

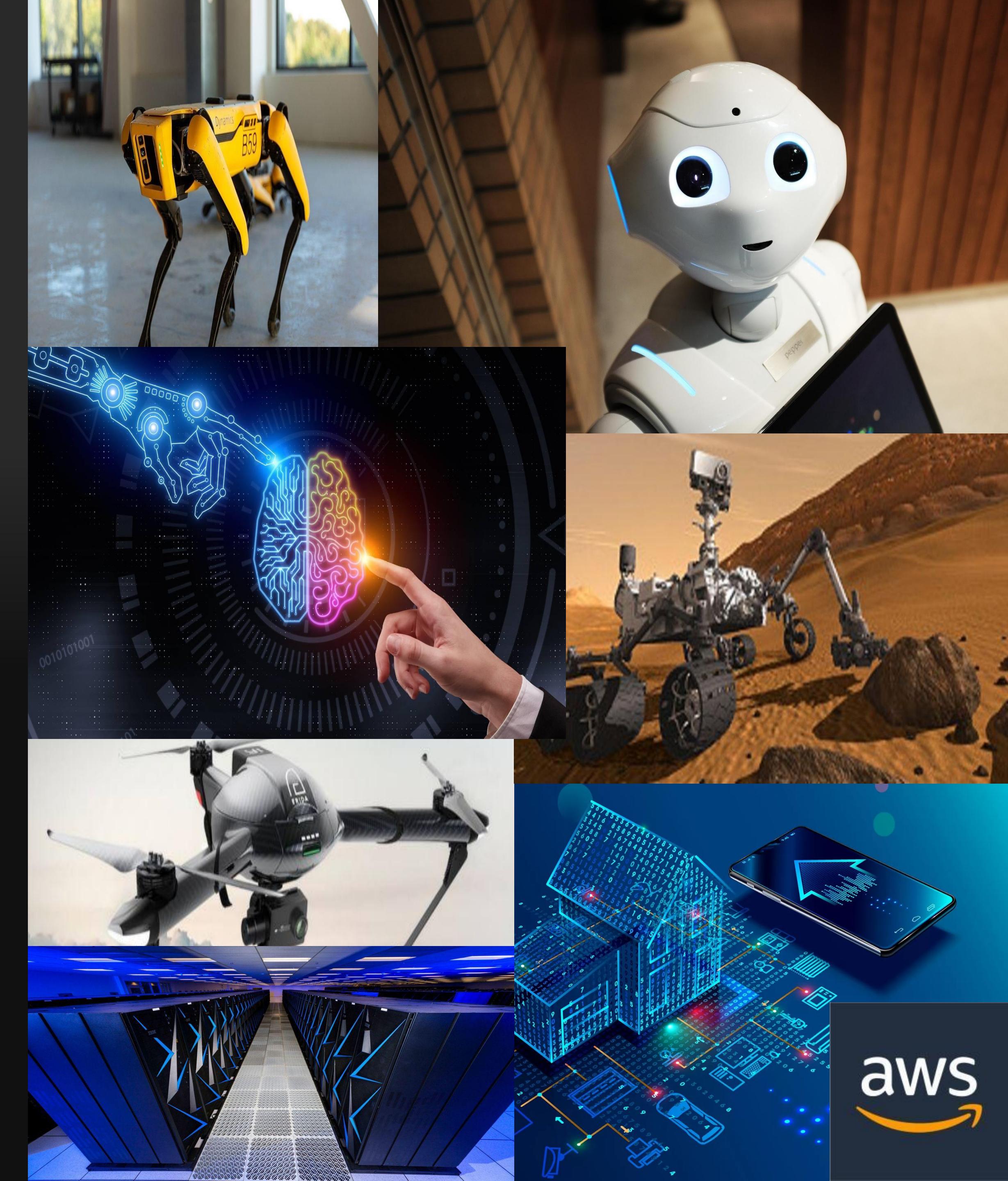
Programación distribuida

Con un enfoque a emprendimiento

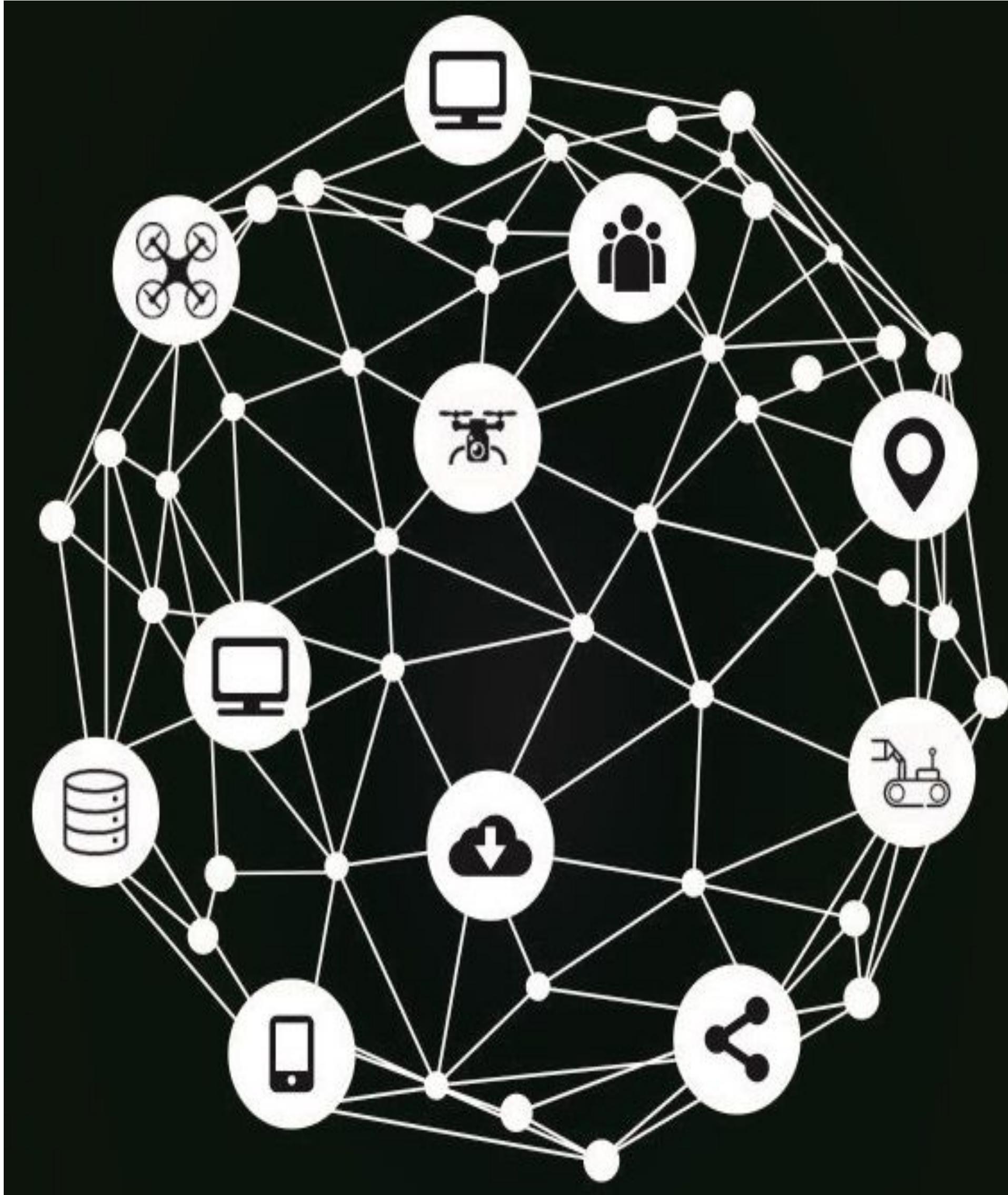
Sesión III: Supercomputing, even with robots

Leonardo Camargo Forero, Ph.D

2021



aws



Agenda

- High Performance Computing a.k.a Supercomputing
- Robotics
- Embedded and High Performance Embedded Computing
- High Performance Robotic Computing
- Applications
- Questions



High Performance Computing

¿For what is supercomputing used for?



Supercomputing is everywhere

¿Why to use Supercomputing?



Simulation

Aircraft design
Computational Fluid Dynamics (CFD)
Origins of the universe
Artificial intelligence
Cyber-heart living heart (25M variables)
Is Cancer written in our DNA?
Boeing lighter 787
Disney-Pixar
Avatar
Facebook / email keyword analysis

Too much computational complexity

Supercomputing

Thousands of years to get results



Even a powerful PC

¿What is Supercomputing?

Distribute
Parallelize
Concur
Optimize
MPI




Supercomputer



Opportunistic computing

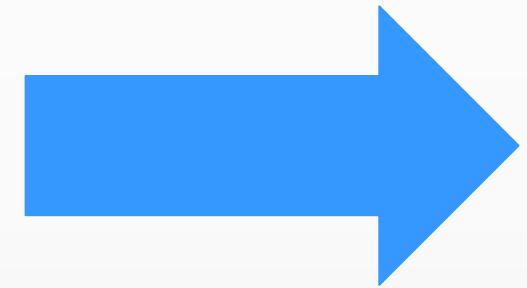


Grid Computing

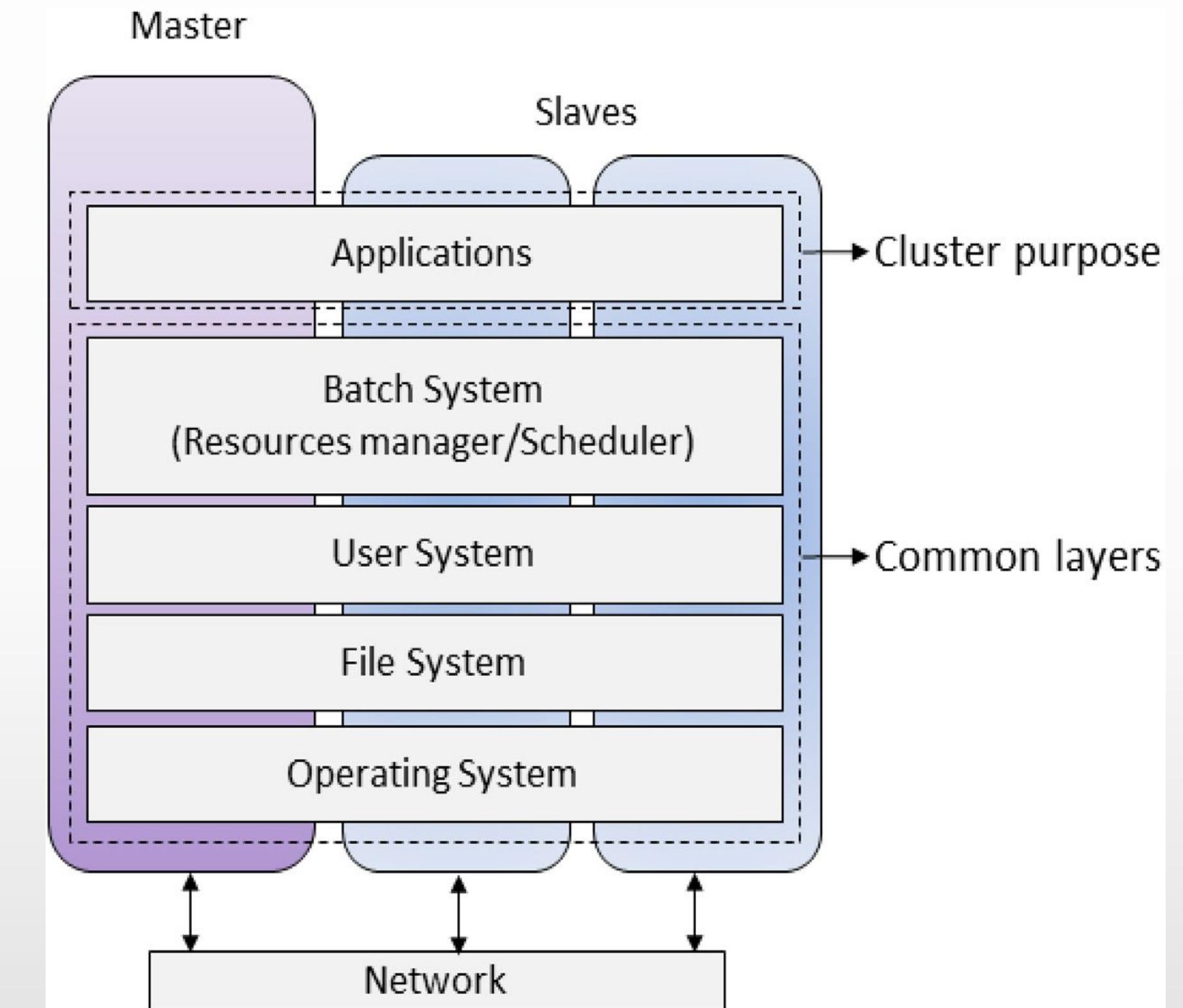


GPGPU

A supercomputer



Supercomputer

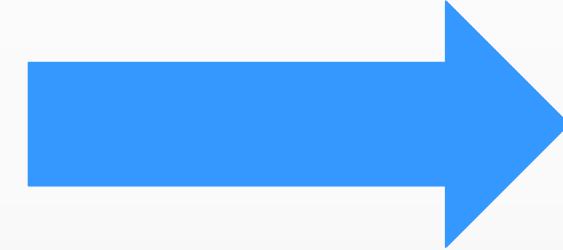


Software architecture



Robotics

The not-so-distant future



A drone (or any robot) might become a platform very similar to a smartphone

Long before ...

Previous ↑



Military applications

10

Next ↓

And now?



Precision agriculture



Search & Rescue



Monitoring



Construction



Oil & Gas



Real estate

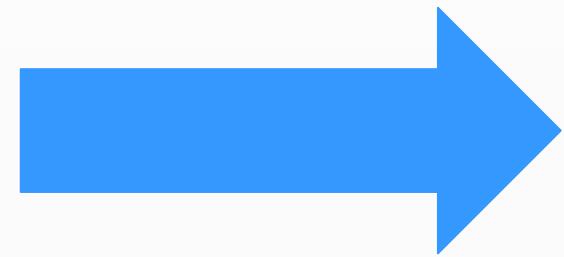


Police / Firemen / Coast
guard



Drone sports

The transition



12

- Minimal autonomy (flight plan)
- Low reactivity
- No integration with other drones
- No integration with other robots
- No integration with other IoT devices
- No scalability



Flying camera

- Hierarchical autonomy
- High reactivity
- Integration with other drones and robots (rovers, subs. etc)
- Scalability
- New business models

Smart machines

What can be done with smart robots?

La siguiente era



Inventory management



Inspection



Police

La siguiente era



Space mission

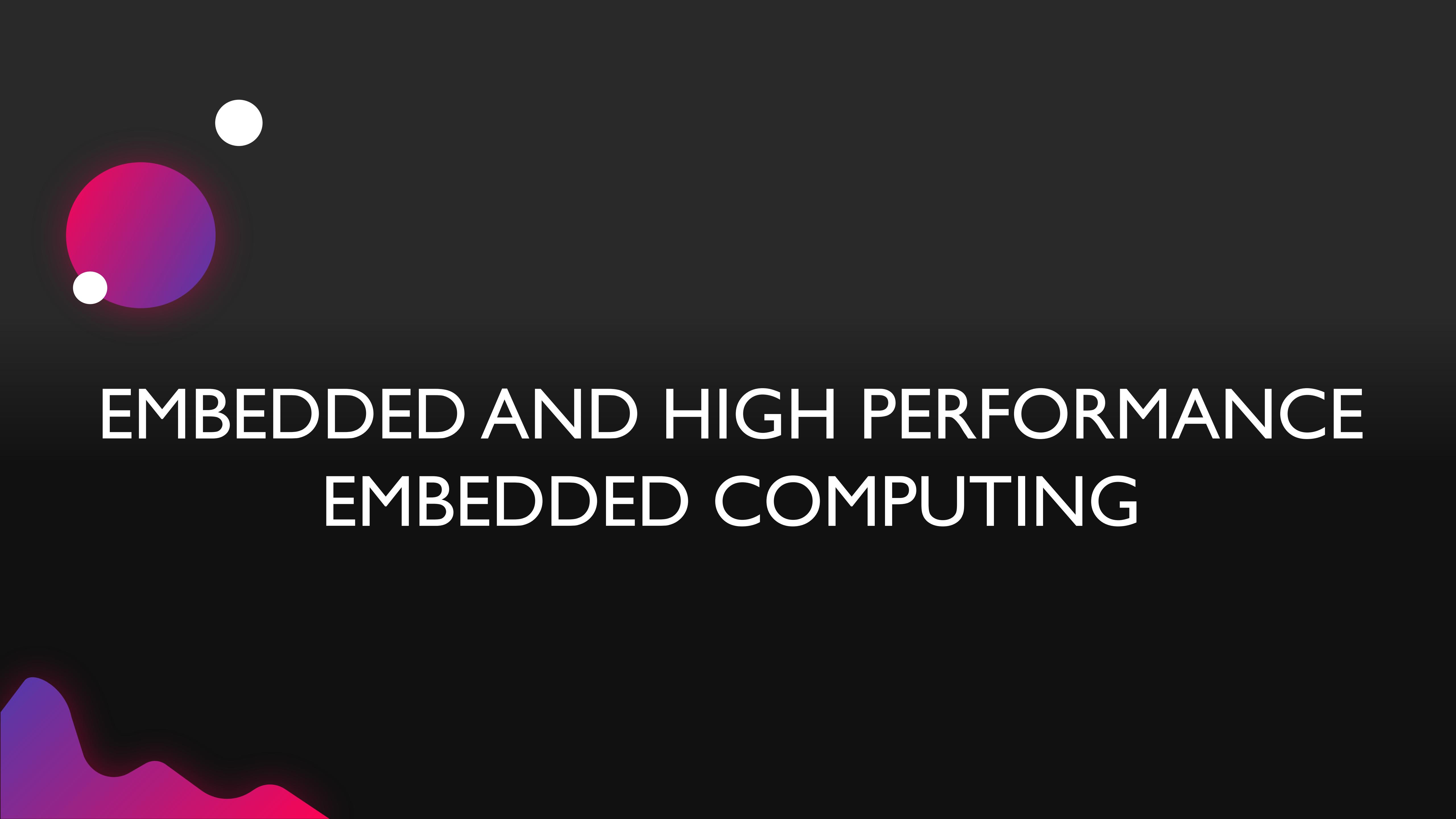


DARPA SubT



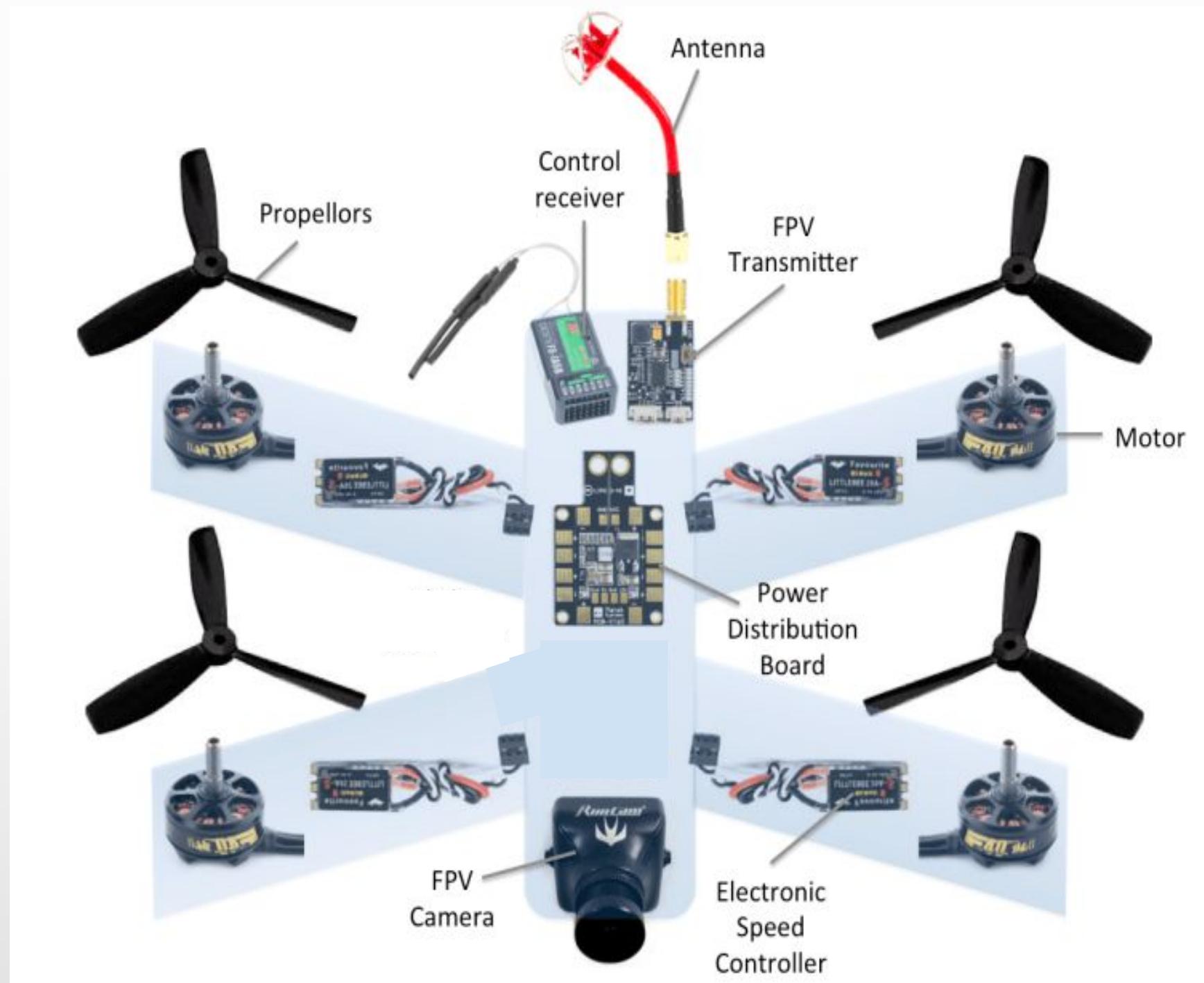
Magic?

What these applications have in common?



EMBEDDED AND HIGH PERFORMANCE EMBEDDED COMPUTING

What is a drone made of?

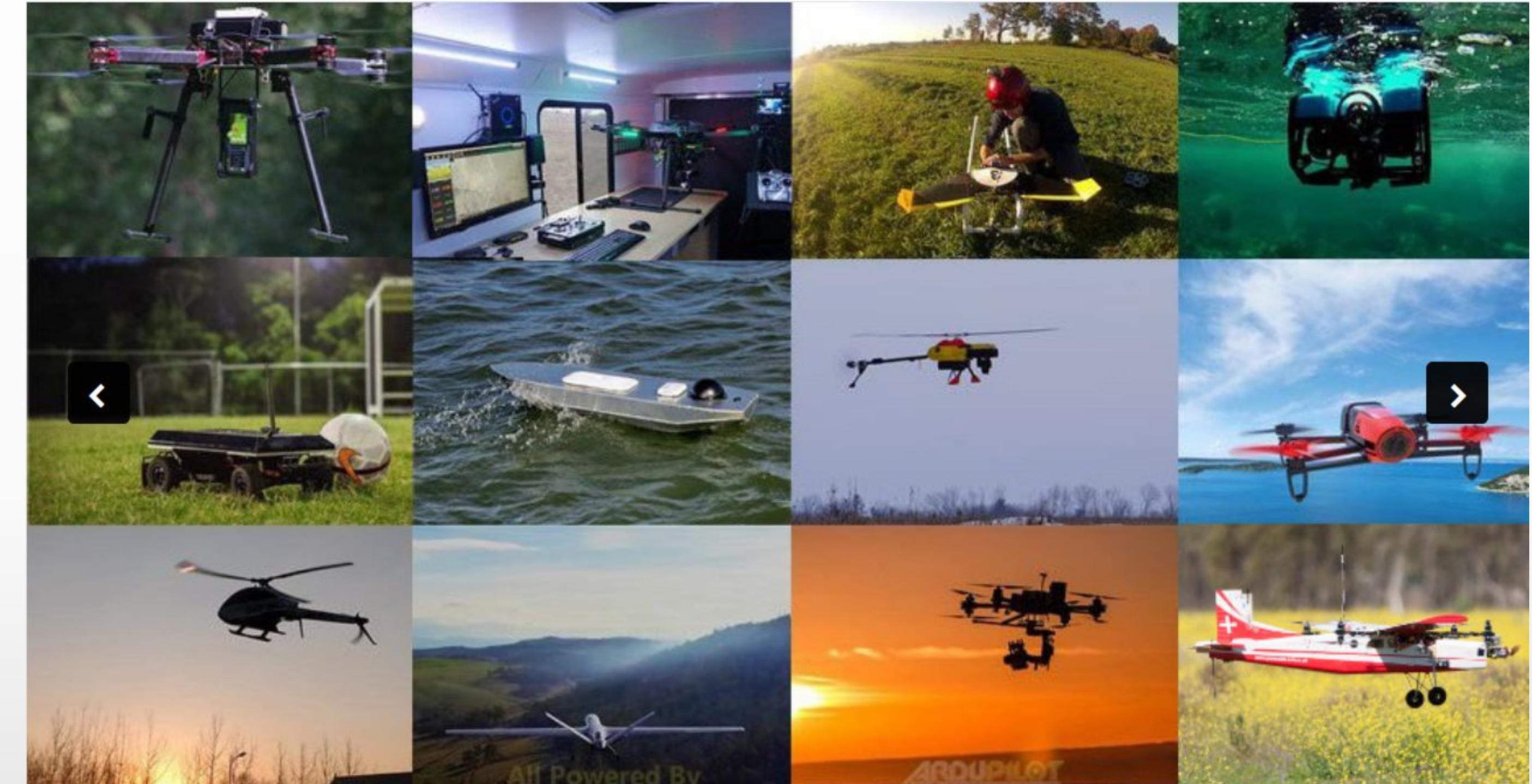


Basic hardware



Flight controllers

Flight controllers



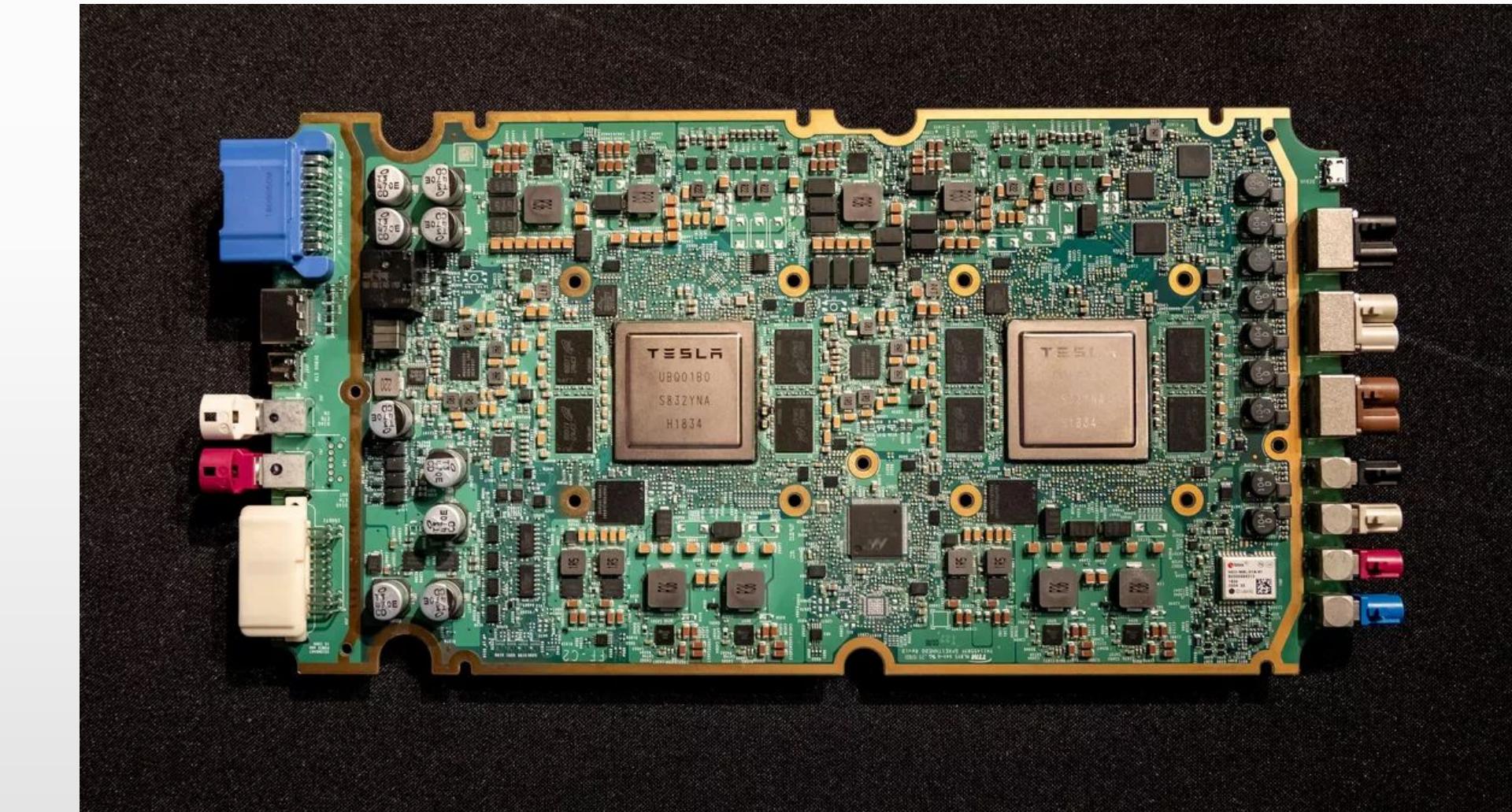
<https://ardupilot.org/>

A first step towards smart machines

Other controllers



MISD approach



2 AI Chips (each with 2GHz and performs 36 trillion operations per second)

What else can we put in a robot?

On-board computers

Raspberry PI



USD 35

CPU Quad core Cortex-A72 (ARM v8)
64-bit SoC @ 1.5GHz
Memory 2GB, 4GB or 8GB LPDDR4-3200
SDRAM

NVIDIA Nano



GPU 128-core Maxwell
CPU Quad-core ARM A57 @ 1.43 GHz
Memory 4 GB 64-bit LPDDR4 25.6 GB/s

USD 100

Embedded supercomputing

NVIDIA Xavier

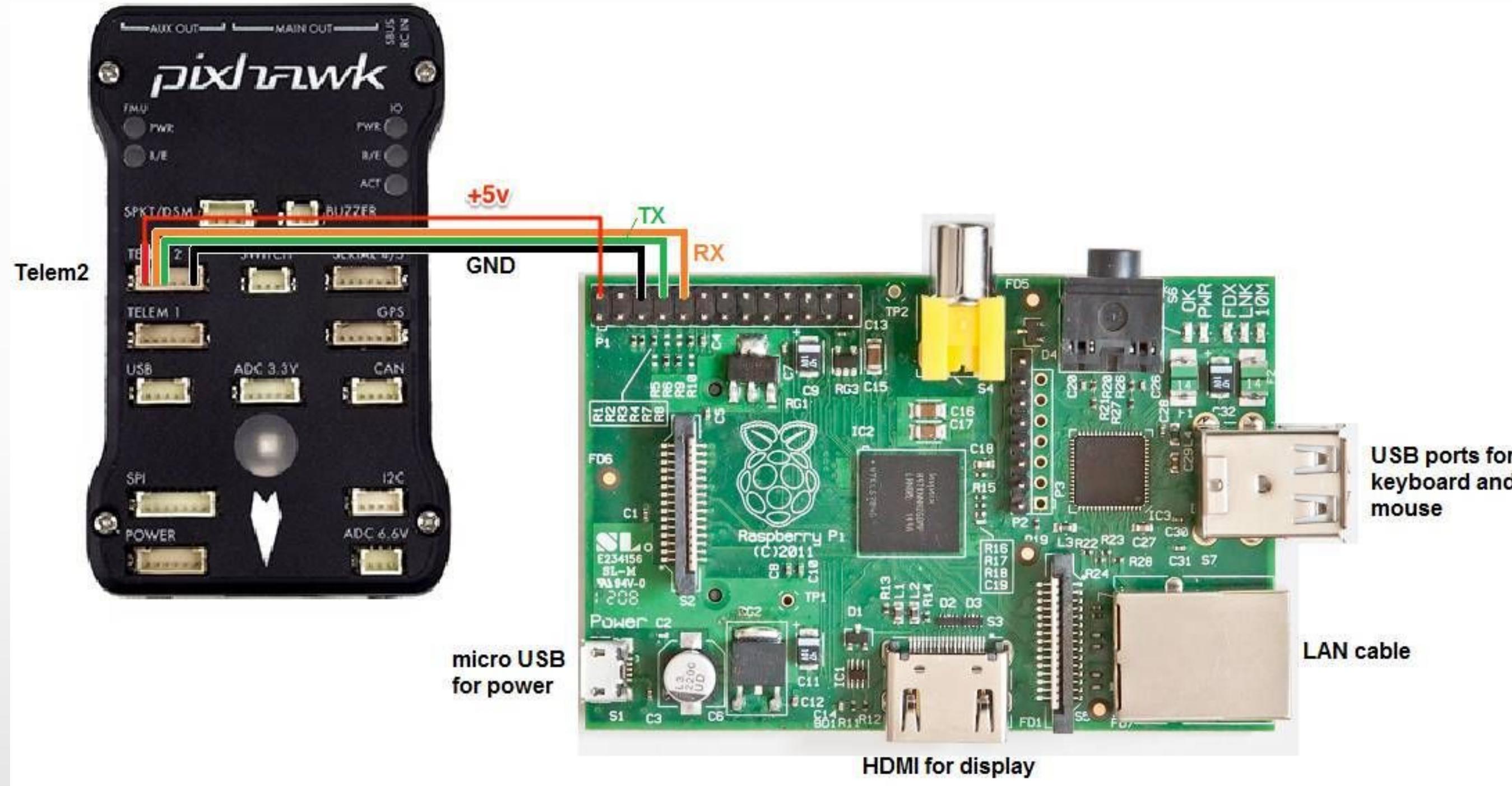


GPU 512-core Volta GPU with Tensor Cores
CPU 8-core ARM v8.2 64-bit CPU, 8MB L2 + 4MB L3
Memory 32GB 256-Bit LPDDR4x | 137GB/s

USD 700

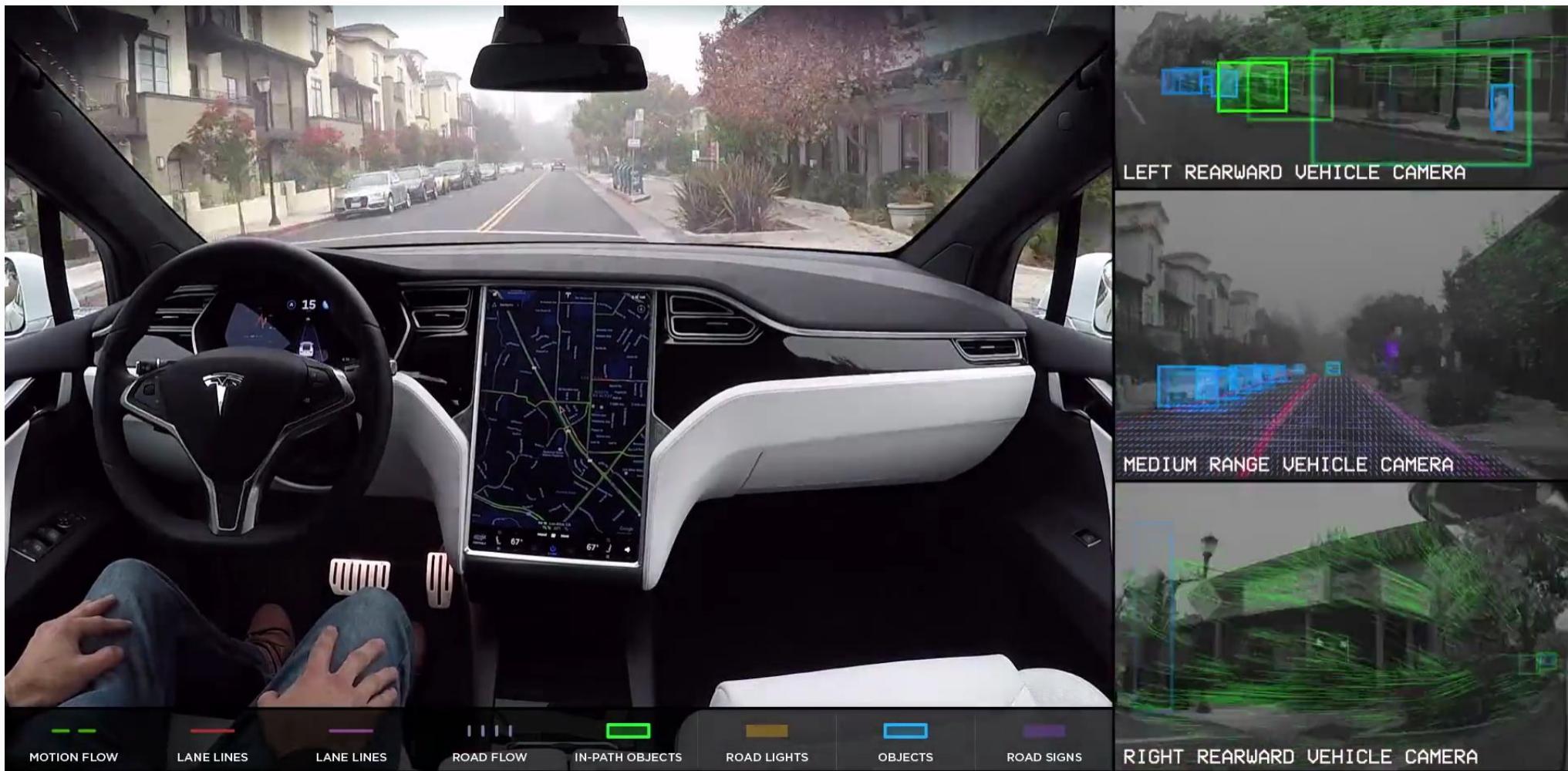


On-board computers



A second step towards smart machines

For what?



Autonomous navigation



Object detection



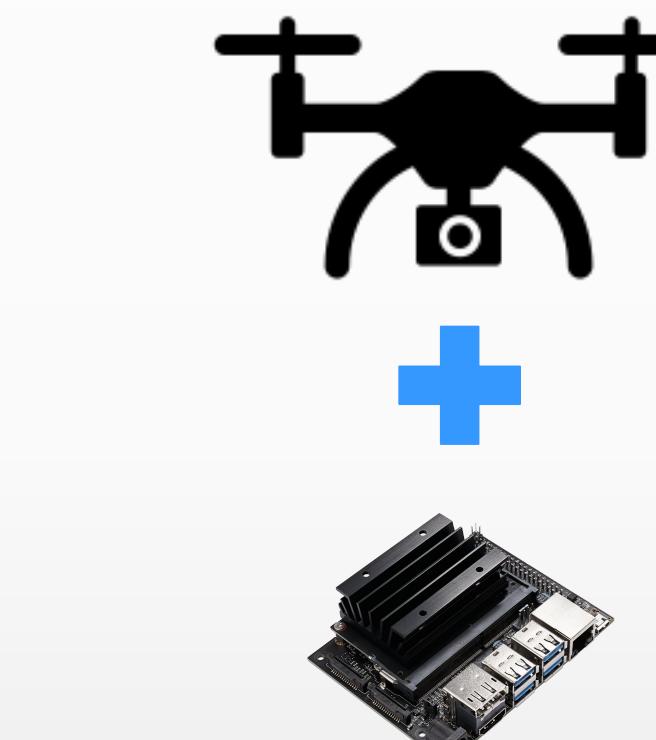
3D map creation

And now what?

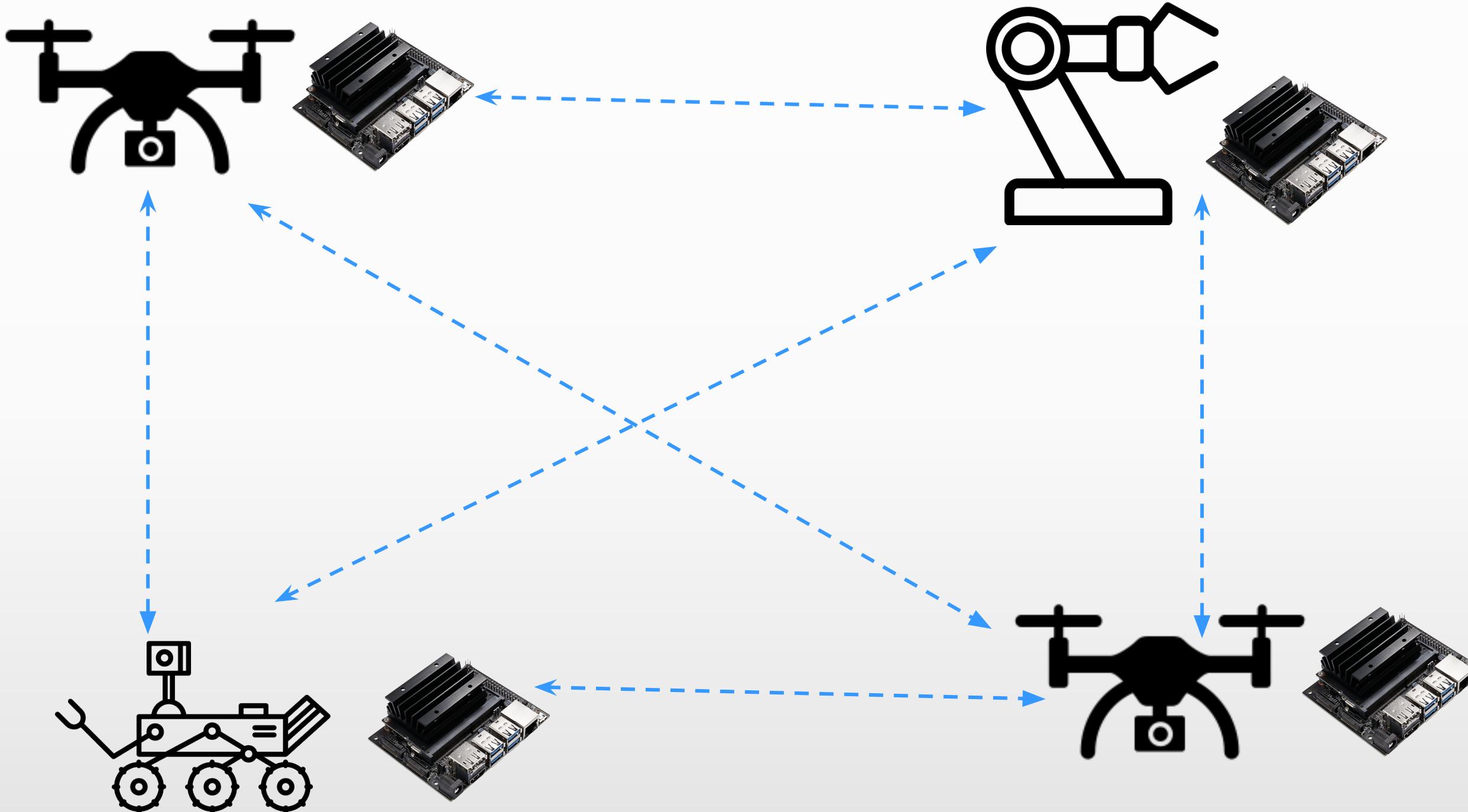


HIGH PERFORMANCE ROBOTIC COMPUTING

The next transition



A single robot embedded with
a computer

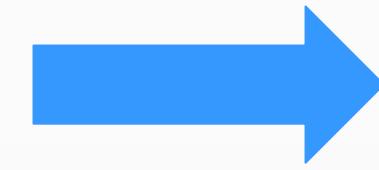


Multiple robots, each one
embedded with a computer

¿What is supercomputing?

Optimize

Reduce computing time / Performance



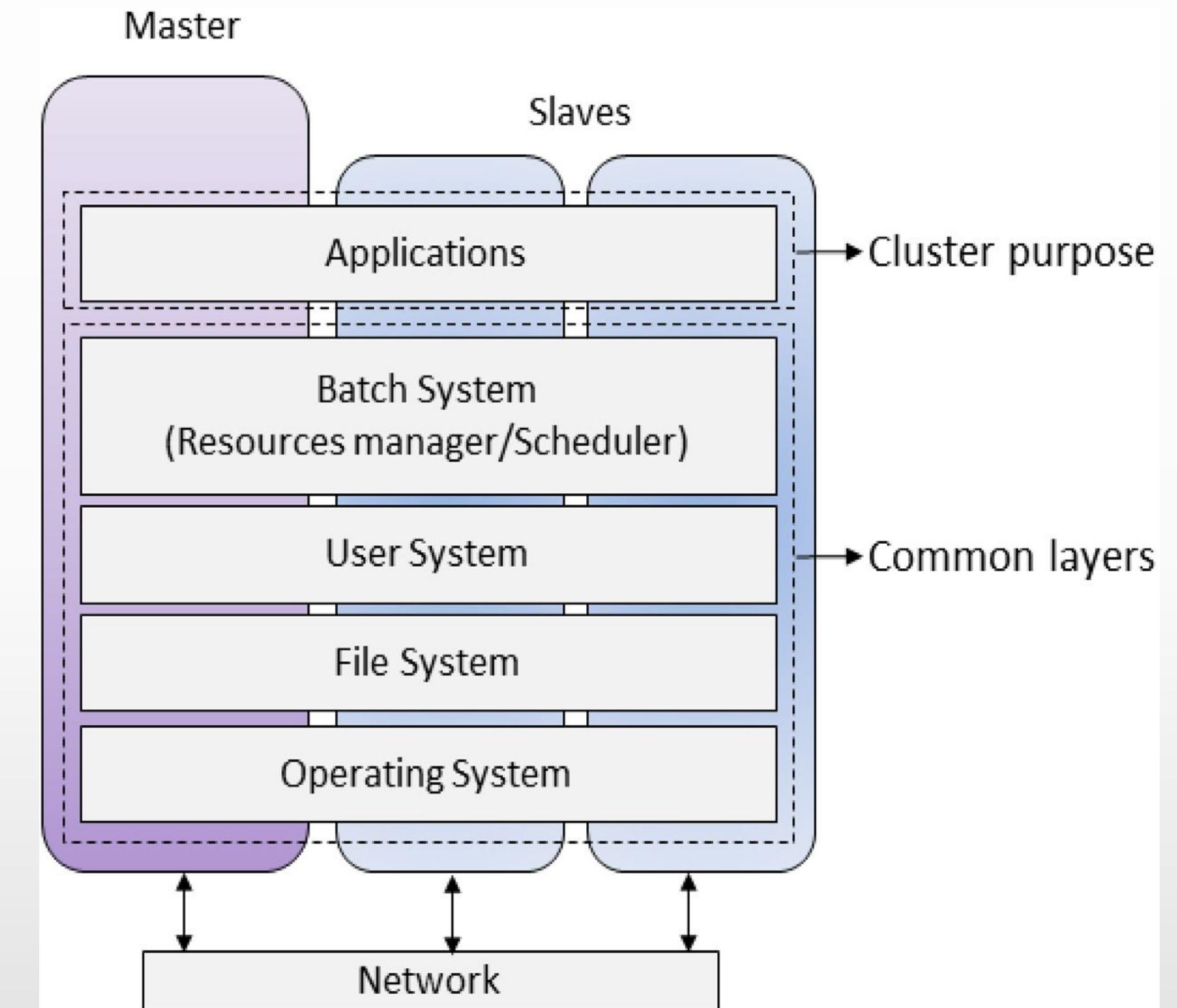
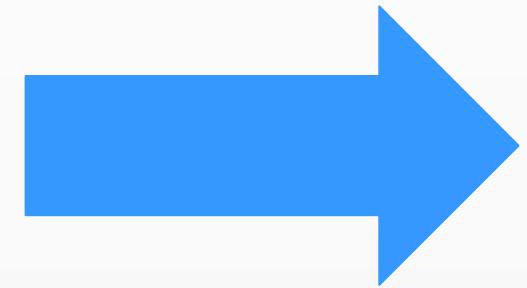
**General-purpose
Scalability
Heterogeneity
User-transparency
Cooperation
Hierarchy
Standardization
Resilience
Centralization/ distribution
Performance**



Cohesión

A single collective intelligence

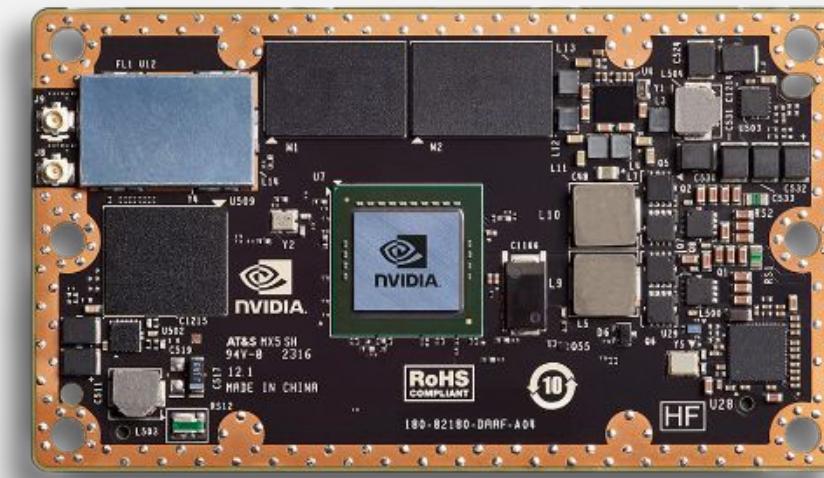
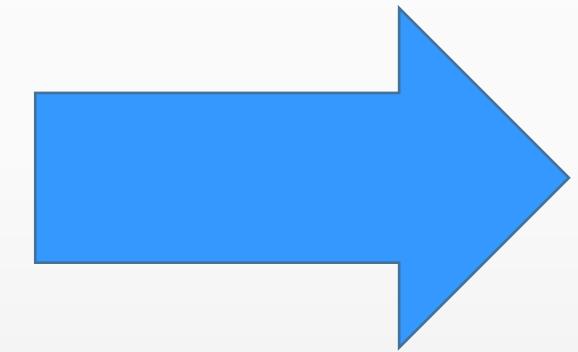
A supercomputer



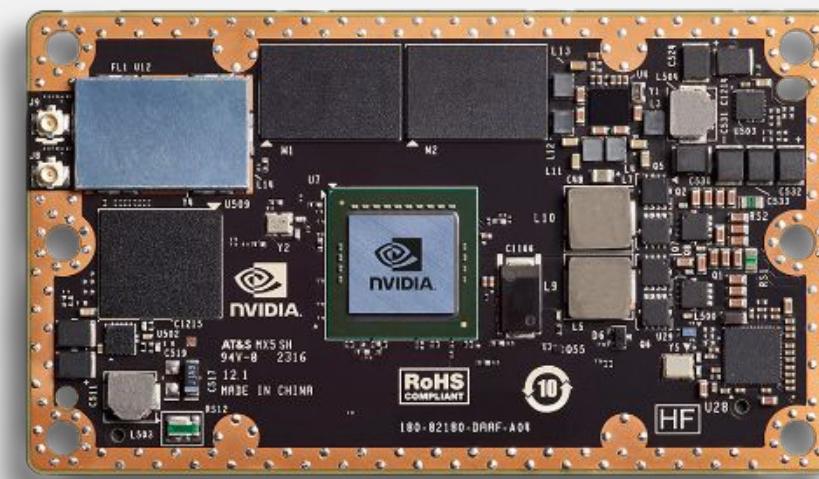
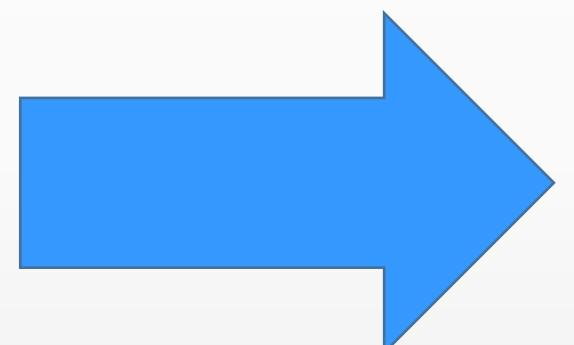
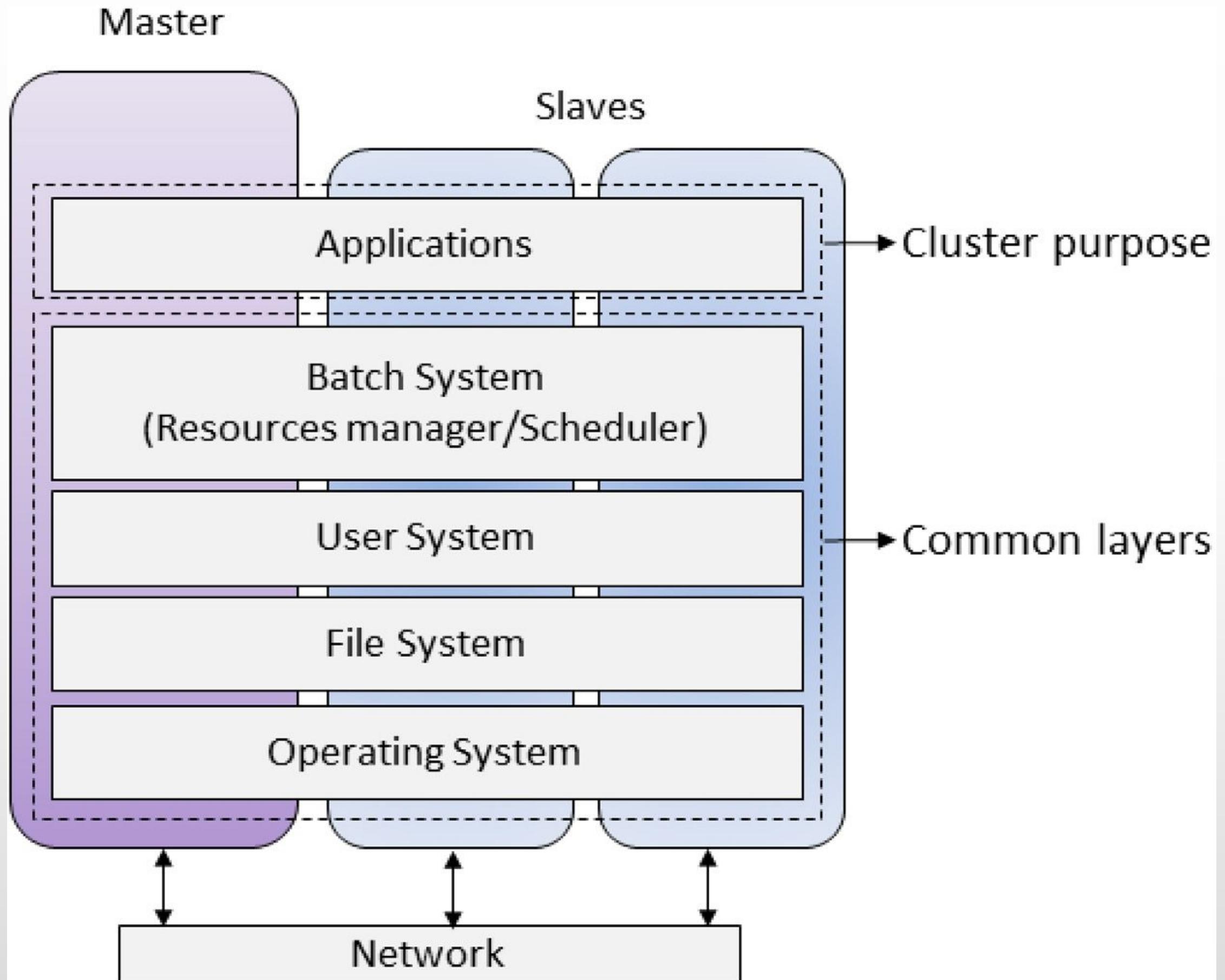
Supercomputer

Software architecture

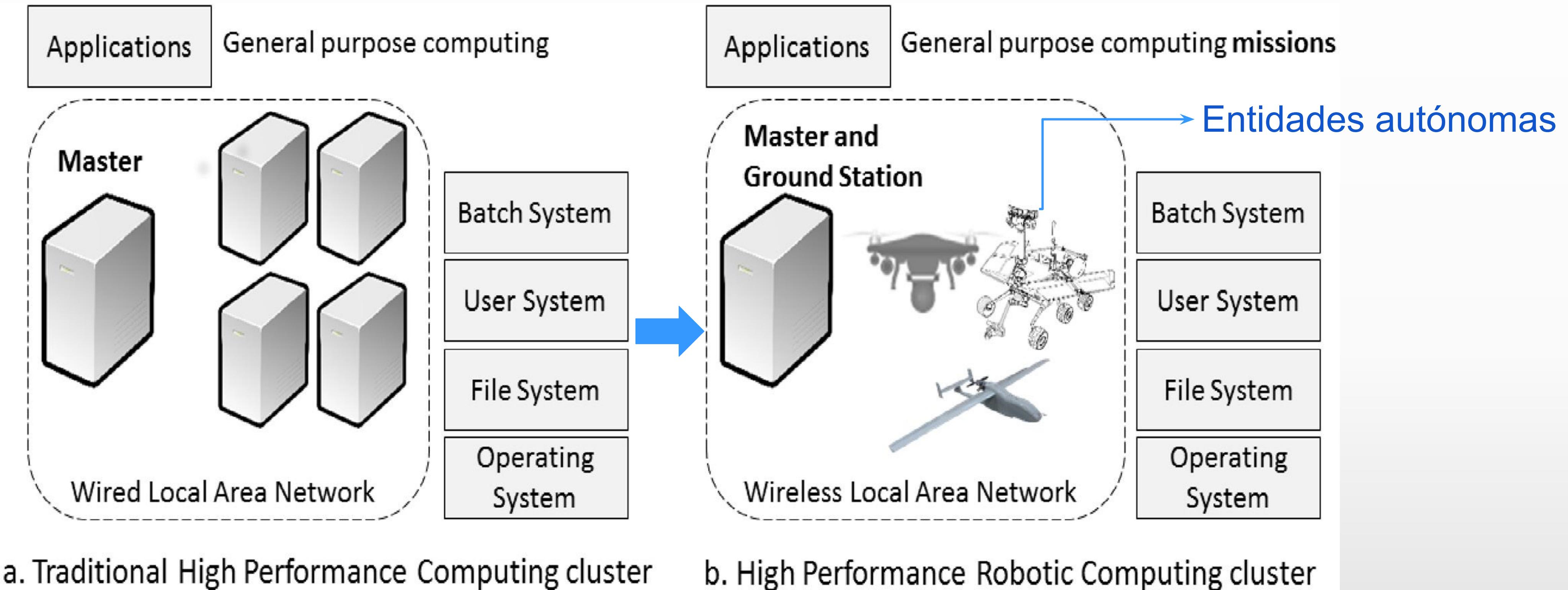
High Performance Robotic Computing



High Performance Robotic Computing



High Performance Robotic Computing



Communications ?

WiFi, 4G, 5G, DTN, etc

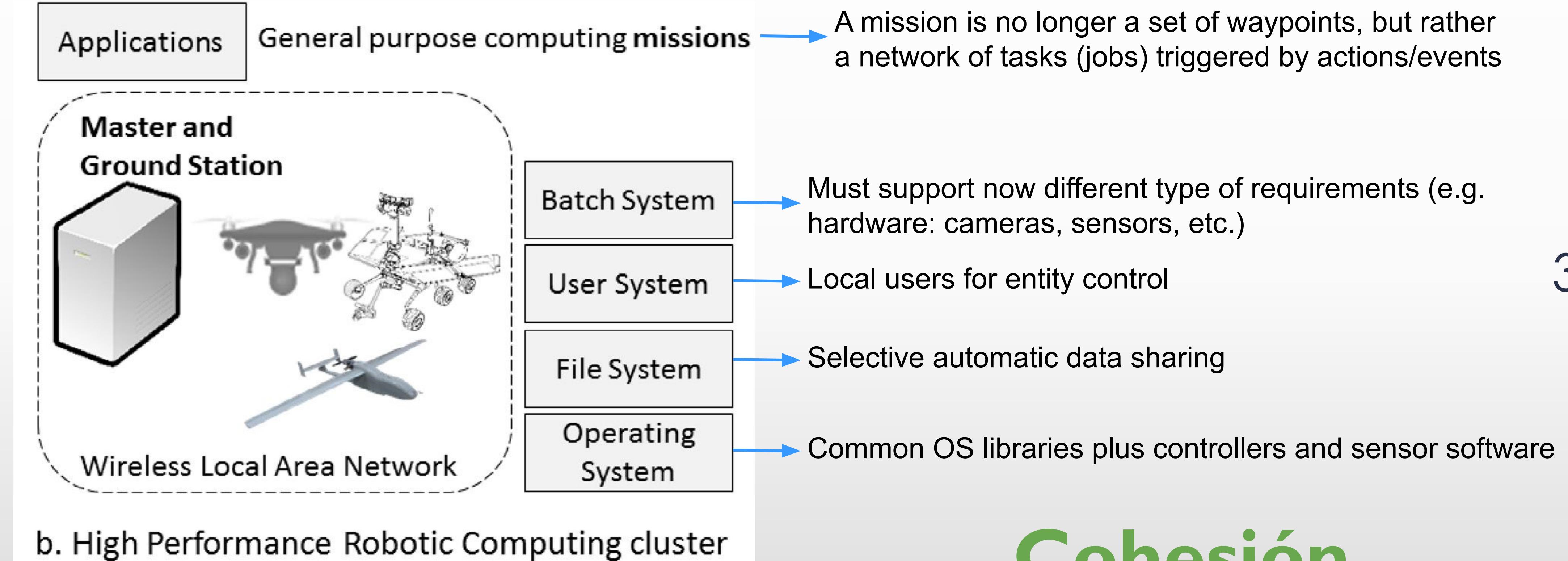
Nodes vs Entities

An entity can have any quantity of nodes

Environment?

Static vs Dynamic

High Performance Robotic Computing



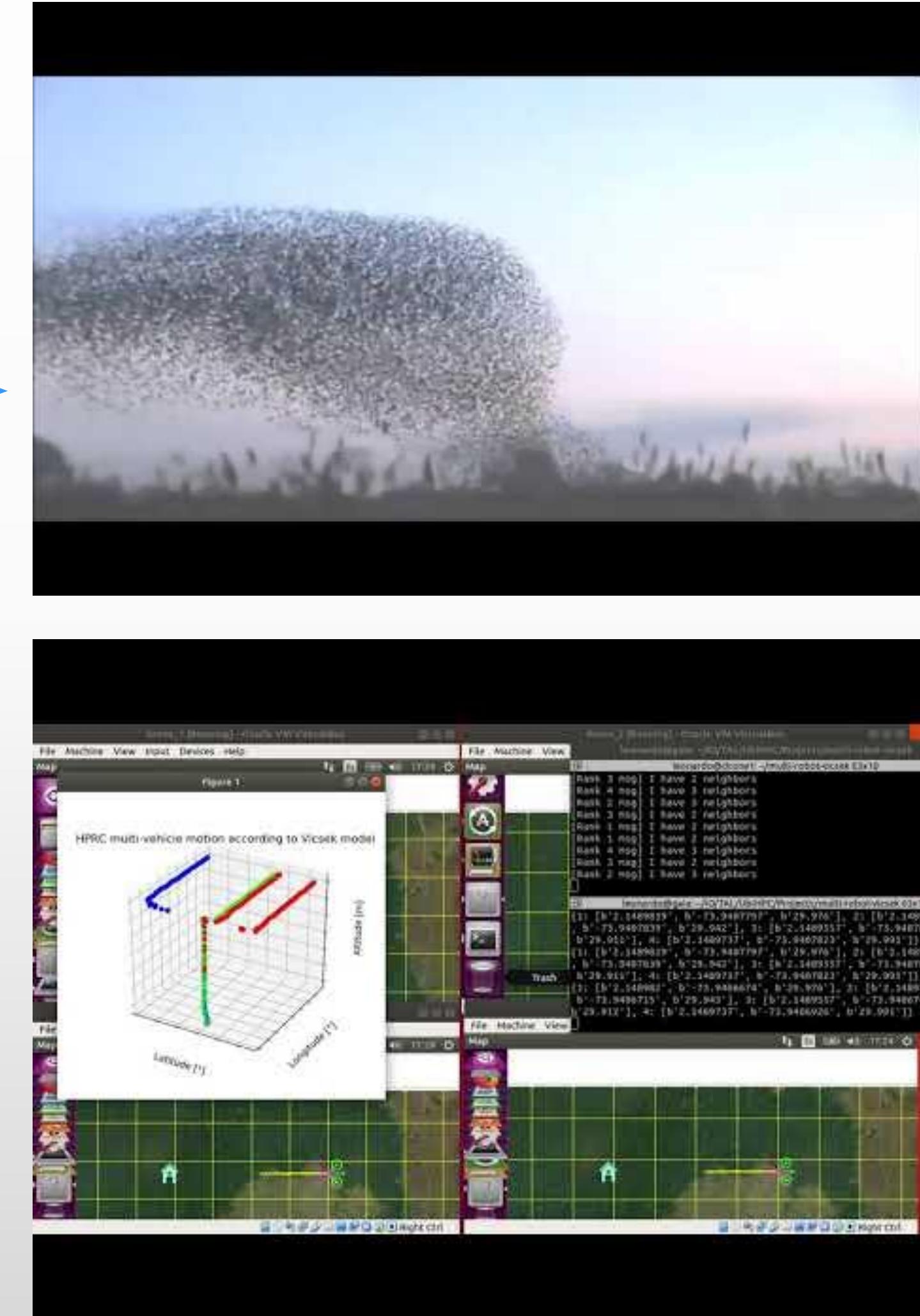
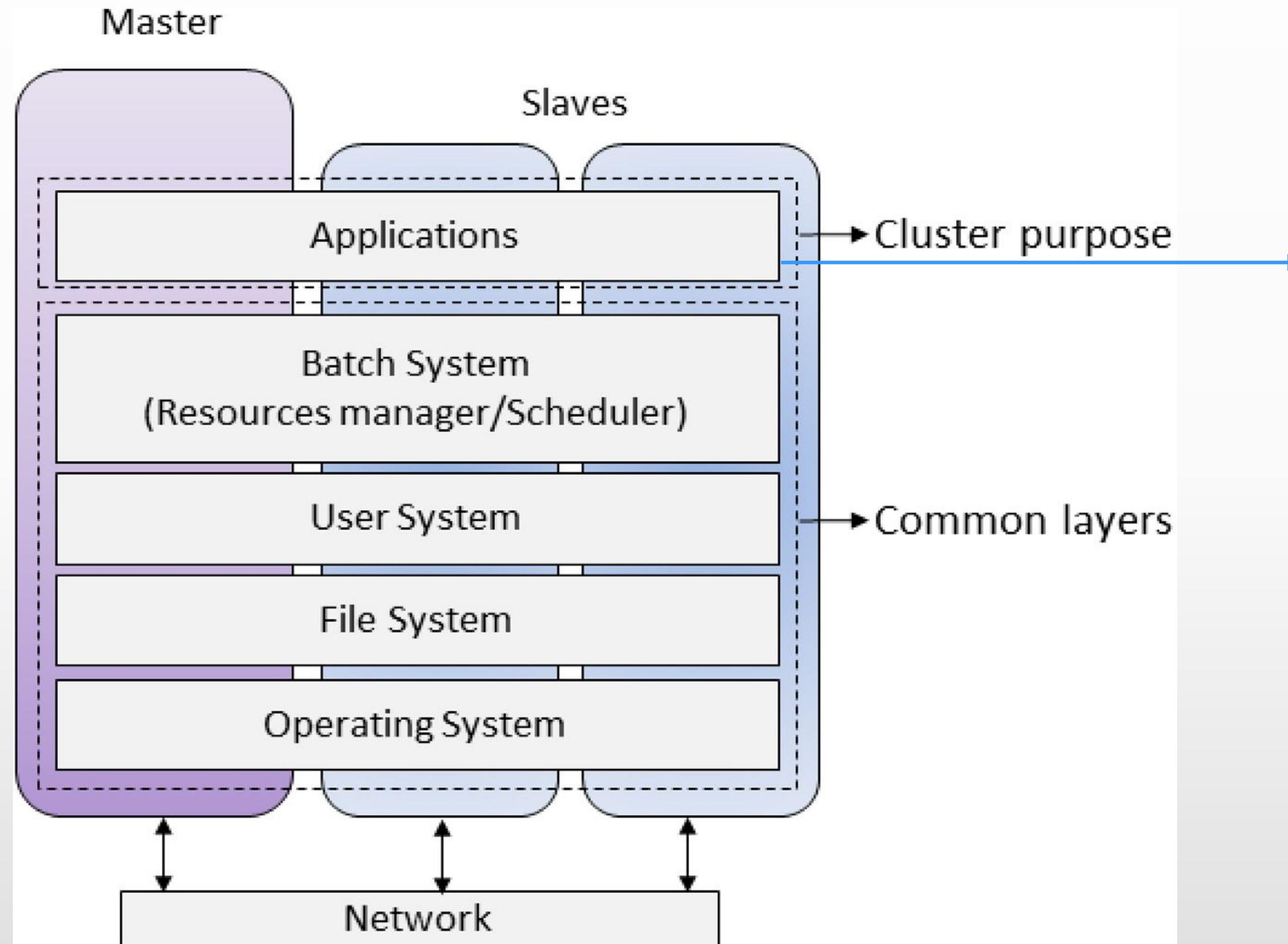
Cohesión

Supercomputer in the edge

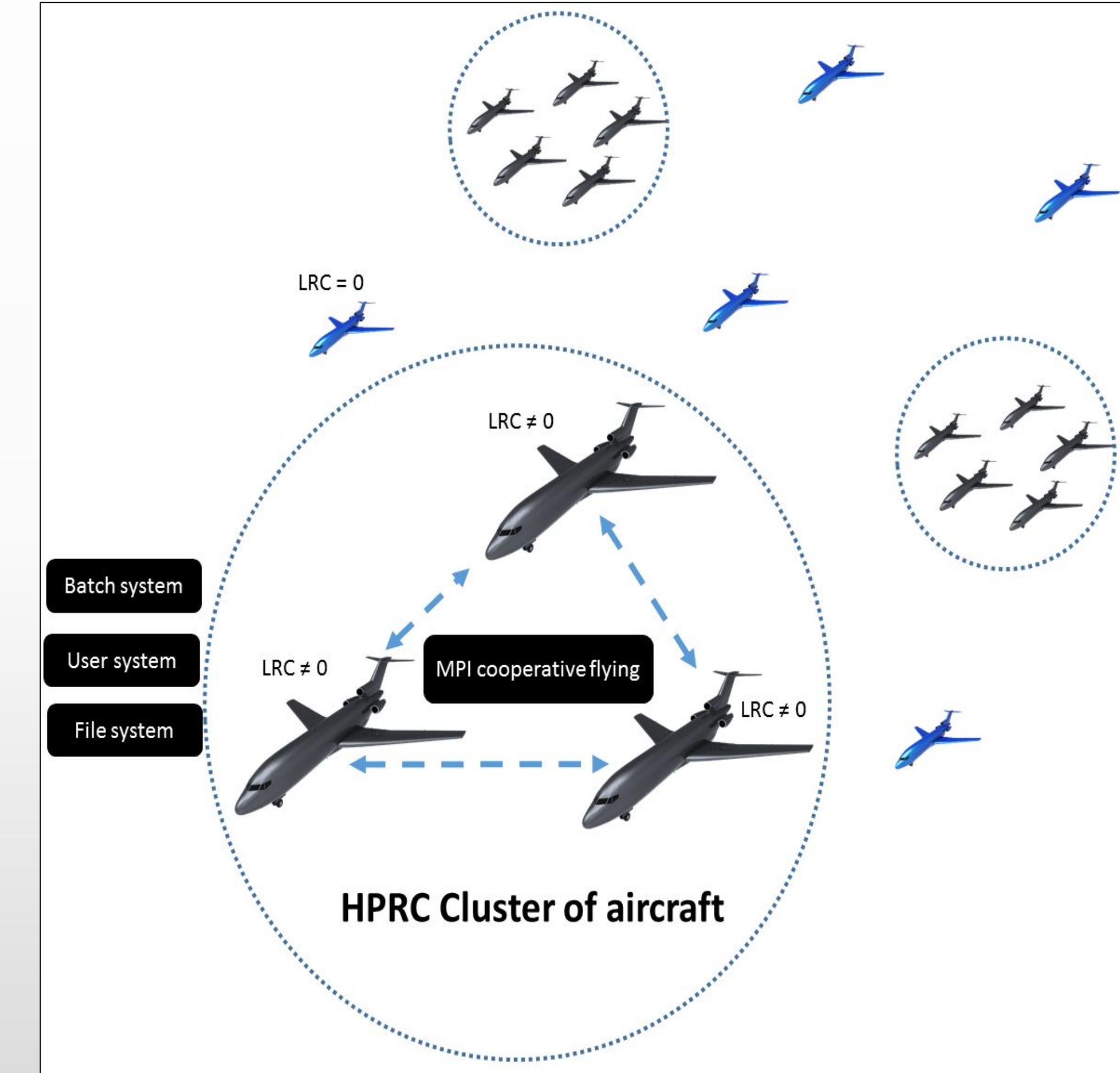
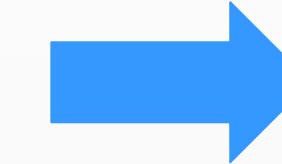
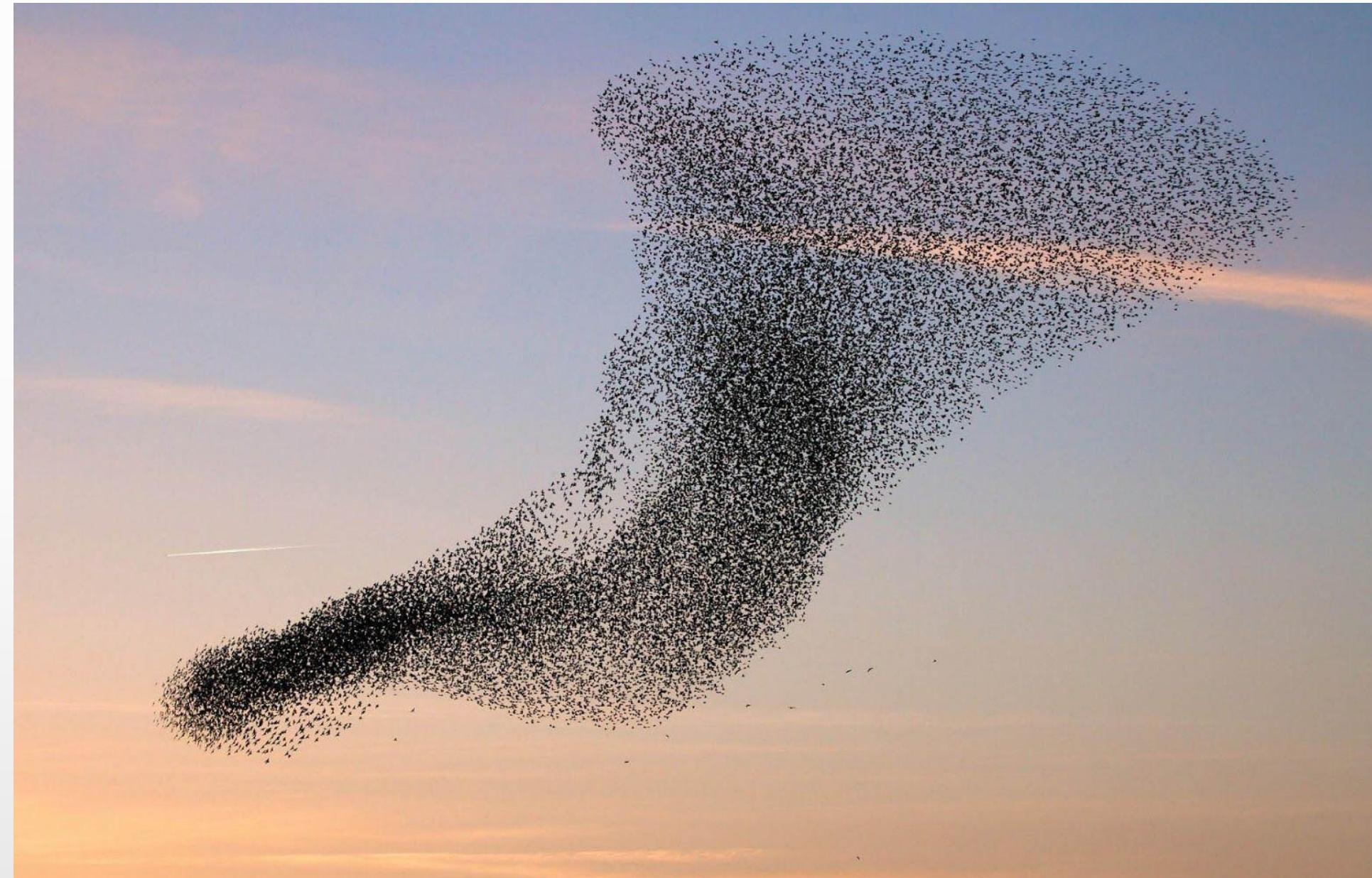
General-purpose, Scalability, Heterogeneity, User-transparency, Cooperation, Hierarchy, Standardization, Resilience, Centralization/distribution, Performance

APPLICATIONS

HPRC Vicsek



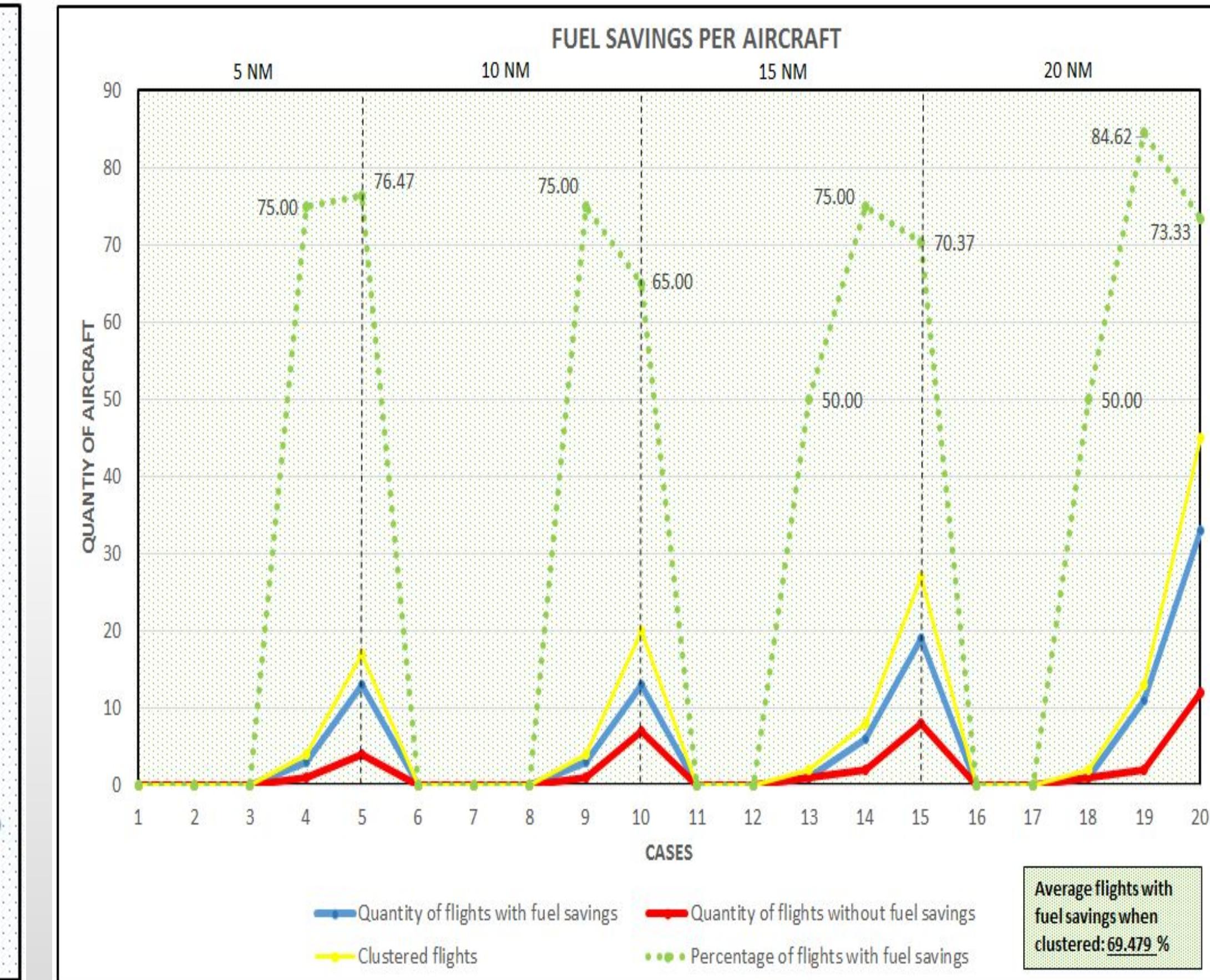
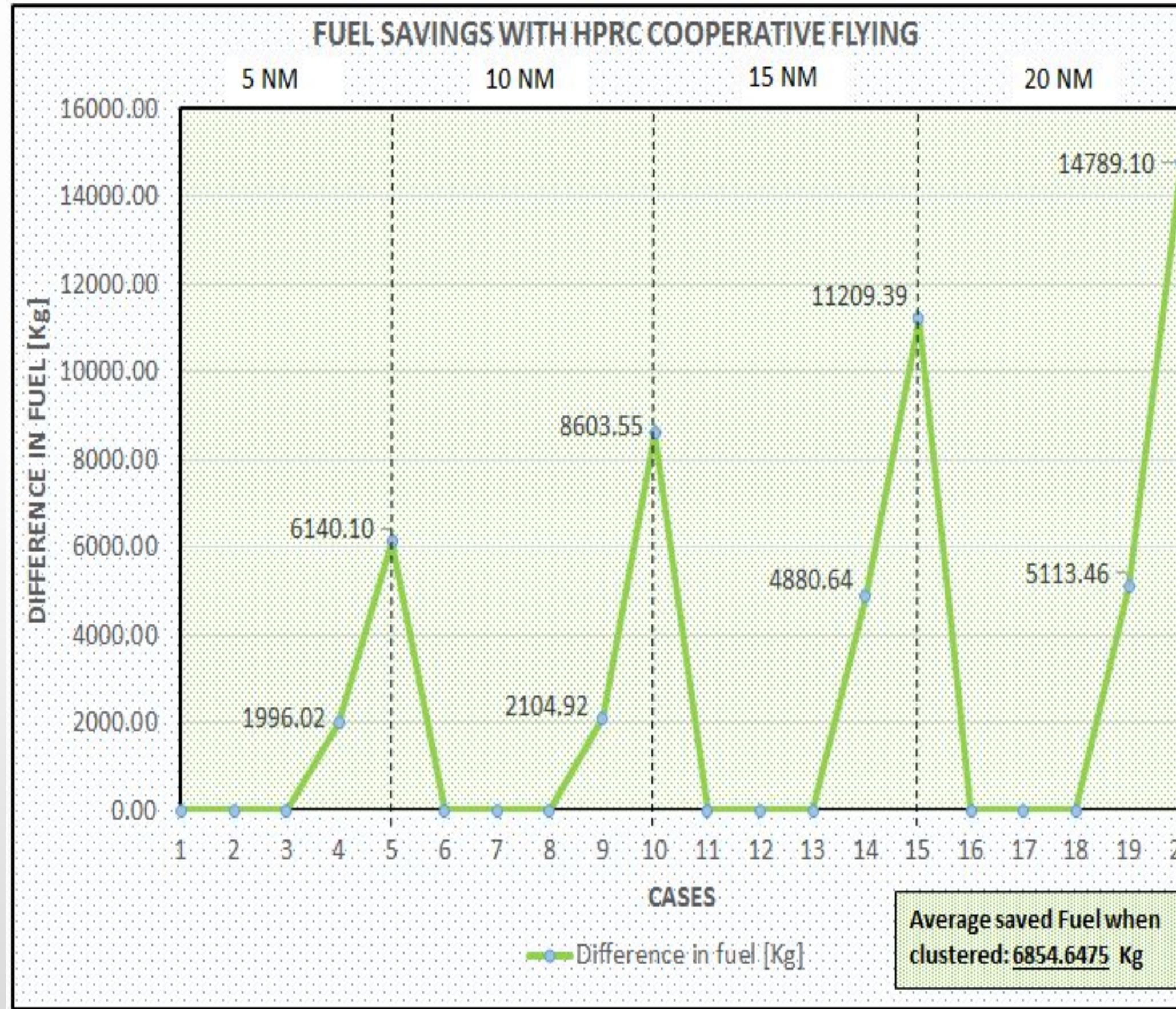
HPRC cluster of aircraft



Cooperative flying via HPRC

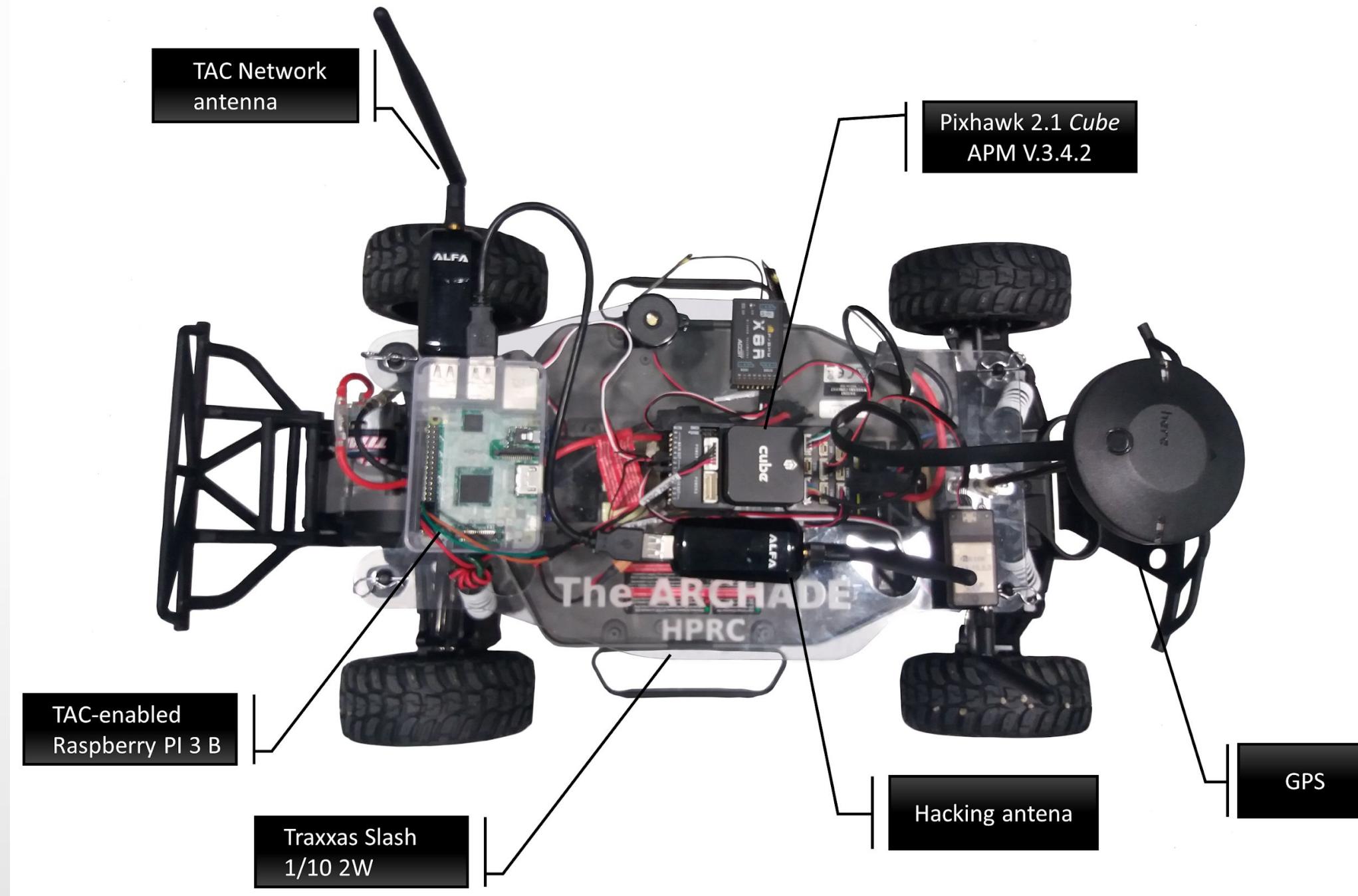
HPRC cluster of aircraft

<https://github.com/leonardocfor/cofl>



Cooperative flying via HPRC

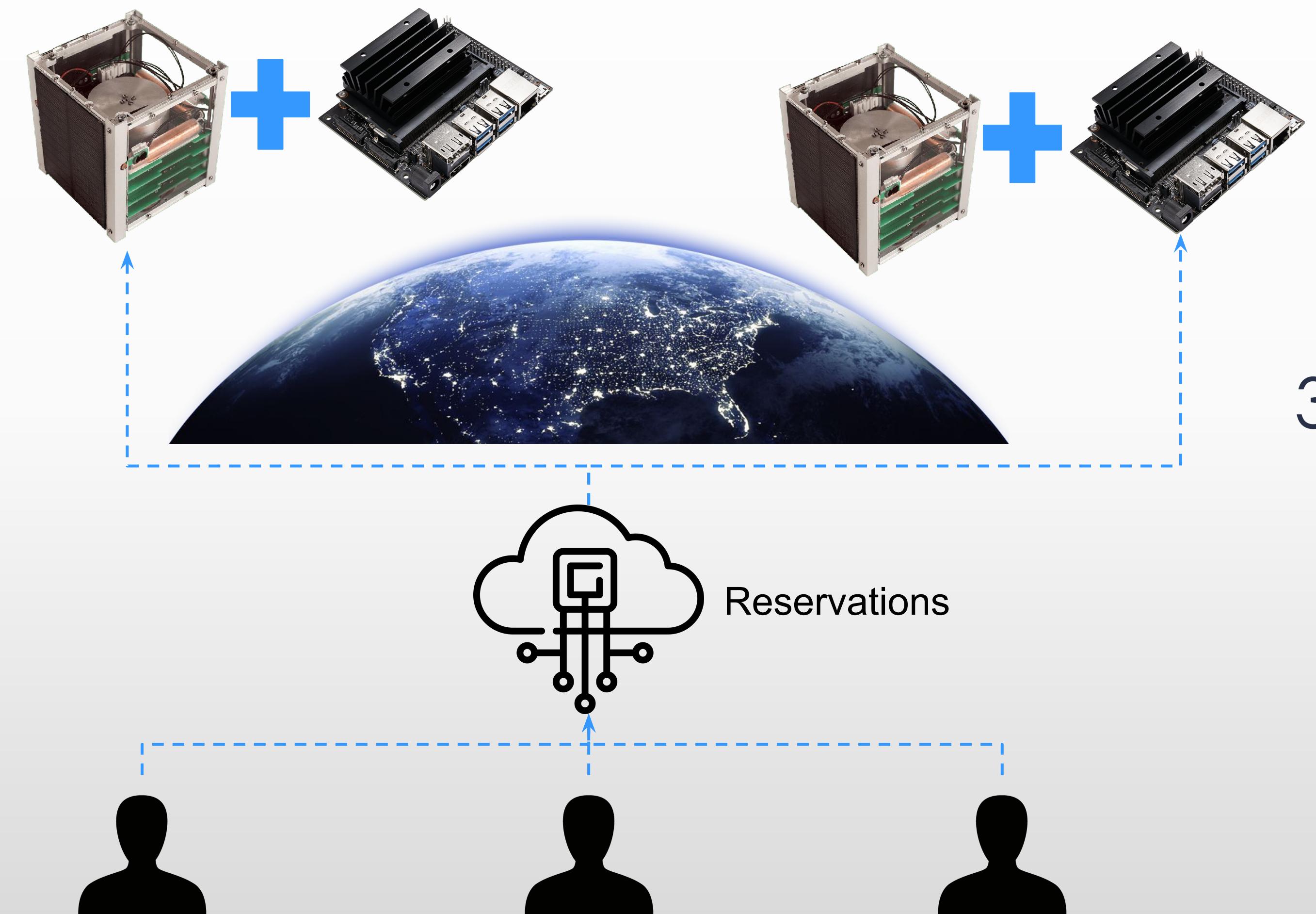
Leader/followers & Hacker rovers



Supercomputer in space



Spacecraft Constellation



Space Mission as a Service (SMaaS)

Where to use HPRC?



Precision agriculture



Search & Rescue



Monitoring



Construction



Oil & Gas



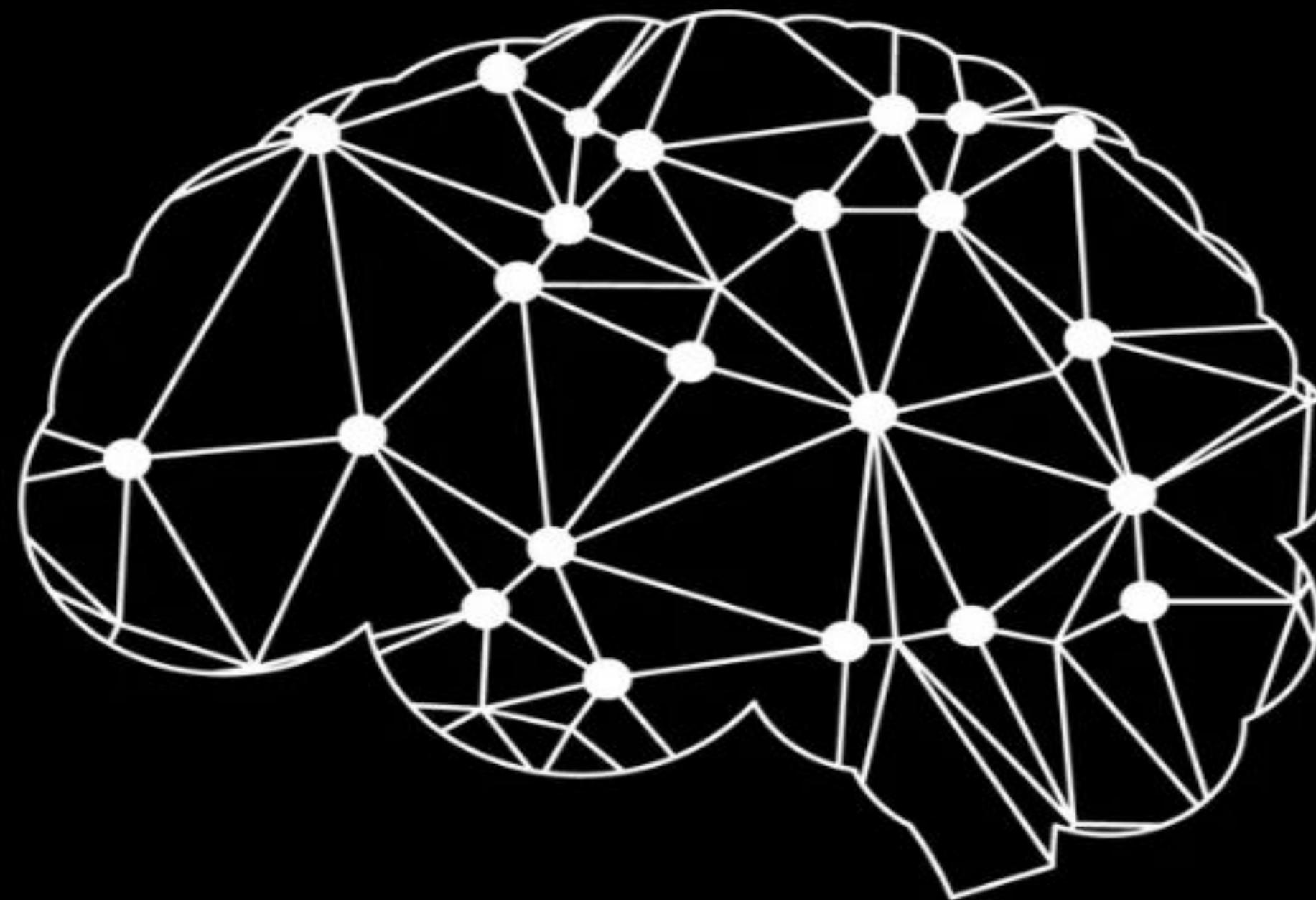
Real state



Police / Firemen / Coast guard



Drone sports



<https://www.ubihpc.com/aiot>

The ARCHADE

- A distributed AIoT collective intelligence to join them all -

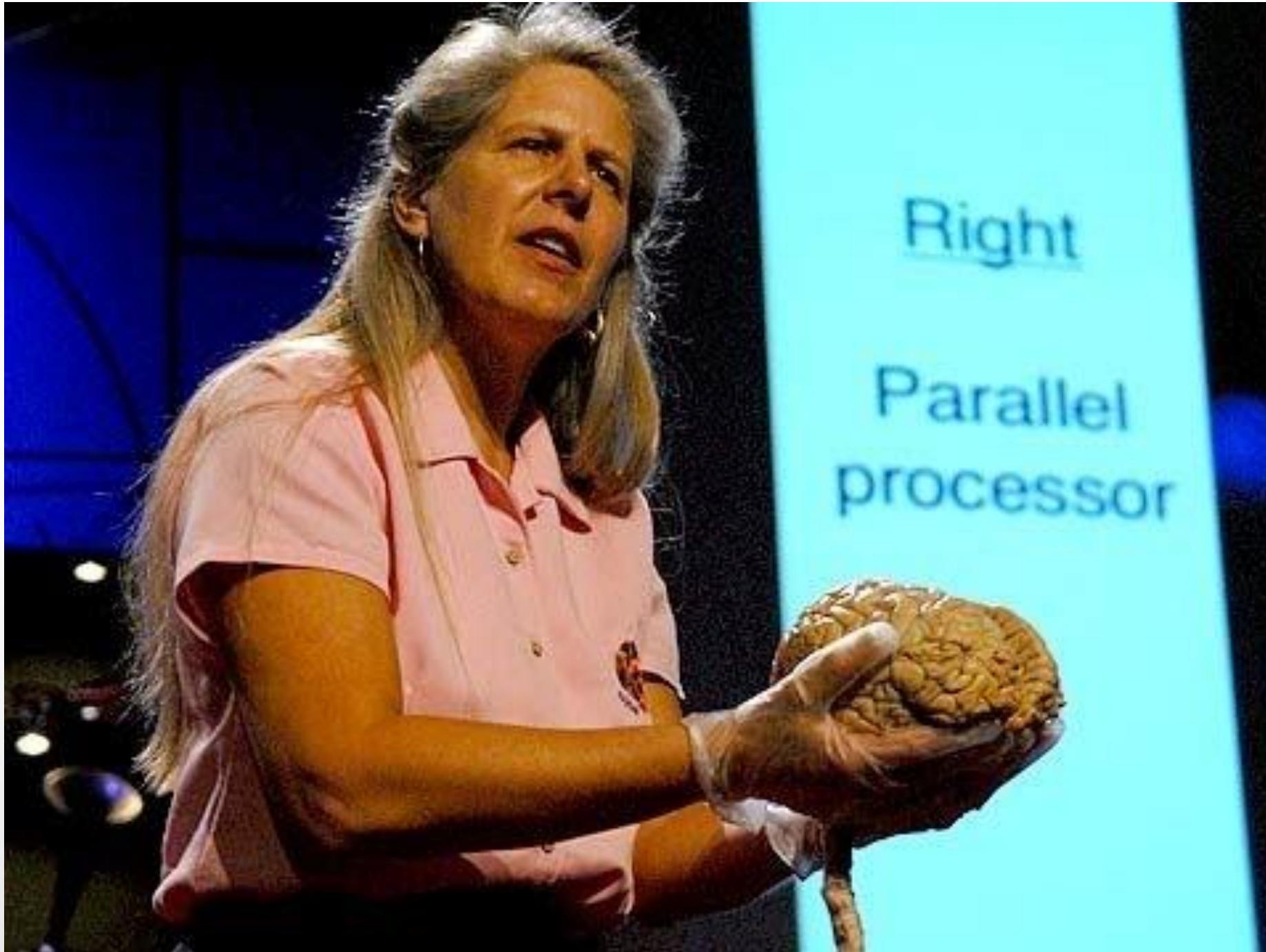
CONTACT US

The ARCHADE is a software framework to quickly and easily build AI-powered systems for anything you wish in industries such as energy, precision agriculture, IoT, robotics, goods or infrastructure monitoring, drone sports, police/military applications, IT security and much more



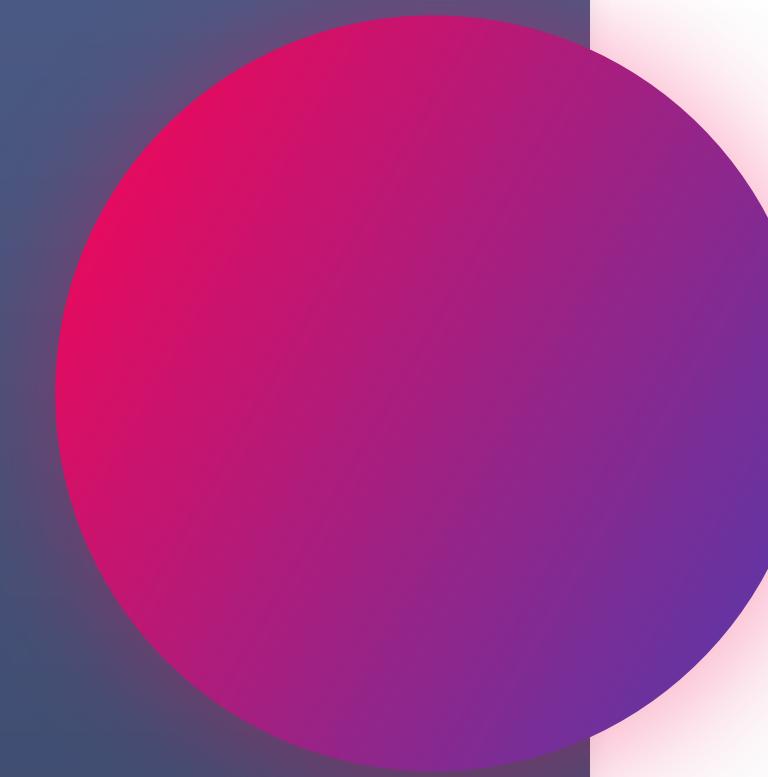
For the next class

For the next class



Elevator pitch
Canvas on class

Gracias



leonardocamargoforero



leonardocamargoforero1@gmail.com