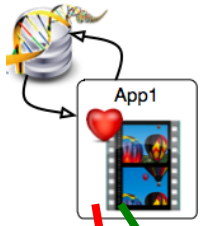


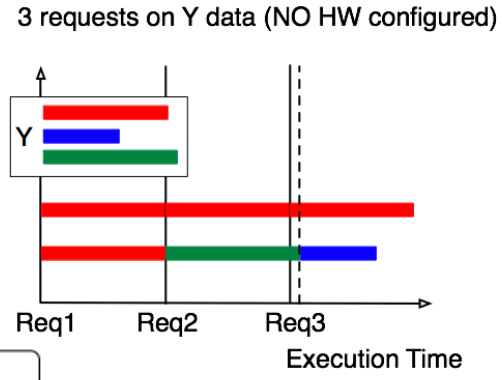


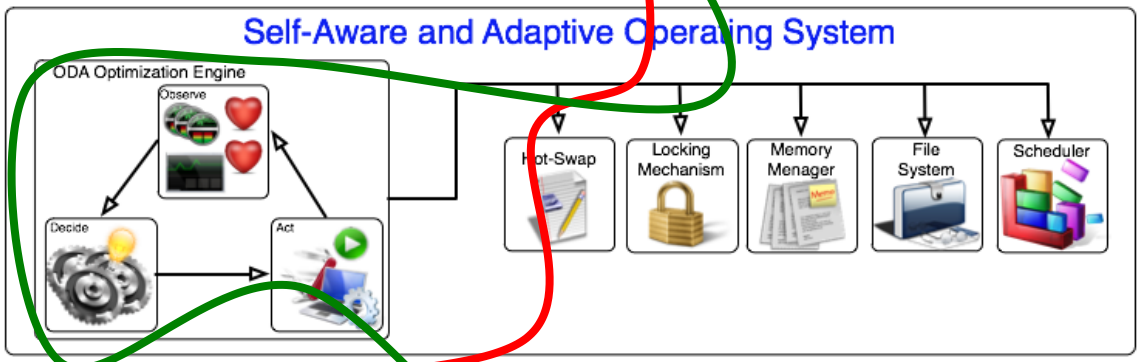


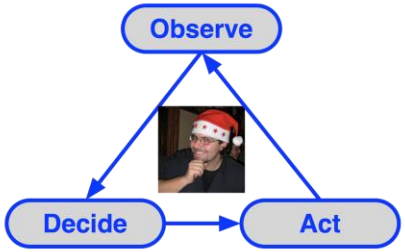
Adaptive Self-Aware CPS

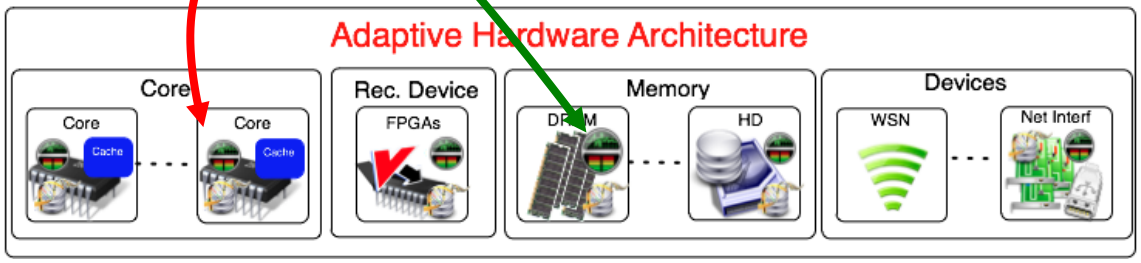


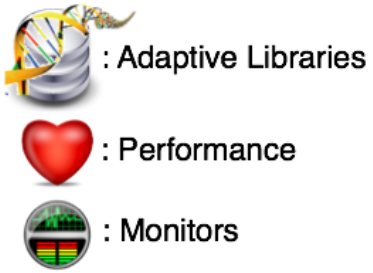






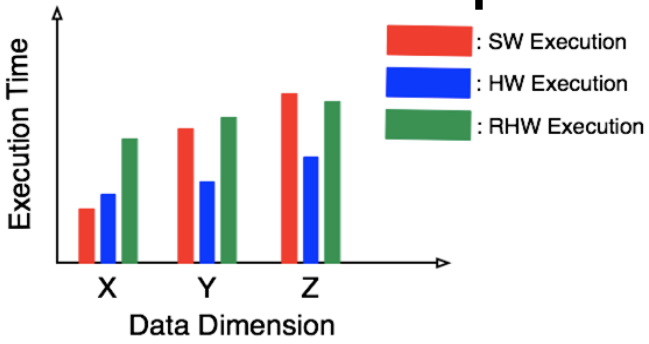


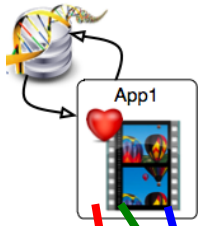


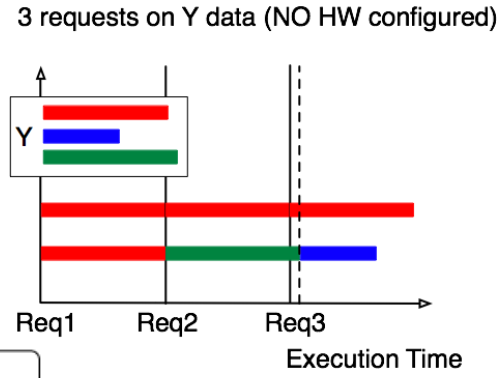


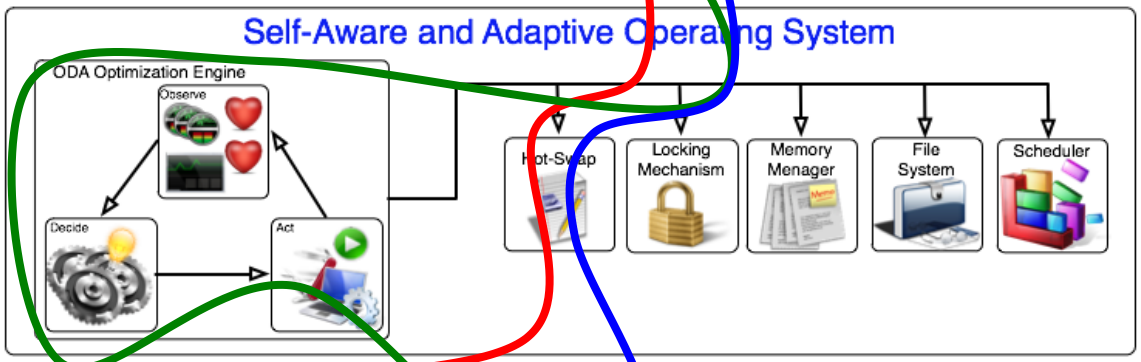

WHAAAAAAT?

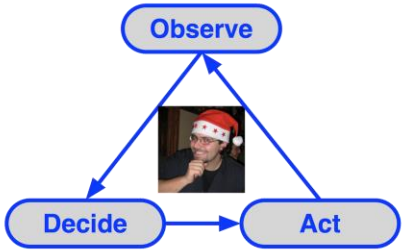
Adaptive Self-Aware CPS

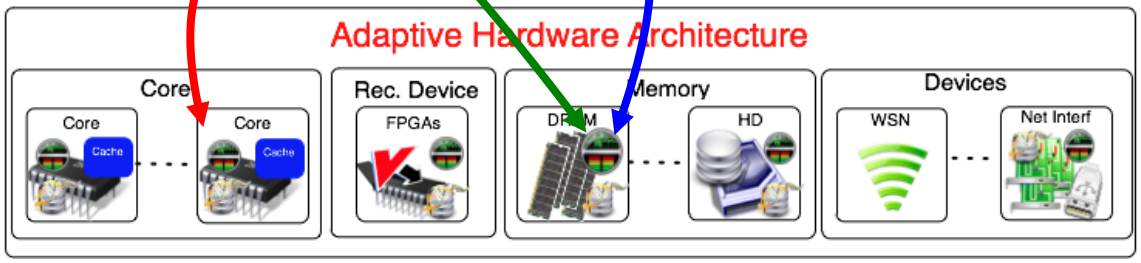


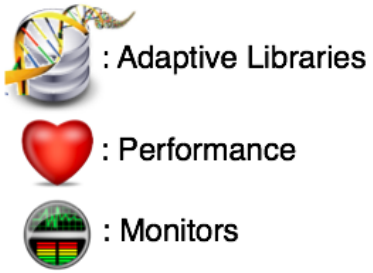












A global property

- Being able to adapt is not a specific domain property
  - Operating system, computer architecture, etc…
  - Cyber Physical Systems
  - Embedded systems
  - IoT

A global property

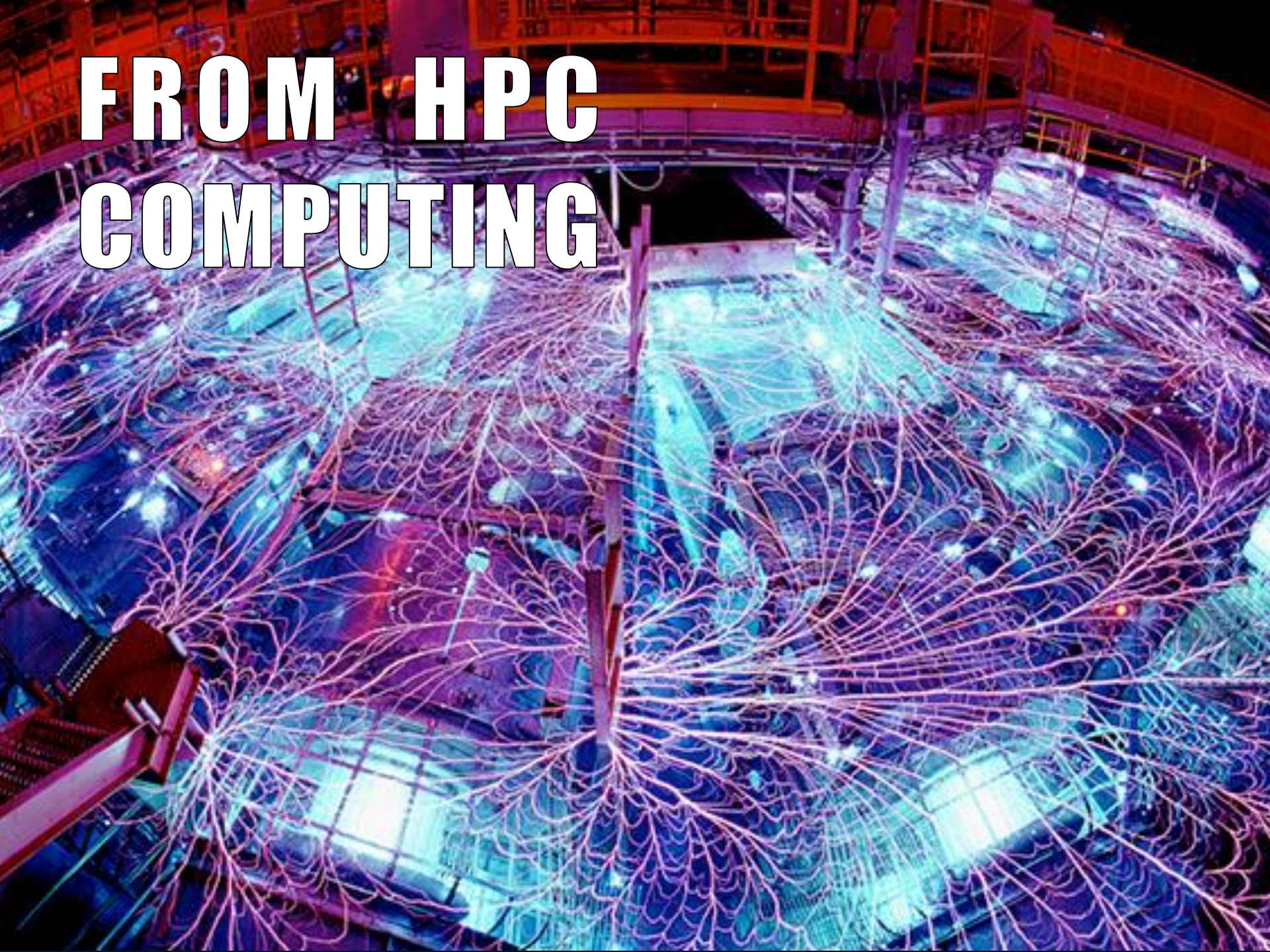
- Being able to adapt is not a specific domain property
  - Operating system, computer architecture, etc…
  - Cyber Physical Systems
  - Embedded systems
  - IoT

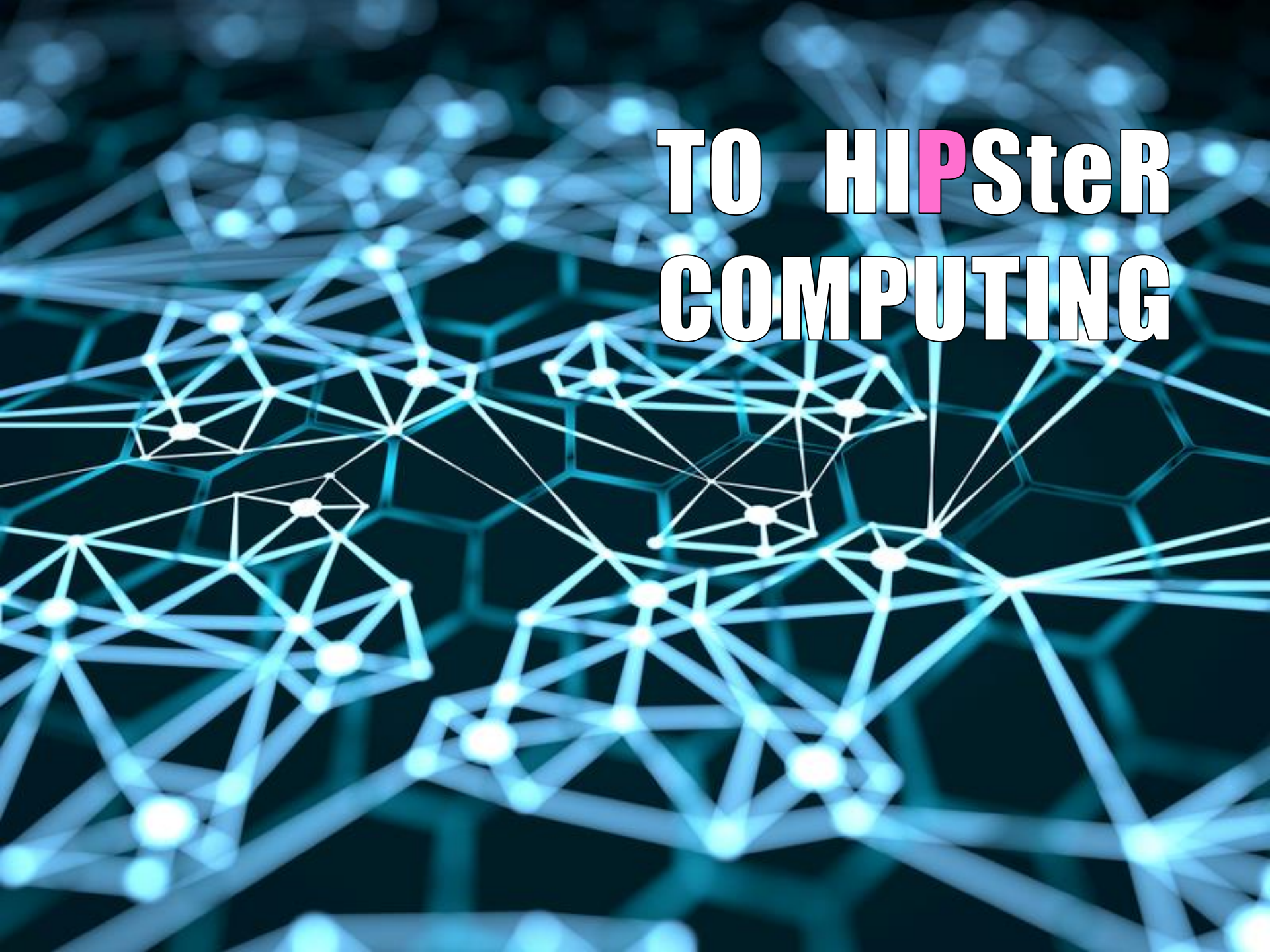
embedded/mobile devices and CPS/distributed computing

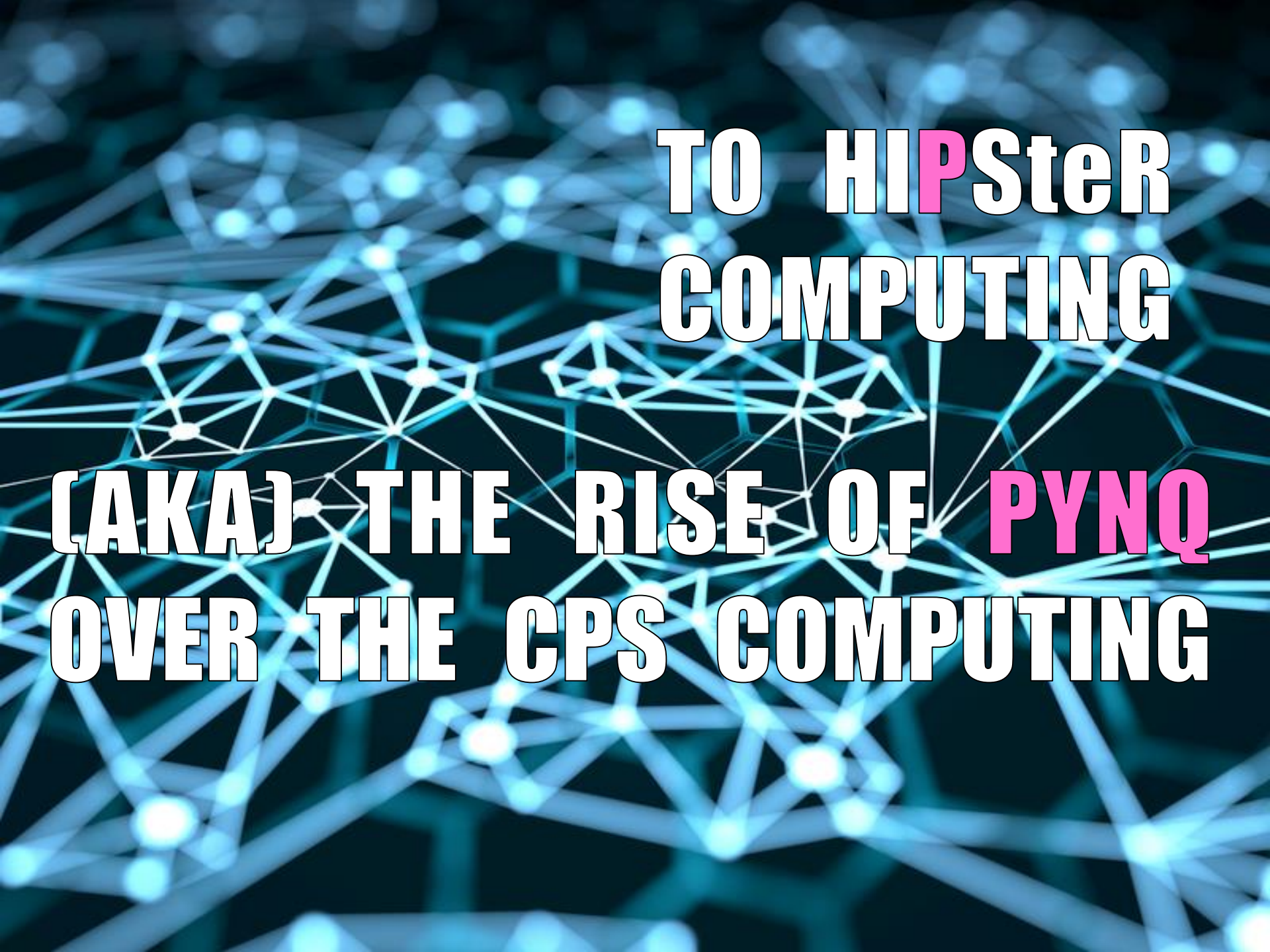
FROM CLOUD COMPUTING

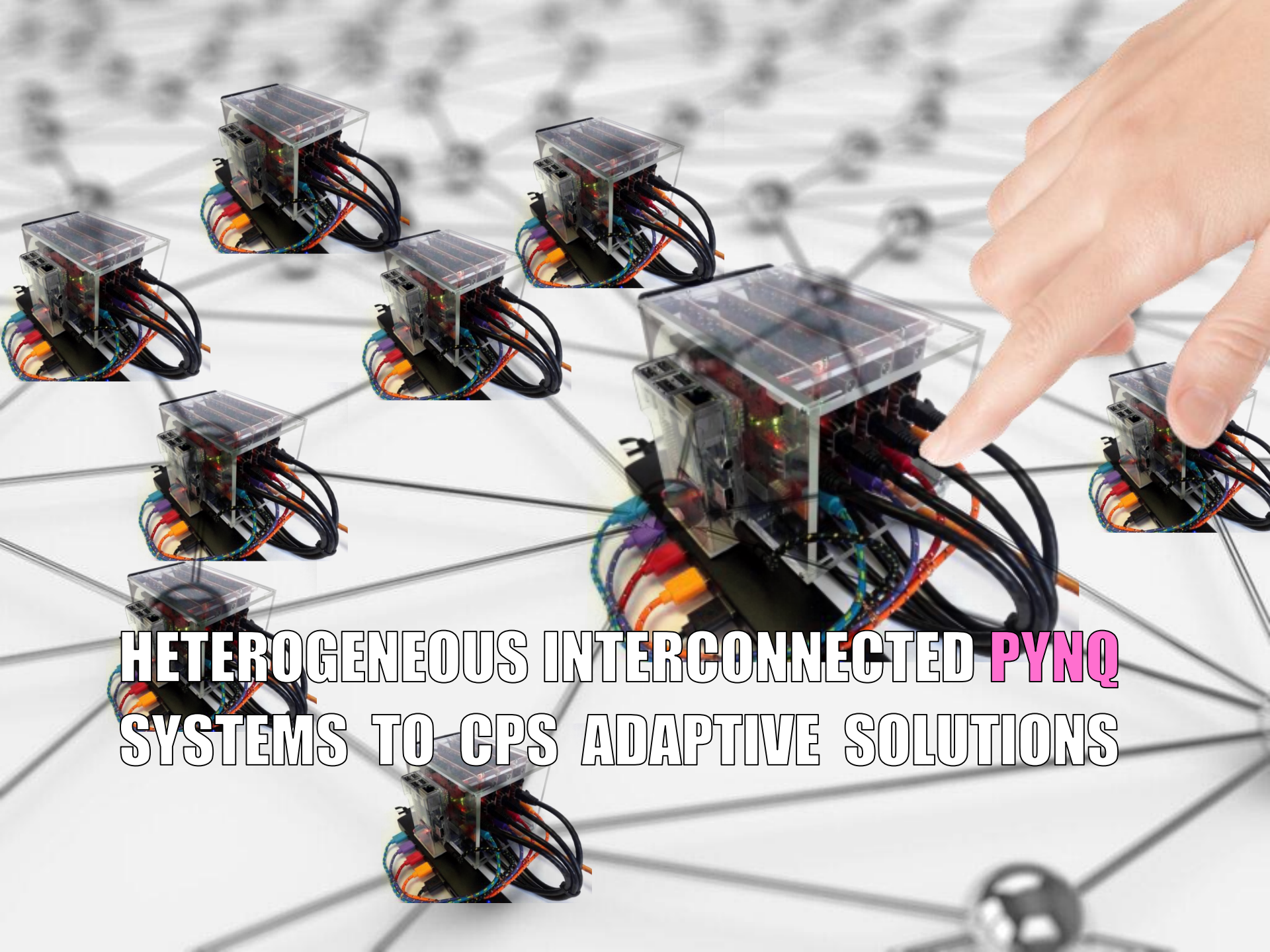

TO FOG
COMPUTING


TO FOG
COMPUTING
(AKA) THE RISE OF CPS
OVER THE CLOUD


FROM HPC
COMPUTING


TO HIPSteR
COMPUTING


TO HIPSteR
COMPUTING
(AKA) THE RISE OF PYNQ
OVER THE CPS COMPUTING


HETEROGENEOUS INTERCONNECTED PYNQ
SYSTEMS TO CPS ADAPTIVE SOLUTIONS

WAT.

THAT'S INSANE!

NOT COMPLETELY INSANE!

Device Name	Price	Look-up Tables	KLUT/$
snickerdoodle	$55	17,600	0.32
snickerdoodle-black	$149	53,200	0.36
PYNQ-Z1 (educational)	$65	53,200	0.81
PicoZed (7015)	$265	46,200	0.17
PicoZed (7030)	$375	78,600	0.20
Zynq MMP	$1295	218,600	0.17

On how new CPS frontiers will impact everyday life

On how new CPS frontiers will impact everyday life

LITTLE+big and heterogeneous

On how new CPS frontiers will impact everyday life

Pervasive, distributed CPS solutions

LITTLE+big and heterogeneous

On how new CPS frontiers will impact everyday life

Autonomic/Self-Aware

Adaptive Solutions

Pervasive, distributed CPS solutions

LITTLE+big and heterogeneous

On how new CPS frontiers will impact everyday life

Autonomic/Self-Aware

Adaptive Solutions

Pervasive, distributed CPS solutions

LITTLE+big and heterogeneous

HOW/WHERE TO APPLY?

ASK TO...

Davide Conficconi

Alberto Zeni

HOW/WHERE TO APPLY?

Cyber Physical Systems
enabling technologies perspective and more…

CPS Summer School – Creative Lab

19 September 2022

POLITECNICO MILANO 1863
NECST laboratory

Marco D. Santambrogio
<marco.santambrogio@polimi.it>
Politecnico di Milano

POLITECNICO
MILANO 1863