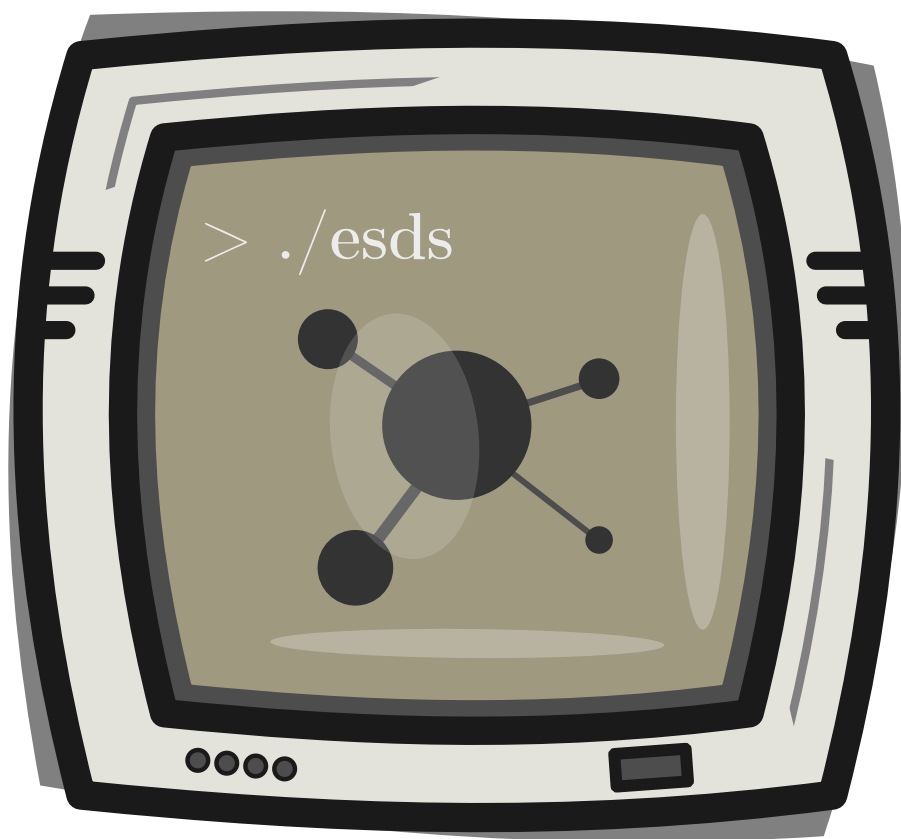


User Manual

— ESDS v0.0.1 —

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ESDS an Extensible Simulator for Distributed Systems

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1 Architecture of ESDS

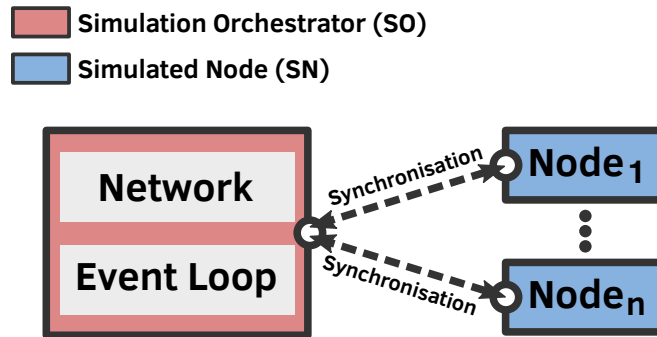


Figure 1: Simulation architecture used by ESDS

ESDS simulator comprises two major components: 1) The Simulation Orchestrator (SO) 2) The Simulated Nodes (SN). This architecture is depicted in Figure 1. The SO is the main process in charge of implementing the simulation main loop. It instantiates the network (e.g bandwidths and latencies), collects and processes the events (e.g communications, turn on/off). On the other hand, nodes are threads that implement the node behaviors.

2 Getting started

To run a simulation, at least 2 files are required: 1) a platform file 2) a node implementation source code. The platform file defines the simulated network platform (network links and performances etc.) and sets various simulation parameters. The node implementation source code provides the logic of the simulated nodes.

2.1 Platform file

Platform files are written in YAML and contains 3 sections namely: 1) *general* 2) *nodes* 3) *interfaces*. The *general* section is optional but all the other sections must be present. Here is an example of a simple platform file to simulate 2 wireless nodes:

```
assets/platform.yaml

general:
  interferences: on # Turns on interferences

nodes:
  count: 2
  implementations:
    - all node.py
  arguments: {
    "0": "sender",
    "1": "receiver"
  }

interfaces:
  wlan0:
```

```
type: "wireless"
links:
  - all 50kbps 0s all # All nodes are reachable by each other
txperfs:
  - all 50kbps 0s
```

2.2 Node implementation file

Nodes implementations are written using python. Here is the implementation of the node mentioned in the last `platform.yaml` file:

`assets/node.py`

```
def execute(api):
    role=api.args # "sender" or "receiver" cf. platform.yaml
    if role == "sender":
        api.send("wlan0", "MY MESSAGE", 10, None)
    else:
        api.receive("wlan0")
```

2.3 Execution

To execute our first simulation, the following command should be executed from the same folder that contains `platform.yaml` and `node.py`:

```
> esds run platform.yaml
```

Here is the output of the simulation:

```
[t=0.000,src=n0] Send 10 bytes on wlan0
[t=0.002,src=n1] Receive 10 bytes on wlan0
[t=0.002,src=esds] Simulation ends
```

In this case, simulation tooks 0.002s and 10 bytes were sent on the wlan0 interface from node 0 (src=n0) to node 1 (src=n1).

2.4 Custom orchestrator instantiation

Instead of using a `platform.yaml` file, it is possible to instantiate manually the esds orchestrator. To do so, you need to implement that procedure in a python file. Here is an example that performs the exact same simulation presented in Section 2.3 but with a custom instantiation of the orchestrator:

`assets/orchestrator.py`

```
#!/usr/bin/env python

import esds
import numpy as np
```

```

n=2 # 2 nodes
B=np.full((n,n),50*1000) # Bandwidth+txperfs 5bps
L=np.full((n,n),0) # Latency 0s

s=esds.Simulator({"wlan0":{"bandwidth":B, "latency":L, "is_wired":False}})

##### Instantiate nodes with their implementation
s.create_node("node",args="sender") # Use node.py for the first node with "sender" as argument
s.create_node("node",args="receiver") # Now the second node

##### Run the simulation
s.run(interferences=True)

```

Next we can run the simulation:

```
> ./orchestrator.py
```

3 Platform file

As explain in Section 2.1, esds platform files comprise 3 sections:

1. **general:** to settings up esds
2. **nodes:** to configure the simulated nodes
3. **interfaces:** to create network the interfaces available for each nodes

Lets see in details the format of each section.

3.1 General

This section is used to settings up the overall parameters of esds. Table 1 reference all the keywords for this section of the platform file.

3.2 Node

The node section is used configure the simulated node of esds. Table 2 references all the keywords used in the nodes section.

Many entries in the platform file use a **range syntax** to map informations (node implementations, links etc.) to node ids. Indeed, when running a simulation with p nodes, each node will have an allocated id such that $id \in [0, 1, \dots, p - 1]$. Here are examples of the range syntax for a simulation that uses 5 nodes:

- **0,1,2,3** Node 0,1,2 and 3
- **0-2** Node 0,1 and 2
- **all** Node 0,1,2,3 and 4
- **2-@** Node 2,3 and 4
- **0-@** Node 0,1,2,3 and 4

Keyword	Description	Example
interferences	Turn on/off interferences detection during wireless communications	<code>interferences: on</code>
debug	Turn on/off esds debugging mode (generate a debug file)	<code>debug: on</code>
debug_file	Specify the file to use as output for the debugging	<code>debug_file: "./myfile.txt"</code>
breakpoints	Specify a list of simulated time (in seconds) at which esds should interrupt and call the specified callback	<code>breakpoints: [5, 6, 7]</code>
breakpoints_every	Specify an interval of time (in seconds) at which esds will interrupt and call the specified callback	<code>breakpoints_every: 5</code>
breakpoints_callback	Tell esds where how to reach the callback used during breakpoints	<code>breakpoints_callback: file: "platform_callback.py" callback: "callback"</code>

Table 1: Usable keywords in the general section of a esds platform file.

Keyword	Description	Example
count	Number of simulated nodes	<code>nodes: 5</code>
implementations	Bind each node to their respective implementation (uses the range syntax)	<code>implementations: - 0 sender.py - 1-0 receiver.py</code>
arguments	Define the arguments that should be pass to each node implementation (keys of each element uses the range syntax)	<code>arguments: { "all": 2 }</code>

Table 2: Usable keywords in the nodes section of a esds platform file.