

An overview of Fed4FIRE testbeds – and beyond?

Or: how to categorize and map all testbeds?

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Problem statement

- ▶ **Many testbeds available**, with diverse features and capabilities
 - ▶ Challenging for prospective users to **understand which testbeds match their needs**
 - ◆ Many experimenters just ignore that our testbeds could help them!
 - ▶ Consequences:
 - ◆ Experimenters using sub-optimal solutions
 - ◆ Additional testbeds being built \rightsquigarrow duplication of efforts
- Side note: this is not necessarily bad:
- ★ Explore different (better?) solutions to the same problem
 - ★ Explore reproducibility of experiments in various environments
- But that requires knowing about the alternatives

How can we (as a community) solve this?

Two different but related problems

► Description of resources inside testbeds: problem mostly solved

- ◆ hardware_type_info RSpec extension (supported by jFed)¹

```
<hardware_type_info xmlns="https://doc.fed4fire.eu/rspec/ext/hwinfo/1">
  <overview media-type="text/plain">Test</overview>
  <overview media-type="text/html" href="https://doc.ilabt.imec.be/ilabt-documentation/virtualwallfacility.html#virtual-wall-2"/>
  <hardware_type name="pcgen03-1p" hrn="Generation 3 (1 iface)">
    <info media-type="text/plain">2x Hexacore Intel E5645 (2.4GHz) CPU, 24GB RAM, 1x 250GB harddisk, 1 gigabit nic</info>
  </hardware_type>
  ...
</hardware_type_info>
```

★ And attempts at processing using ontologies²

- ◆ JSON-based description of resources for cloud testbeds (Grid'5000, Chameleon), and tools to explore this data³

► Description of testbeds

- ◆ Much harder problem
- ◆ Several attempts in the past (e.g. FI-XIFI EU project, ended in 2015; testbed categories filters in jFed)
- ◆ **Open issue: no good current overview**

¹ <https://doc.ilabt.imec.be/jfed-documentation-5.9/amdevelopers#advertisement-rspec-extension-hardware-information>

² Alexander Willner et al. "Using Semantic Web Technologies to Query and Manage Information within Federated Cyber-Infrastructures". In: *Data 2 (2017)*, page 21.

³ David Margery et al. "Resources Description, Selection, Reservation and Verification on a Large-scale Testbed". In: *TRIDENTCOM 2014*.

What we should do

- ▶ Inspiration: Wikipedia comparison pages
- ▶ Start small, get something done, iterate
 - ◆ *Perfect is the enemy of good*
 - ◆ Surveys of fast-moving targets are difficult to maintain
 - ★ Trade-off with level of detail

What we should do (2): testbeds categories

Proposed plan:

➊ Identify testbeds categories based on typical target experiments

(First attempt:)

- ◆ Cloud and HPC
 - ★ Test software stacks, usually distributed, at scale, on servers with bare metal deployment capability, controllable network, etc.
- ◆ Internet-scale networking and SDN
 - ★ Nodes deployed in various sites, manageable network equipment, netFPGAs, etc.
- ◆ Wireless
 - ★ Nodes (often controllable) that can communicate over various protocols, SDR devices, etc.
- ◆ Federations and other kinds of testbeds aggregates

What we should do (3): features per categories

2 For each category, identify the main distinguishing features

Example: Wireless testbeds

- ◆ **Environment:** Anechoic chamber, Indoor, Outdoor
- ◆ **Hardware (and configurability):** embedded PC with Linux, microcontrollers, USRPs (SDR)
- ◆ **Supported protocols**

Also more general features, such as:

- ◆ Supported experiment management protocols (SFA?) and tools
- ◆ Access and usage policy
- ◆ Health level / TRL

Example: Fed4FIRE and FIT (20 testbeds)

- ▶ Cloud and HPC: **Virtual Wall (+ Tengu), Grid'5000, ExoGENI@UvA**
- ▶ Internet-scale networking and SDN: **OFELIA I2CAT island, PL-LAB, GTS, PlanetLab Europe**
- ▶ **Wireless:**

Name	Hardware	Environment	Typical protocols	Configurability
IRIS	20x USRP N210	Indoor	5G, any (SDR)	
LOG-a-TEC	VESNA sensor nodes (ARM Cortex M3)	Outdoor	6LoWPAN, ZigBee	
NETMODE	embedded PCs	Indoor + roof	Wi-Fi	
PerformLTE / Triangle	LTE equipment: eNodeB, UE, emulators	Indoor	4G / LTE	
Smart Santander		outdoor	802.15.4	access to collected data only
w-iLAB.t	embedded PCs, USRPs, spectrum scanners	Indoor (utility room + offices)	Wi-Fi, 802.15.4, BT	bare-metal access
CityLab	embedded PCs	Outdoor (city)	Wi-Fi, 802.15.4, BT, LORA	bare-metal access
Portable Wireless Testbeds	embedded PCs with several wireless NICs	depends	Wi-Fi, 802.15.4	bare-metal access
NITOS	embedded PCs, USRPs, spectrum scanners	indoor and outdoor	Wi-Fi, WiMAX, LTE	
FIT IoT-Lab	Microcontrollers (MSP430, STM32), emb. PCs, mobile robots	Several indoor deployments (dedicated rooms or offices)	802.15.4. some BLE	bare metal access
FIT CortexLab	29 x USRP N2932, Nutaq Pi-coSDR	Anechoic chamber	any (SDR)	
FIT R2Lab	Nitos X50, USRP B210, USRP N210, USRP 2, and USRP 1, LimeSDR, smartphones	Anechoic chamber	Wi-Fi, any (SDR)	bare metal access

Next steps

- ▶ Refine categories and features
- ▶ Correct information (together with testbeds owners)
- ▶ Extended to other testbeds (and maybe identify other categories)
- ▶ Publish
- ▶ Maintain over time

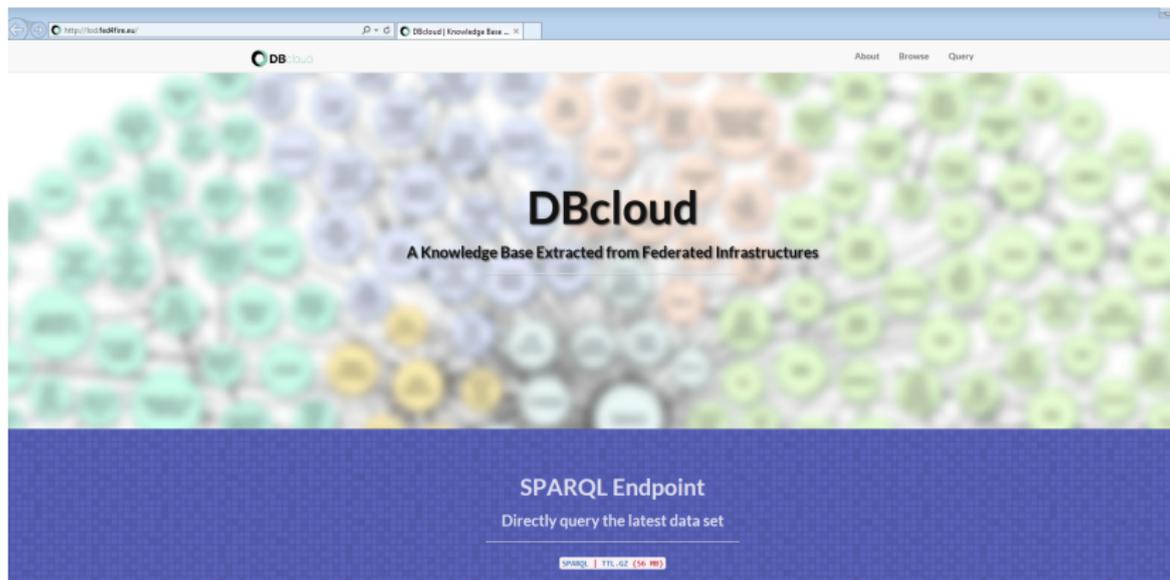
Interested in contributing? Talk to me or email me!

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Backup slides

Ontologies and Fed4FIRE

Live version on <http://lod.fed4fire.eu/> or <http://193.191.148.159/>



The screenshot shows a web browser window with the address bar containing <http://lod.fed4fire.eu/>. The page header includes the DBcloud logo and navigation links for 'About', 'Browse', and 'Query'. The main content area features a background image of a network graph with nodes in various colors (green, blue, orange, yellow). The text 'DBcloud' is prominently displayed in the center, with the subtitle 'A Knowledge Base Extracted from Federated Infrastructures' below it. At the bottom, a dark blue banner contains the text 'SPARQL Endpoint' and 'Directly query the latest data set', with a small 'SPARQL | ITIL-G2 (V0.00)' logo at the very bottom.

jFed hardware selection (based on Rspec)

Virtual Wall 2

The hardware of Virtual Wall 2 consists out of:

1st jupyter node:

- 1x Intel Xeon E5-2650v4 CPU
- 1x 32GB RAM
- 1x 250GB Hardisk
- 1x 10GbE network interface

2nd jupyter node:

- 1x Intel Xeon E5-2650v4 CPU
- 1x 32GB RAM
- 1x 250GB Hardisk
- 1x 10GbE network interface

3rd jupyter node:

- 1x Intel Xeon E5-2650v4 CPU
- 1x 32GB RAM
- 1x 250GB Hardisk
- 1x 10GbE network interface

Properties of node0

Node name: node0

Select testbed: imec Virtual Wall 2

Health: ♥ 54%

Free Bare Metal: ■ 64 of 321

Free IPv4's: ■ 30 of 53

Maintenances: ■ None planned

Infos:

- Testbed info
- Testbed documentation
- Hardware info

Health updated less than a minute ago.
Counts updated 15 minutes ago.

Disk Image:

Node:

- Any available node
- Specific node:
- Specific hardware type:
 - pcgen03-1p

Type: Generation 3 (1 iface)

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Details: 2x Hexacore Intel E5645 (2.4GHz) CPU, 24GB RAM, 1x 250GB harddisk, 1 gigabit nic

Only show available nodes/hardware types

Save Cancel

Availability per hardware type

Type	Available	Total
gpunode	2	2
gpunode2	4	26
gpunode3	3	8
gpunode3-v100	1	2
gpunode4	1	3
gpunode4b	0	1
netfpga4	1	2
pcgen03-1p	6	34
pcgen03-2p	4	24
pcgen03-4p	10	18
pcgen03-5p	3	16
pcgen03-7p	3	10
pcgen04	5	22
pcgen04-1p	1	3
pcgen04lsi	2	9
pcgen04raid-2p	0	1
pcgen05	5	48
pcgen05b	2	8
pcgen05c	11	18
pcgen06	0	65
supermode	0	1

Opens browser to testbed documentation

More specific hardware info (from Rspec)

jFed testbed selection

TestbedCategory Filters

- TestbedCategory selected
- cloud (contains 3 testbeds)
 - dev (contains 9 testbeds)
 - openflow (contains 3 testbeds)
 - wired (contains 4 testbeds)
 - wireless (contains 10 testbeds)



The screenshot shows the jFed Experimenter Toolkit interface. The top menu bar includes 'General', 'Topology Editor', and 'Device Editor'. The 'Resources' panel on the right lists various testbed types: Physical Node, Wireless Node, Virtual Machine, XEN VM, OpenVZ VM, Docker Container, Physical Router, Programmable Switching Device, Gateway, Dedicated Ext. Network Connection, LTE, 5G, IoT, Raspberry Pi, Wireless Channel, and Address Pool. A context menu is open over the 'Resources' panel, showing options: 'Add Testbed Filter...', 'Add Testbed Filter using map...', 'Add Federation Filter...', 'Add Organisation Filter...', 'Add Category Filter...', and 'Clear all Filters'.