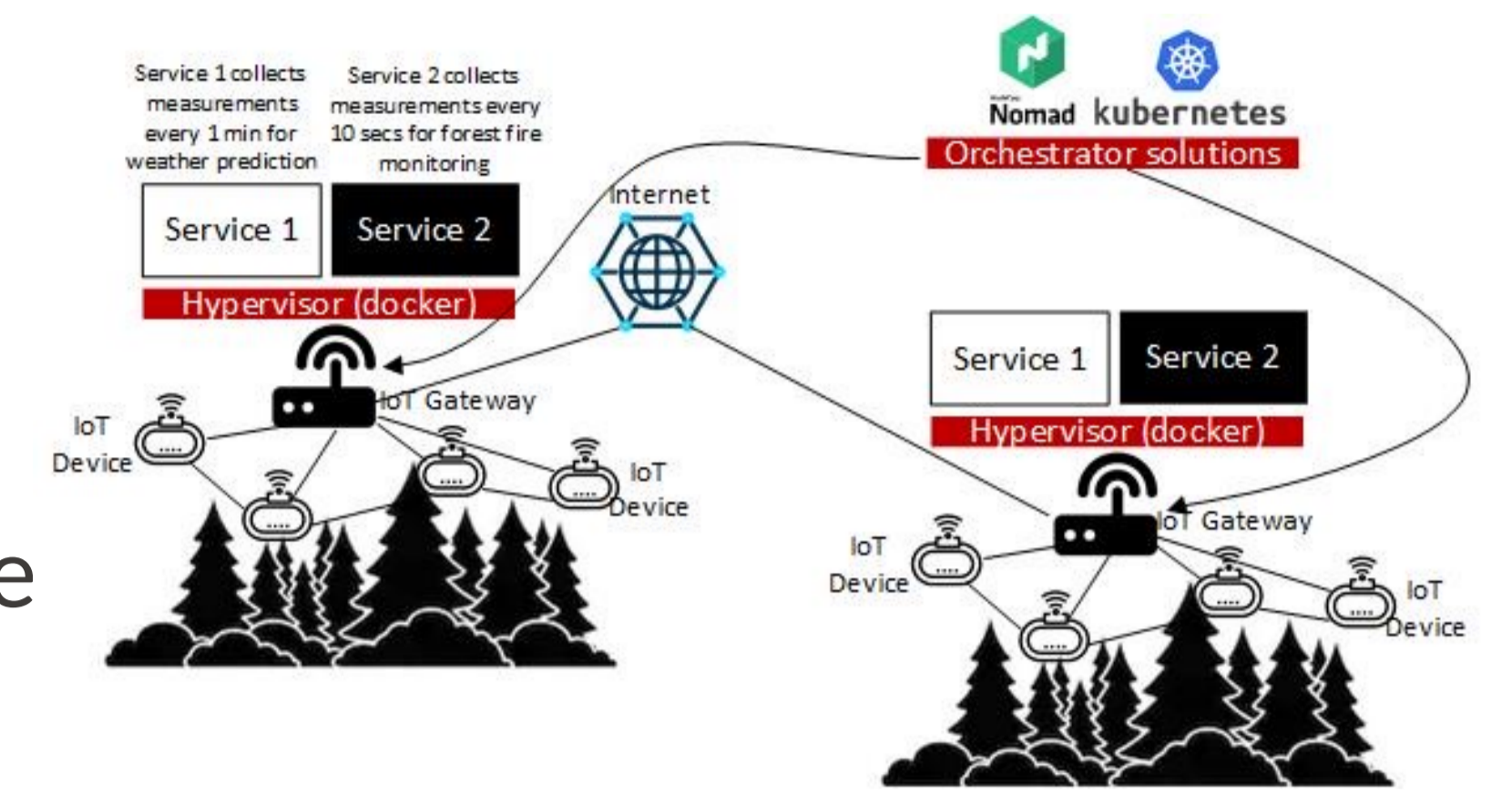


Background and Objectives

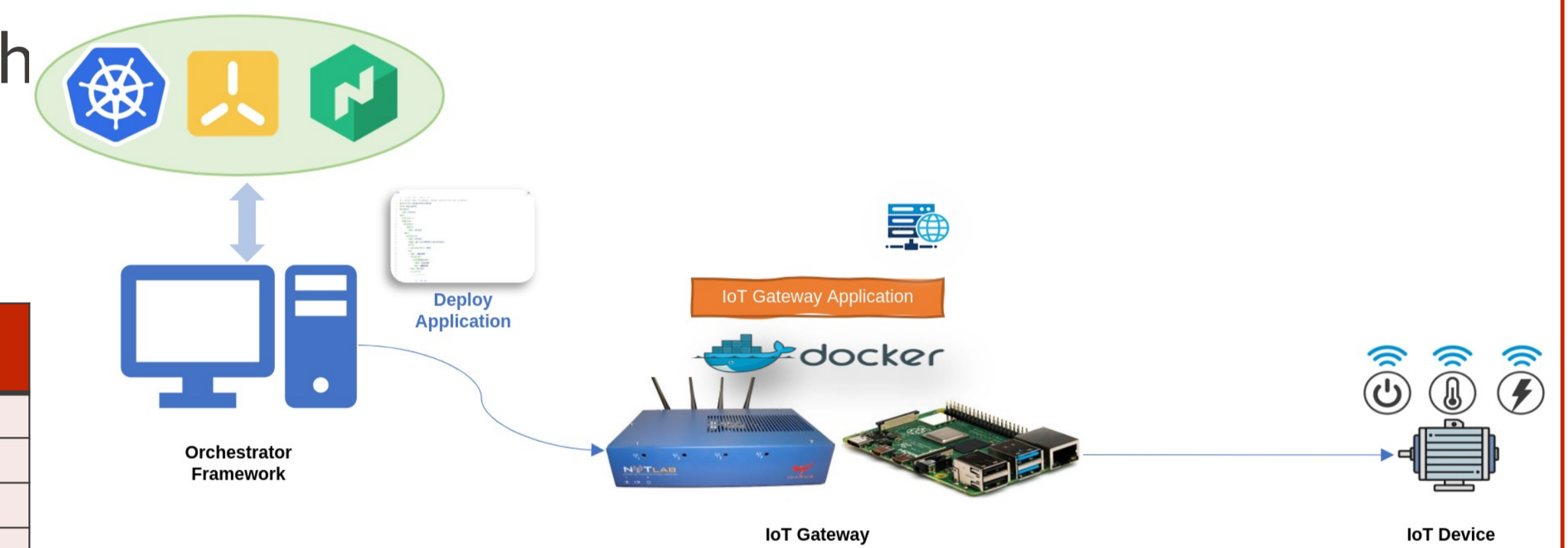
- Goal: can we virtualize an IoT gateway platform efficiently in a 5G based environment?
 - Gateways are usually low-powered resource constrained devices, optimized for their operation of collecting and uploading measurements over the network
- Objectives:
 1. To evaluate the execution of virtualized services on top of IoT equipment over two different gateway platforms (x86 and ARM)
 2. To examine different solutions for orchestrating such virtualized IoT environment
 3. To examine the feasibility of slicing and multi-tenancy in IoT equipment



Experiment Setup

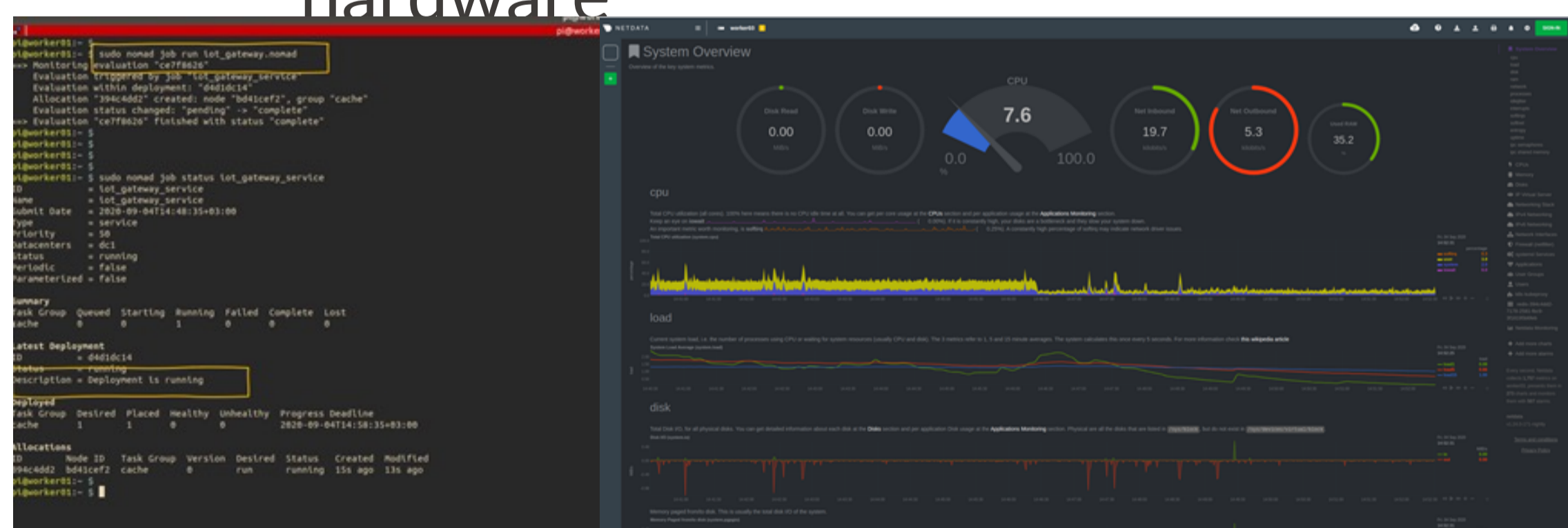
- Experimental evaluation of different orchestration solutions for resource constrained IoT gateway devices
- Polytech IoT gateway solution has been developed in a docker virtualized format
- Three orchestration solutions have been evaluated, allowing the deployment of docker containers
 - Hashicorp Nomad, optimized for devices with nomadic behaviour (that appear and disappear from the network)
 - Kubernetes framework, the state-of-the-art solution for managing edge datacenters
 - K3s, a lightweight fork of the Kubernetes project, showing better behaviour in resource constrained devices
- The respective images were developed in the NITOS testbed for enabling the orchestration over NITOS nodes, or Polytech IoT devices
- Configuration includes the setup of one testbed node as the “master” and a second one as the “worker” node that hosts the IoT gateway application

	Hardware Requirements					
	CPU (core)		RAM		DISK	
	Master	Worker	Master	Worker	Master	Worker
Nomad	1	0.5	512 MB	256 MB	512 MB	512 MB
K3s	1	0.5	512MB	75 MB	200 MB	200 MB
K8s	1.5	0.5	2 GB	1 GB	2 GB	2 GB

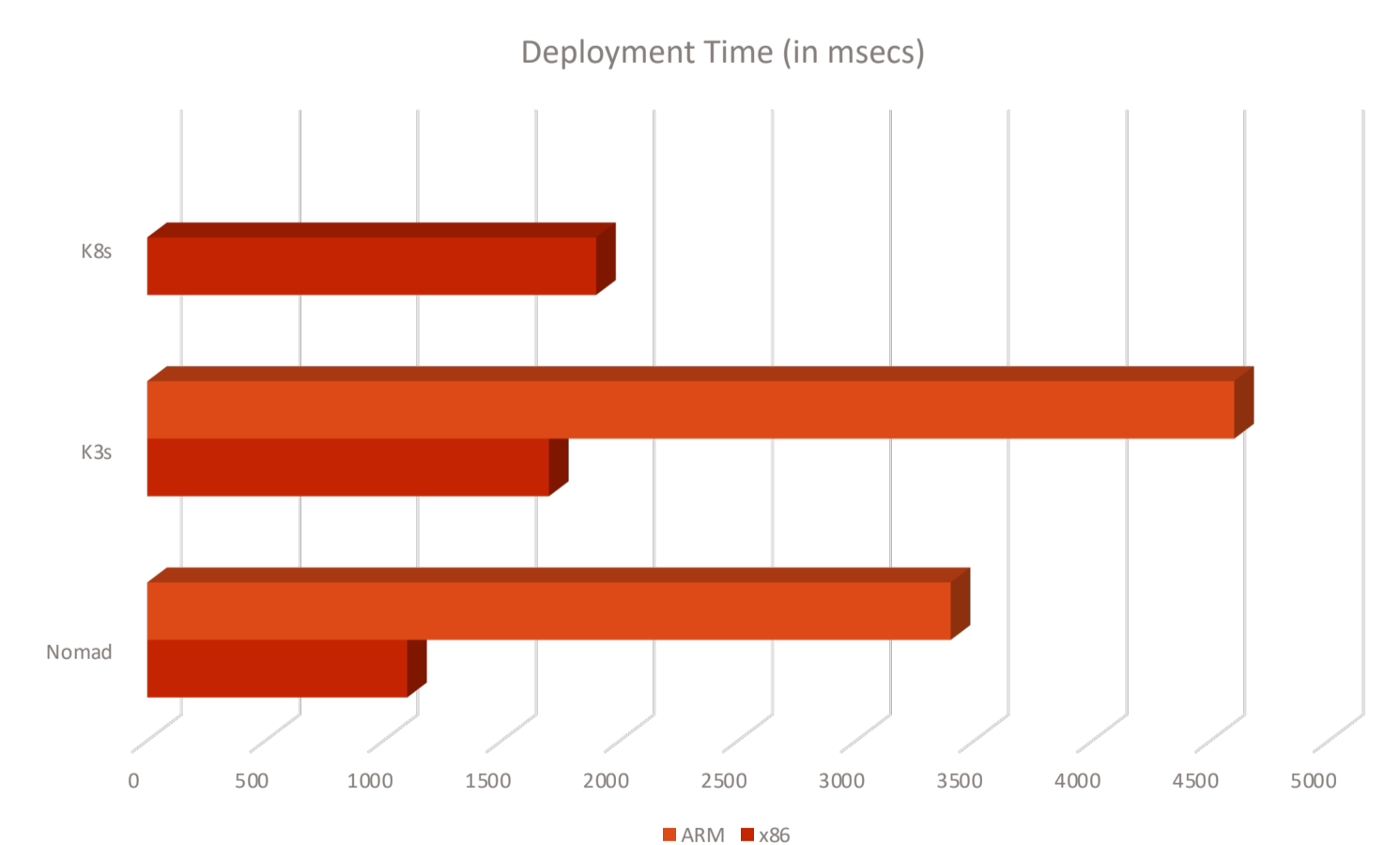


EXPERIMENT RESULTS

- We measure the time needed to deploy and initialize the IoT gateway application on the nodes
- Additional tools were deployed for monitoring the health and resource consumption of the hosting hardware (NITOS and Polytech nodes)
 - Tools included the popular Prometheus tools, and the NetData application installed as services on the hosting hardware



IoT Gateway Device	Deployment Time		
	Nomad (sec)	K3s (sec)	K8s (sec)
X86	1.1	1.6	1.8
ARM	3.3	4.6	-



CONCLUSIONS & POST MORTEM

- Results denote that the Nomad solution is the best performing for such environments
- The hosting hardware plays a significant role in the overall performance
- Multi-tenancy has been evaluated over the Polytech IoT hardware, and can support up to three concurrent experiments without any performance degradation
- The experiment outcomes are considered for integration to the Polytech IoT labs, enabling to drastically cut down the costs of the extra hardware needed in classroom environments