

Federation of Community Networking Testbeds

Master Thesis



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Outline

1. Objective

2. Methodology

3. Federation

- Definition
- Pros and cons
- Challenges

4. Context

- Projects (Confine and Fed4FIRE)
- Community-Lab

5. SFA

- Basic concepts
- Federation standard

6. Federation of C-Lab

- Design (SFA Wrapper)
- Technical details
- Possibilities and limitations
- Evaluation

7. Demo

- jFed and C-Lab wrapper

8. Conclusions

- Summary
- Future work

Objective

Federation of Community Networking testbeds

Interoperability across experimental testbeds:

- Develop a federation tool for **Community-Lab** testbed that enables **federation** with other testbeds.

Methodology

- Analysis
- Design
- Implementation
- Testing
- Validation
- Operation
- Documentation

Definition

“A model for the establishment of a large scale and diverse infrastructure by the interconnection of multiple independent administrative domains” [1]

- Multiple independent systems working together: **Interoperability**
- Creation of a **richer environment**
- Applied on **FIRE**: cloud, testbeds

[1] *Pan-European testbed and experimental facility federation – architecture refinement and implementation*, Sebastian Wahle, Bogdan Harjoc, Konrad Campowsky, Thomas Magedanz, and Anastasius Gavras (2010)

Pros and Cons

- Creation of **heterogeneous** infrastructure
 - Cost reduction by **sharing** of resources
 - **Scalability, sustainability** of distributed systems
-
- Need for **standards**
 - **Accountability**
 - Trust, Central authority

Challenges

- Adaptation to **standards**
- Mapping of **testbed-specific** concepts
- **Users** management
- **Resource** management

Projects



Community Networks Testbed for the
future Internet:

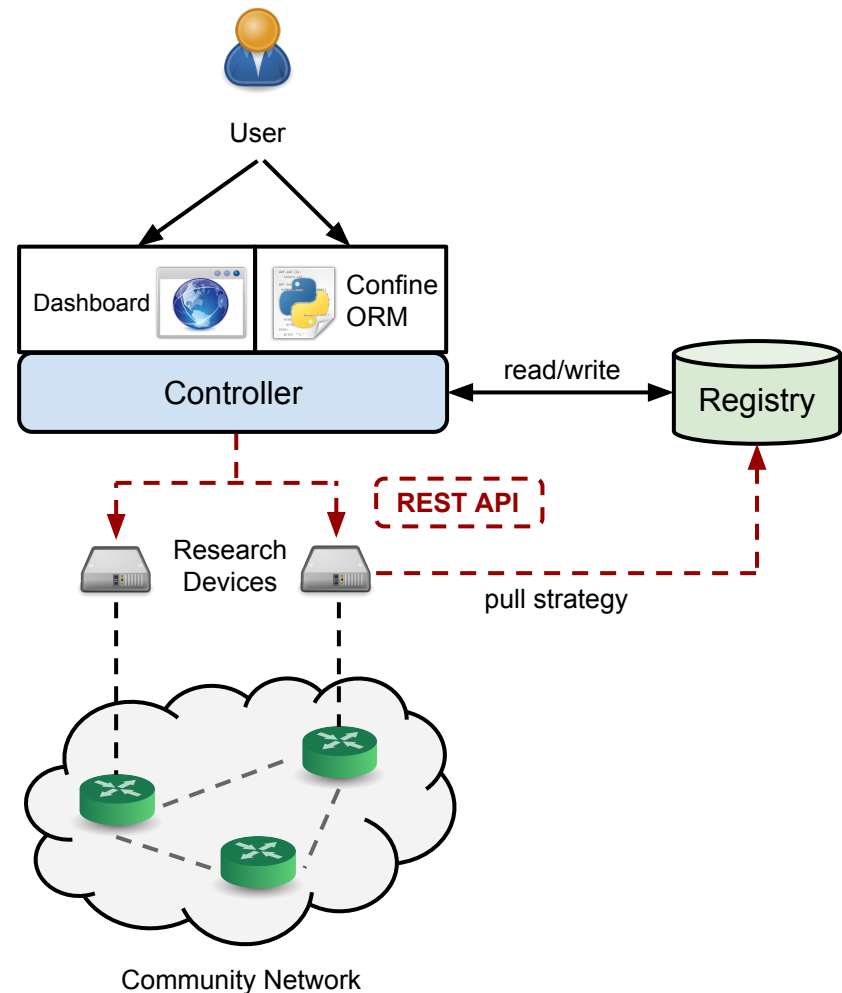
Community-Lab testbed



Federation of FIRE facilities

Community-Lab (C-Lab)

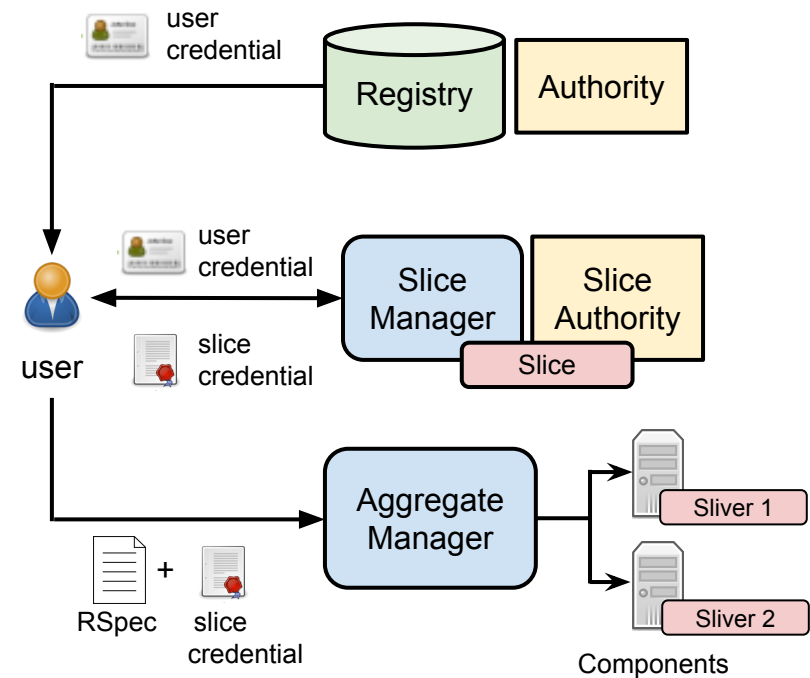
- Nodes from Community Networks
- **Research Devices**
- **Controller and Registry**
- Pull strategy
- Eventually consistent
- **REST API**
- **Dashboard**
- CONFINE Object Resource Mapper (**ORM**)
- Based on **SFA**



Slice-based Facility Architecture

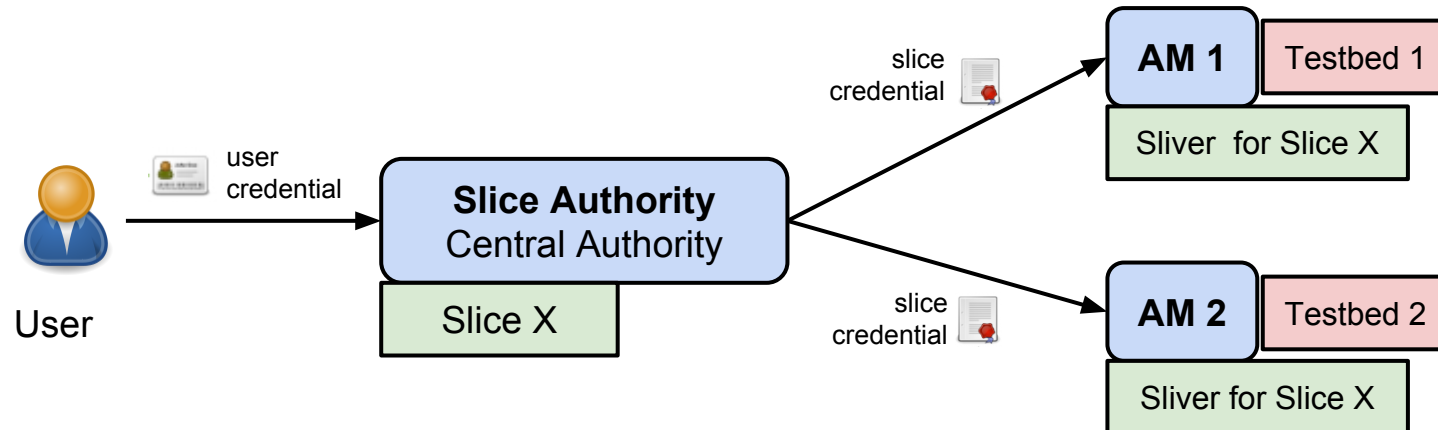
“Architectural model for testbeds that enables the sharing of resources and the federation”

- PlanetLab project
- Components, **slivers**, **slices**
- Managers: **Aggregate**, **Slice**
- Registry (database)
- Authorities (domains)
- **Credentials** (users, slices)
- Resource description: **RSpec** (XML)



Federation standard

- Central authority (credential issuer)
- Multiple AMs **trust** central authority
- **Slice** registered in **Central Authority**
- **Slivers** created in **multiple AMs**



Design

- C-Lab as a **federated facility** in Fed4FIRE
- Resource allocation procedure (resources available for the federation)
- **SFA** as federation **standard**
- All facilities expose a SFA **Aggregate Manager** interface
- Need of **SFA-compliant interface** in Community-Lab

Development of a C-Lab SFA Wrapper: software layer on top of the testbed that exposes a SFA AM standard interface

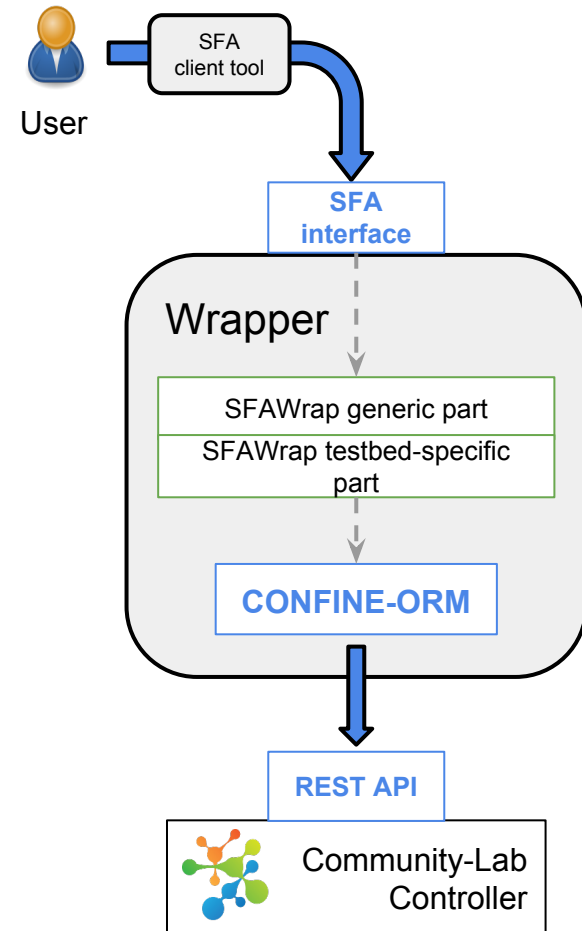
- Adapts, wraps

Technical details (1)

- **C-Lab SFA Wrapper** based on **SFAWrap**
- **SFAWrap**: free open-source software that allows to federate testbeds through SFA
 - *Generic part* (servers, creds, rspecs...)
 - *Testbed-specific part* (driver)
- Testbed-specific part adapts the **testbed API to the SFA** model

Technical details (2)

- Use of **Confine-ORM** (Python library) to interact with the testbed **REST API**
- SFA AM v3
- GENI RSpec v3 (standard RSpec)



Discussion

Wrapper exposes a **SFA AM interface** & **trusts** the Fed4FIRE **authority**

- Interact with the testbed through a SFA client tool (generic)
 - Create **slivers in C-Lab** for **slices from Fed4FIRE authority**
 - **Federation** in resource allocation **achieved**
-
- **Standard RSpec**: impossibility to map **specific features** of C-Lab slivers
 - **Anonymous usage** (*Sfawrap* user in C-Lab)
 - C-Lab **sliver access**: join Management Network overlay (**tinc** software)

Evaluation

Behaviour rather than **Performance**

- **jFed**: SFA client application in Java (iMinds, Fed4FIRE)
 - *Probe, Automated-tests*
- **Reference Experiment**: automated interaction with C-Lab wrapper
 - Reproduce typical use case (with experiment deployment)
 - jFed framework (Java)
- **Automated Tests Fed4FIRE**: for deployed wrappers
 - Periodic validation tests
 - “health” monitoring

jFed with C-Lab SFA Wrapper

jFed Probe

1. Login Fed4FIRE account certificate
 2. Get userCredential
 3. Register new Slice and get SliceCredential
- Fed4FIRE Authority
4. Create new sliver in C-Lab for the slice
- C-Lab Wrapper

Summary

- Importance of **FIRE facilities federation**
- **SFA** as standard federation (testbeds, Fed4FIRE)
- **SFA Wrapper** for Community-Lab testbed
 - **Operational status**: It works!
 - Limitations: rspec, tinc, anonymous usage

Future work

- **C-Lab RSpec**
- New **federation** scenarios (multiple controllers, other testbeds)

References

Pan-European testbed and experimental facility federation – architecture refinement and implementation, Sebastian Wahle, Bogdan Harjoc, Konrad Campowsky, Thomas Magedanz, and Anastasius Gavras, 2010.

A case for research with and on community networks, Bart Braem et al. ACM SIGCOMM Computer Communication Review, July 2013.

Slice-based facility architecture, Larry Peterson et al. Draft version, 2009.

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