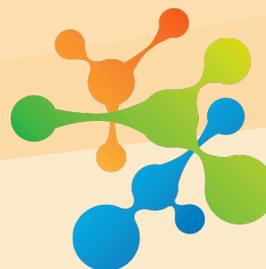


## COMMUNITY NETWORKS TESTBED FOR THE FUTURE INTERNET

CONNECTED COMMUNITIES

# CONFINE



### Scope

The CONFINE experimental facility supports experimentally-driven research on Community-owned Open Local IP Networks. These networks are already successful in developing internet access in many areas of Europe and the world. The project takes an integrated view of community networking.

This project offers Community-Lab, a testbed for experimental research that integrates and extends three existing community networks: Guifi.net (Catalonia, Spain), FunkFeuer (Wien, Austria) and AWMN (Athens, Greece); each is in the range of 500 – 20,000 nodes, a greater number of links and even more end-users. These networks are extremely dynamic and diverse, and combine successfully different wireless and wired (optical) link technologies, fixed and ad-hoc routing schemes, and management schemes. They run multiple self-provisioned, experimental and commercial services and applications.

This testbed provides researchers with access to these emerging community networks, supporting any stakeholder interested in developing and testing experimental systems and technologies for these open and interoperable network infrastructures.

Community-Lab is a resource for the research community to address the limits and obstacles regarding Internet specifications that are exposed by these edge networks. It supports an integrated and multi-disciplinary effort to address and assess the usefulness and sustainability of community networking as a model for the Future Internet.

### Technical and innovation approach

Community-Lab is being built starting from the federation of existing community IP networks which will be opened up to researchers and enabled for experimentation.

The project develops unified access to networks that extend to more than 20,000 outdoor nodes and links. An entry point with tools allows researchers to select a set of resources, and then deploy, run, monitor and experiment with services and protocols. This is done on real-world IP community networks that incorporate a wide variety of wired and wireless links, nodes, routing, applications and users. It combines researchers and end-users following an innovative model of self-provisioned, dynamic and self-organizing networks using unlicensed and public radio spectrum and optical links.

The platform is created according to the following principles:

- ^ Federation: a physical or logical interconnection of several independent testbeds for accomplishing advanced tests and experiments. This federation can be horizontal (several similar testbeds) or vertical (across networking or service layers: e.g. with PLANETLAB or other FIRE testbeds).
- ^ Virtualization: the virtualization of key elements in these networks (physical interface e.g. radio, links, graphs, nodes, hosts) must be considered to share resources, isolate multiple concurrent experiments,

#### Type of project

**Large-scale Integrating Project (IP)**

#### Contract number

FP7 – 288535

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#### Project website

[www.confine-project.eu](http://www.confine-project.eu)

#### Community contribution to the project

4.942.000 Euro

#### Project start date

1st October 2011

#### Duration

48 months

prevent experimental services from disrupting each other or production services, and provide greater controllability of experiments e.g. network topologies and configuration of components.

- ⤴ Decentralization: the multiple dimensions of scale, dynamics and heterogeneity in these networks create a demand for moving the decision-making governance closer to the elements of concern. This will enable the testbed to operate despite the sheer amount of information and decisions to be taken continuously, and regardless of the changes, failures, and overloads to which the network and the nodes are subject.
- ⤴ Openness: an open platform for the development, deployment, monitoring and usage of experimental systems at different levels that facilitate the continuous introduction of new services and protocols – in coexistence with those already established – from interested third parties in the research community, but also from innovative service providers.
- ⤴ Usability: a unified, user-friendly access for web-based and service-based tools that supports the whole experimental life-cycle – definition, set-up, execution, monitoring, and analysis. This access must consider the need for managing users from multiple administrative domains including federated testbeds and third parties.

The project contributes new equipment, extending the existing community networks with additional nodes, network interfaces, links and computing resources. This extra capacity is required to accommodate the additional load caused by experiments running in the community networks. Nodes and links could also be incorporated on a voluntary basis from other parties, such as end-users willing to contribute resources to the testbed, or external research groups interested in actively participating or using the testbed (e.g. national research projects and other EU projects connecting to any of the participating community networks).

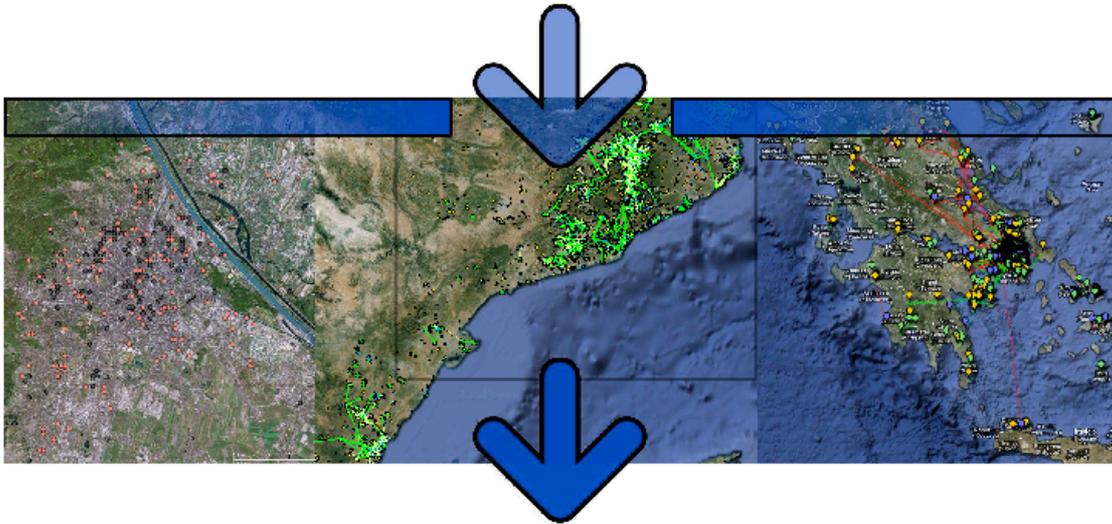


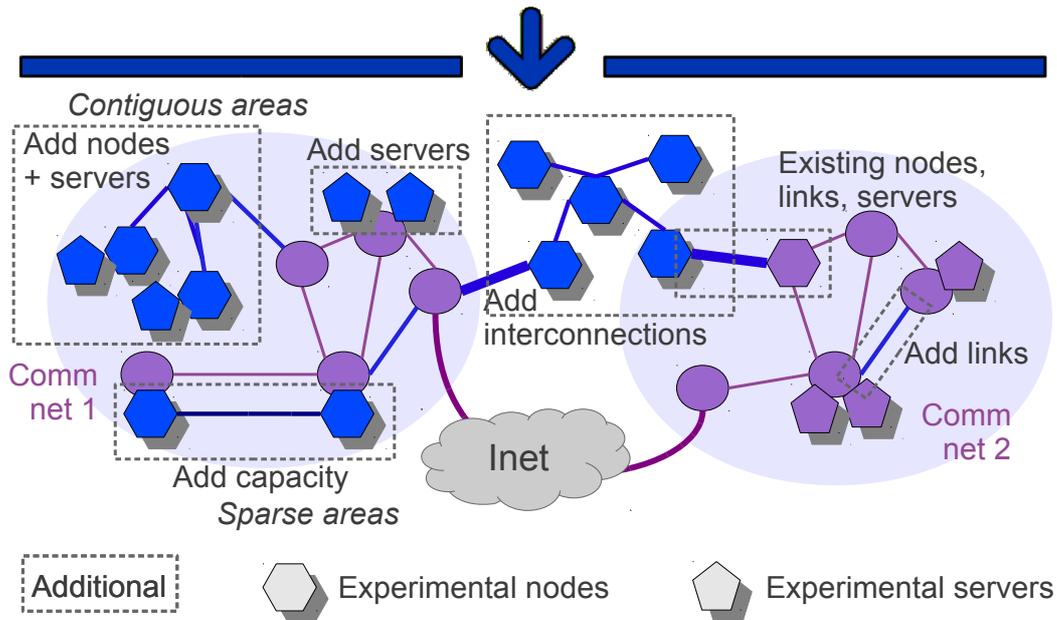
Fig. 1: Community-Lab, the CONFINE testbed as an entry point for experimentation on real community networks (left: FunkFeuer, center: Guifi.net, right: AWMN)

The Community-Lab testbed aims to be operational internally after 9 months, and by the end of the first year for external use. Through two open calls, one near the end of Year 1 and another near the end of Year 2, external experimenters will be attracted, leading to an open and demand-driven expansion of the testbed functionality, the federation and its usage. During the second half of the project the spare capacity of the testbed will be made available to external researchers, especially those willing to contribute hardware resources in exchange.

## Example of application

Community-Lab allows experimental validation of several scenarios, such as the cooperation and comparison between nodes using diverse mesh routing protocols; self-managing (or autonomic) application protocols that adapt to the dynamic conditions of nodes, links and routes in these networks; network self-management or cooperative and decentralized management; and the adaptation of services such as VoIP or live video streaming to the conditions of community networks.

The testbed could be used for remote benchmarking of ad-hoc routing protocols and applications. There are many gatherings where researchers and implementers of routing systems and other applications for ad-hoc networks get together in one place, discuss, build a test network, benchmark the progress of different implementations under realistic test deployments, and make public the results and rankings from these tests. Community-Lab allows a group of implementers to remotely set up experimental virtual networks built from a selection of devices and links in this testbed, and then perform these tests remotely, more frequently, with a larger scale, and perhaps using a set of test networks that cover several scenarios with different characteristics. Community-Lab facilitates a faster evolution of these algorithms and implementations, and more robust and interoperable implementations across a larger set of experimental environments. Of course this would not prevent the participants from meeting periodically to share the fun and excitement of discussing, sharing ideas, coding, and doing other social activities together.



**Fig. 2: The project brings in additional users (researchers) with a common entry point and additional resources (nodes, servers, links) in contiguous and sparse areas**

## Target users and benefits

The scientific and technical objectives of the project can be drawn from the need to explore models for the Future Internet that are socially, economically, and technically sustainable. The CONFINE project targets the exploration and advancement of the community networking model, towards providing the right quality of experience and sustainability of community networks by looking at the social, technical, economic and legal implications. That requires contributions from all societal groups. This testbed aims at researchers from academia and industry to perform experimentally-driven research on obstacles and limitations in community networks, addressing:

- ⤴ Scale, heterogeneity and limited resources in the infrastructure (links, nodes, hosts) such as routing extensions for large and heterogeneous networks, and interoperability among routing protocols.
- ⤴ The need for cross-layer interactions and optimizations, such as QoS for a variety of real-time (e.g. voice) and non-real-time services (e.g. media distribution), for heterogeneous networks.
- ⤴ The definition of global parameters (e.g. QoE through user perceived parameters such as quality, price, reputation, and security) concerning the usability of the infrastructure and user-friendliness as seen from the user perspective.
- ⤴ Self-management: self-configuration (e.g. adaptive channel and address allocation), self-healing (adaptation to node or link failures), and self-optimization (adaptation to different resource management functions depending on internal or external influences).
- ⤴ Creation of open data sets for experimentation: generation of different data sets for off-line experimentation or simulation.
- ⤴ Development of a benchmarking framework to ensure repeatability, reproducibility and verifiability of experiments with stable configurations.
- ⤴ Best practices: documenting the different experiments performed on the experimental facility.
- ⤴ Contributions to standardization of different key specifications for community networks.
- ⤴ Contributions to open-source implementations of reference software components and services for community networks.
- ⤴ Socio-technical-economic-legal evaluation and sustainability model based on the results of the testbed's provision, usage, and operation.

| Project partners   | Country        |
|--|----------------|
| Universitat Politècnica de Catalunya                                 | Spain          |
| Fundació Privada per a la Xarxa Oberta, Lliure i Neutral guifi.net   | Spain          |
| FunkFeuer  | Austria        |
| Athens Wireless Metropolitan Network                                 | Greece         |
| The OPLAN Foundation   | United Kingdom |
| Comunicació per a la Cooperació - Pangea                             | Spain          |
| Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. | Germany        |
| iMinds   | Belgium        |