User Manual

— ESDS v0.0.1 —

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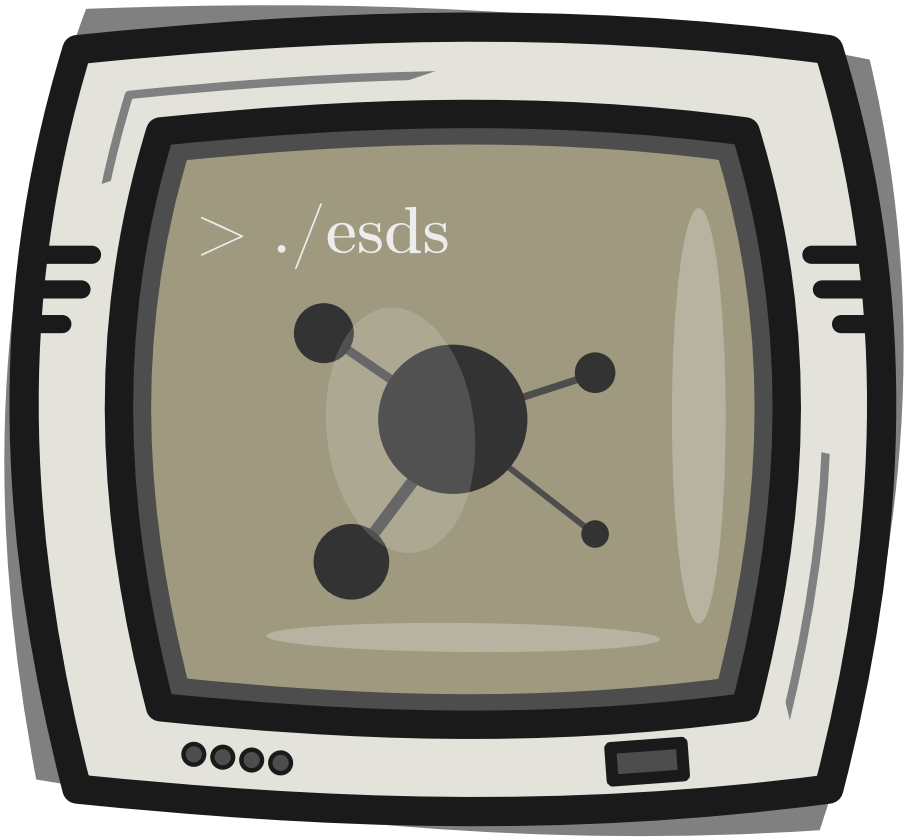

ESDS an Extensible Simulator for Distributed Systems

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1 Architecture of ESDS

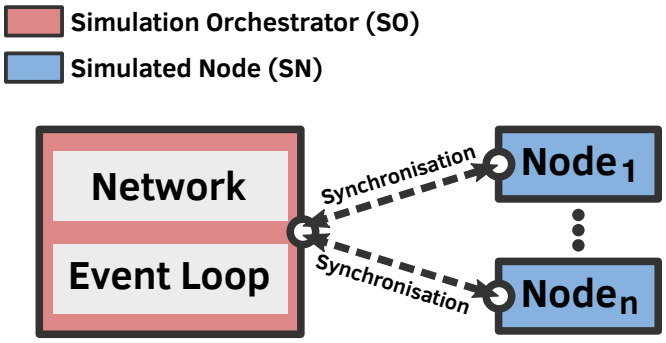

Figure 1: Simulation architecture used by ESDS

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

```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 run our first simulation, the following command can be run: 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 and 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) # Bandwith+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 The general section

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.

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

breakpoints_callback	Tell esds where how to reach the callback used during breakpoints.	`breakpoints_callback:`
		`  file: "platform_callback.py"`
		`  callback: "callback"`

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

3.2 The node section

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

Keyword	Description	Example
count	Number of simulated nodes.	`nodes: 5`

implementations	Bind each node to their respective implementation (uses **the range syntax**).	`implementations:`
		`  - 0 sender.py`
		`  - 1-@ receiver.py`

arguments	Define the arguments that will be passed to each node implementation (keys of each element uses **the range syntax**).	`arguments: {`
		`  "all": 2`
		`}`

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

Several 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 $id \in [0, 1, ..., p-1]$. Here are examples of valid 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 (same as **all**)

4 The interfaces section

The interfaces section allows to define the network interfaces that will be usable by each node during the simulation. For each interface the Table 3 references the available keywords.

Keyword	Description	Example
type	Interface is "wireless" or "wired".	`type: "wireless"`

links	List all the links between nodes on the interface (uses **the range syntax**).	`links:`
		`  # Link node 0 to node 1:`
		`  - 0 10Mbps 0s 1`
		`  # Link node 1 and 2 to node 3 and 4:`
		`  - 1,2 1 Mbps 5s 3,4`

txprefs	Define the transmission performance of each wireless node (keys of each element uses **the range syntax**). This keyword is only available for wireless interfaces.	`txprefs:`
		`  - 0 10kbps 0s`
		`  - 1 10kbps 5s`

Table 3: Usable keywords for each interface in the interfaces section of a esds platform file.

In esds, txprefs (or transmission preferences) corresponds to the transmission performance of the wireless interface. It is used to compute the transmission duration of the wireless communication. When using custom orchestrator instantiation, the txprefs can be assigned on the diagonal components of the bandwidth and latency matrices.