

Clouds of Small Things

Provisioning Infrastructure-as-a-Service from within Community Networks

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Community Networks

Sharing collective to build up ICT infrastructure for local communities



guifi.net

Members share **bandwidth** and their time and effort



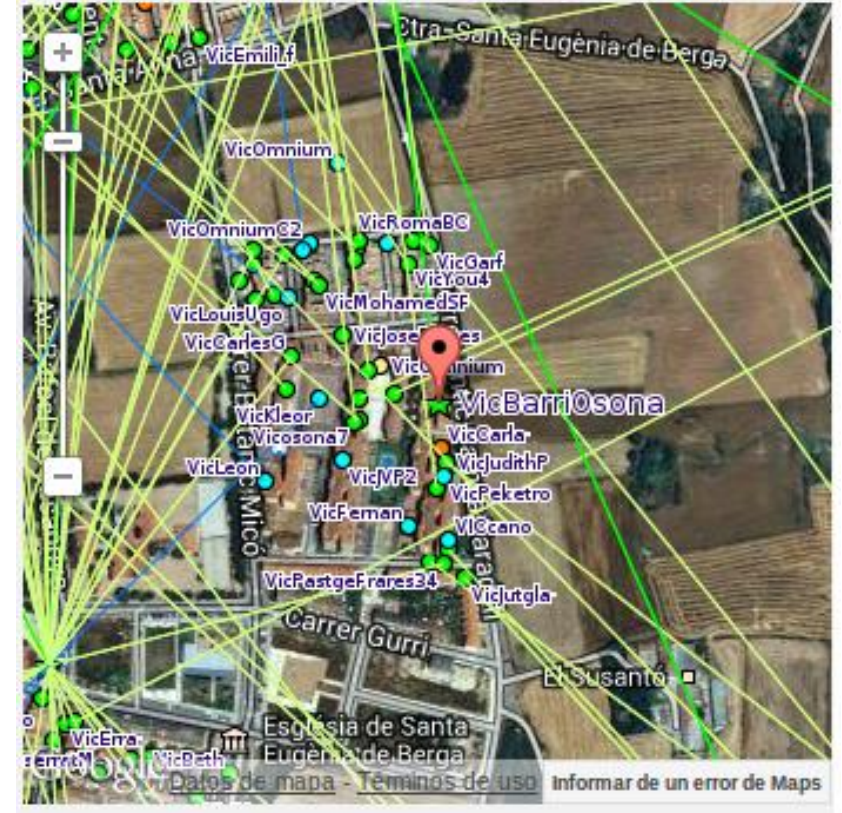
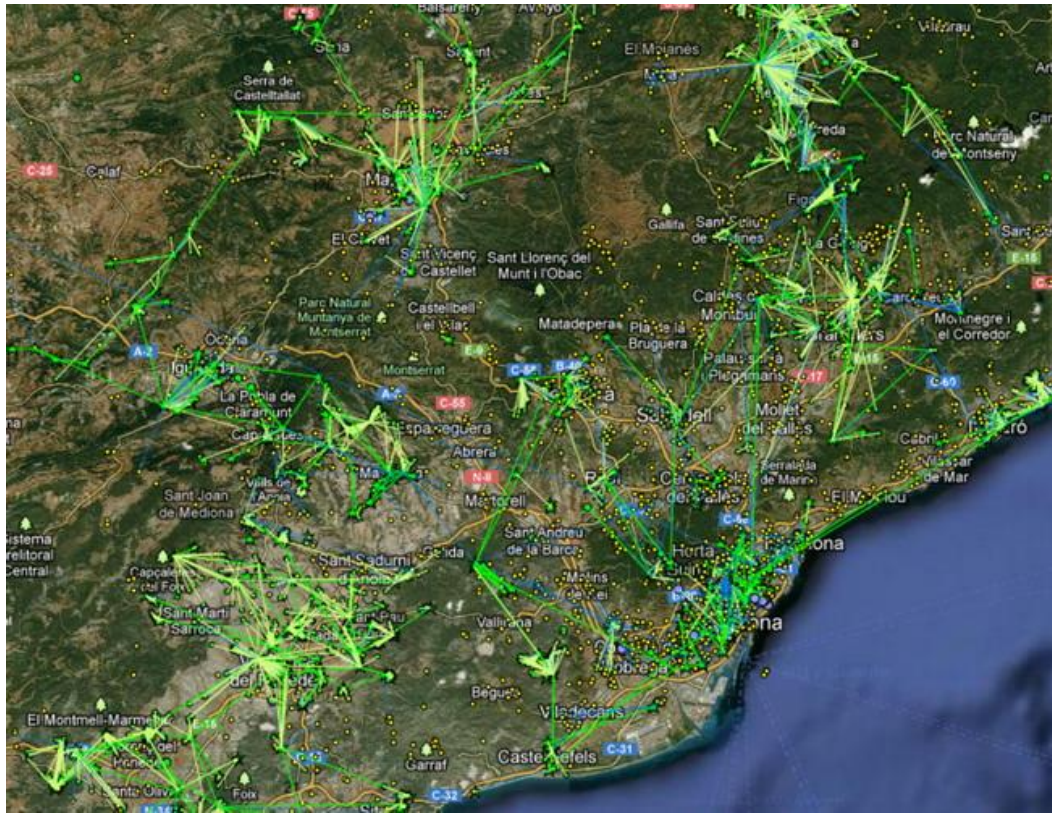
Mobile Ad-Hoc Networks
Mesh Networks
Wi-Fi Hostspots
Bottom-up Broadband

*Community
Networks*



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For People, By People



Can we extend this sharing?

Voluntary Computing
P2P Distributed Storage
Computational Grids
Cycle Sharing
Cloud Computing



Folding@home



Community Networks
Wireless Mesh Networks
Bottom-up Broadband
Social Networks

Community Cloud



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There is a war coming.



Vs



Are you sure you're on the right side?



Data Centres **Vs** Community Cloud

Is this David vs Goliath?

So are you going to replace YouTube?

Seriously. Are you out of your mind?



Data Centres **Vs** Community Cloud

Is this David vs Goliath?

So are you going to replace YouTube?

Seriously. Are you out of your mind?

No, but ...

More like David meets Goliath!

Augment. Complement. Innovate.

Existing Cloud models and services



Our Contributions

Identify

Hardware &
Configurations

Realize

Cloud Scenarios

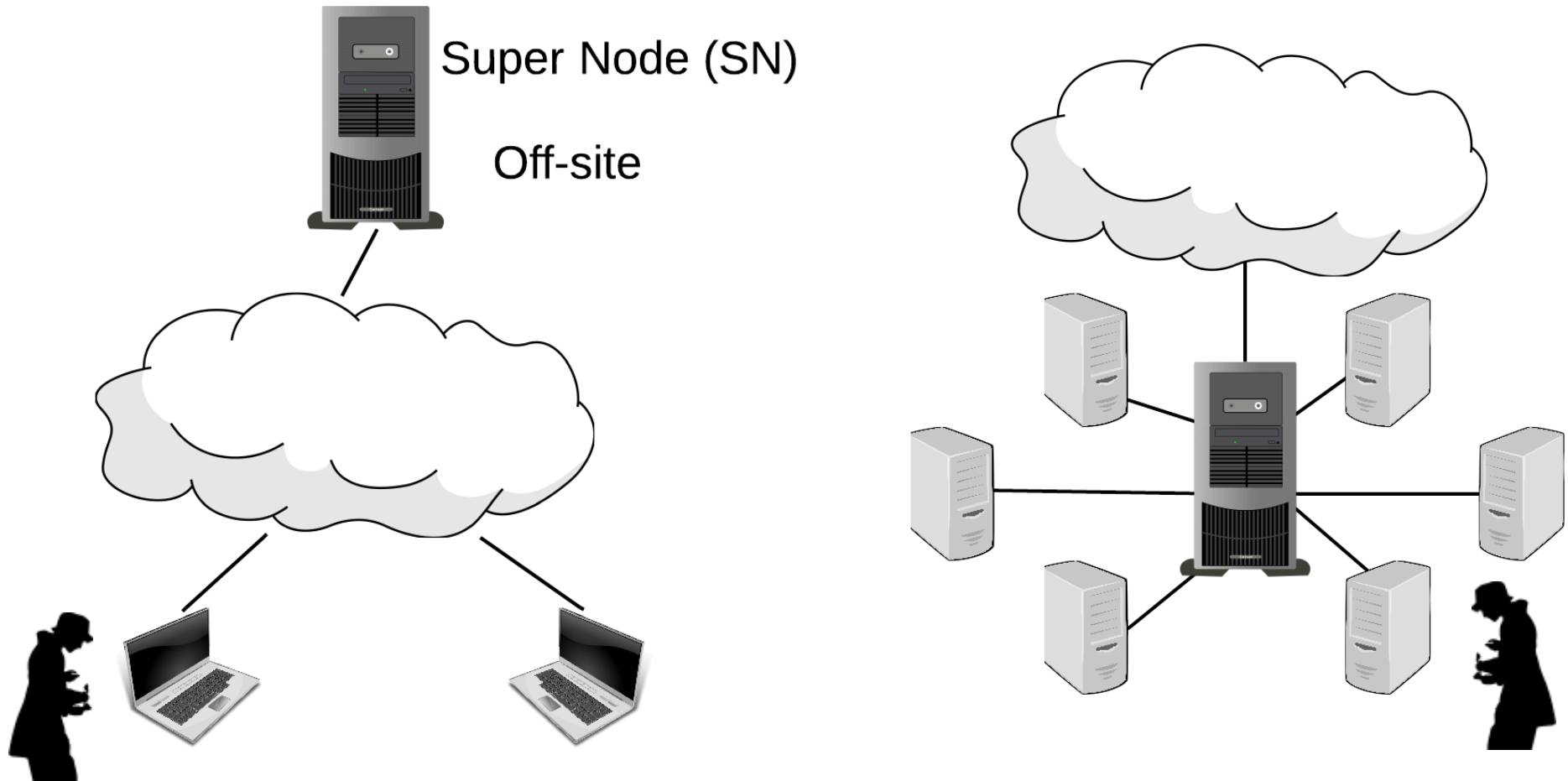
Evaluate

Simulation Experiments
Prototype

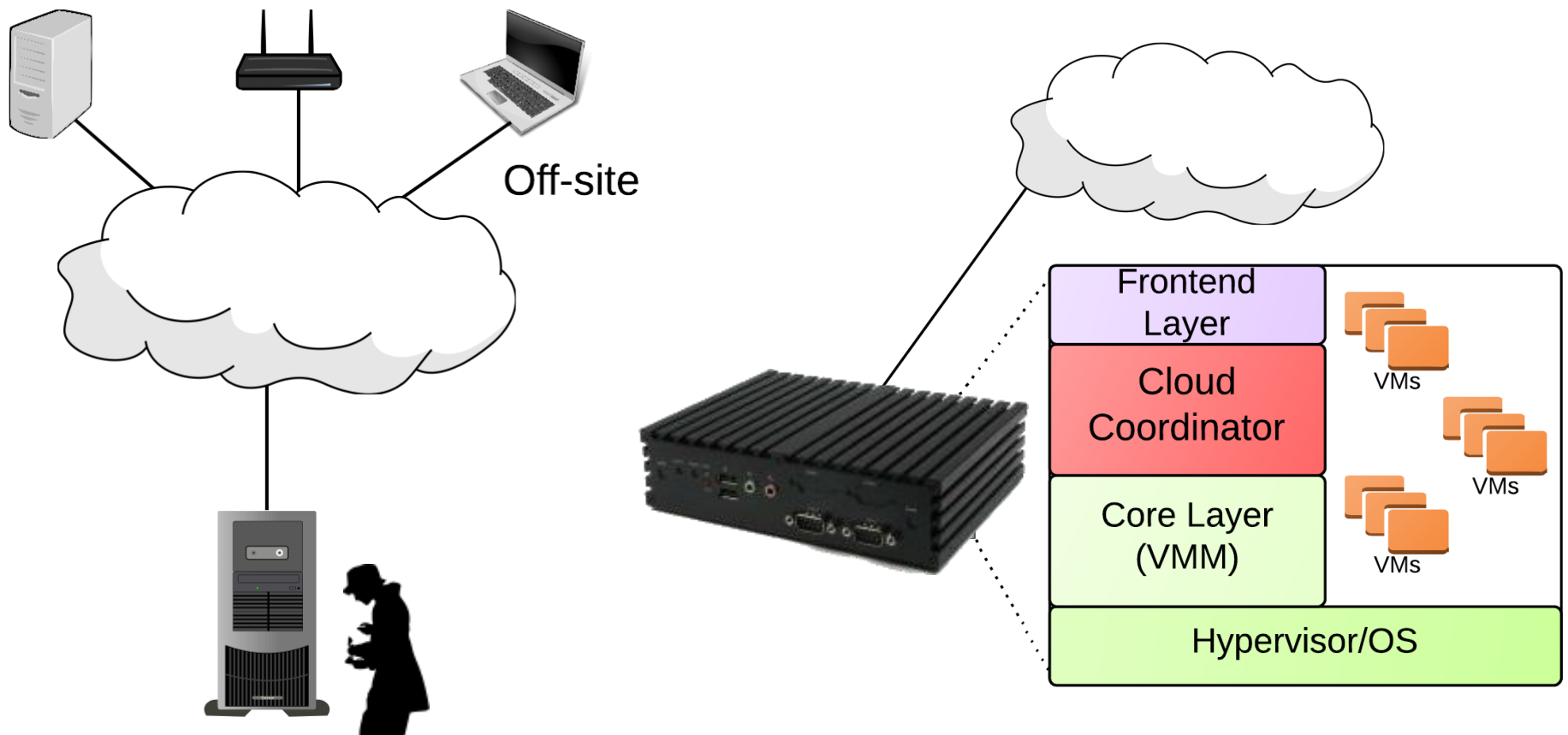
Hardware in Community Cloud



How to Setup Your Cloud?



And Cloud-in-a-Box?



Identify

Hardware &
Configurations

Realize

Cloud Scenarios

Evaluate

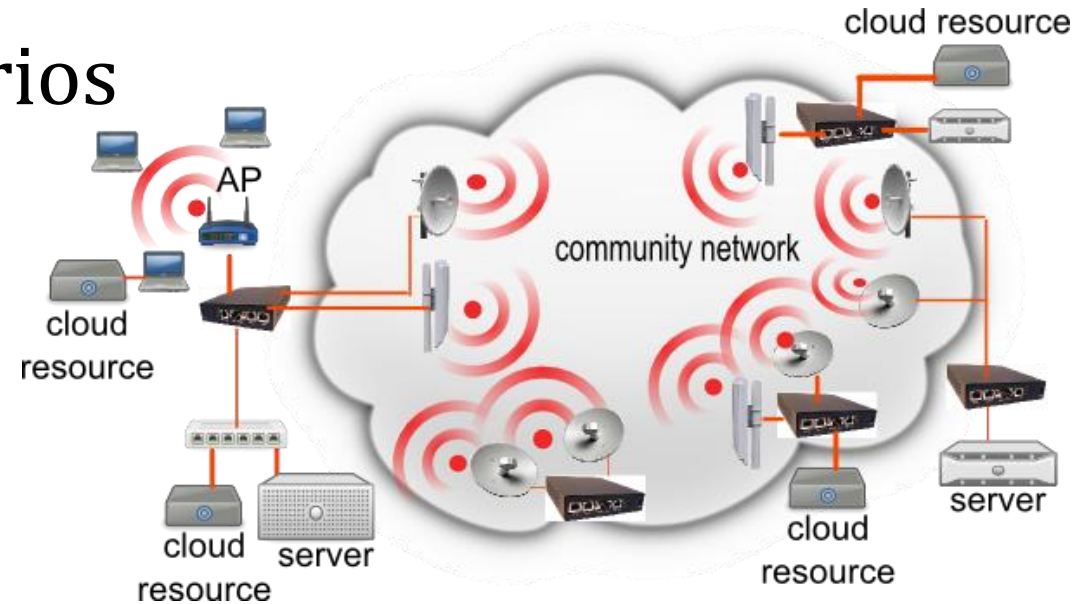
Simulation Experiments
Prototype

Zones in Community Networks

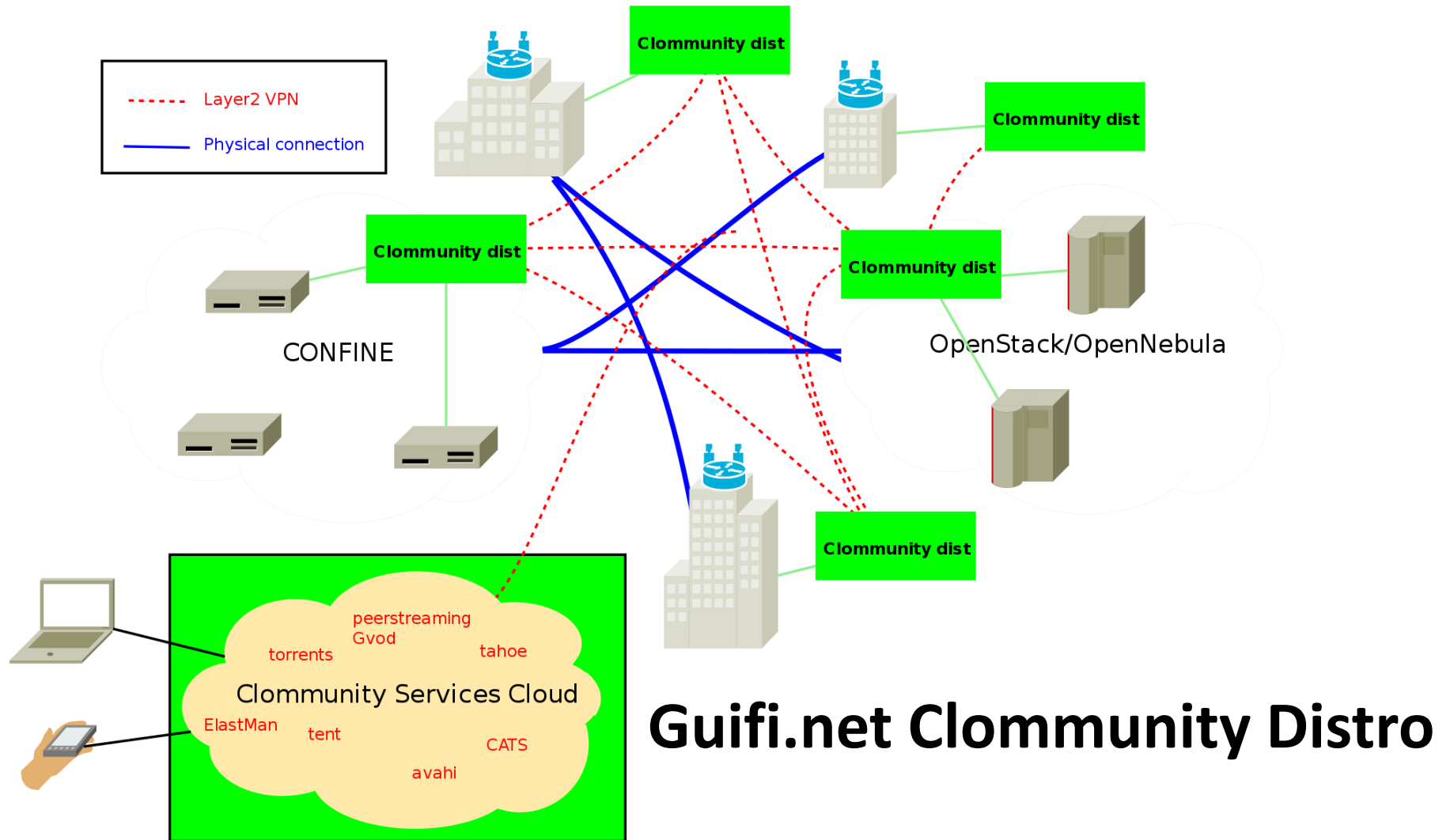
More a Socio-Economic Construct than Technical
Detailed Support and Coordination **between Zones**

Super and Ordinary Nodes in Zones

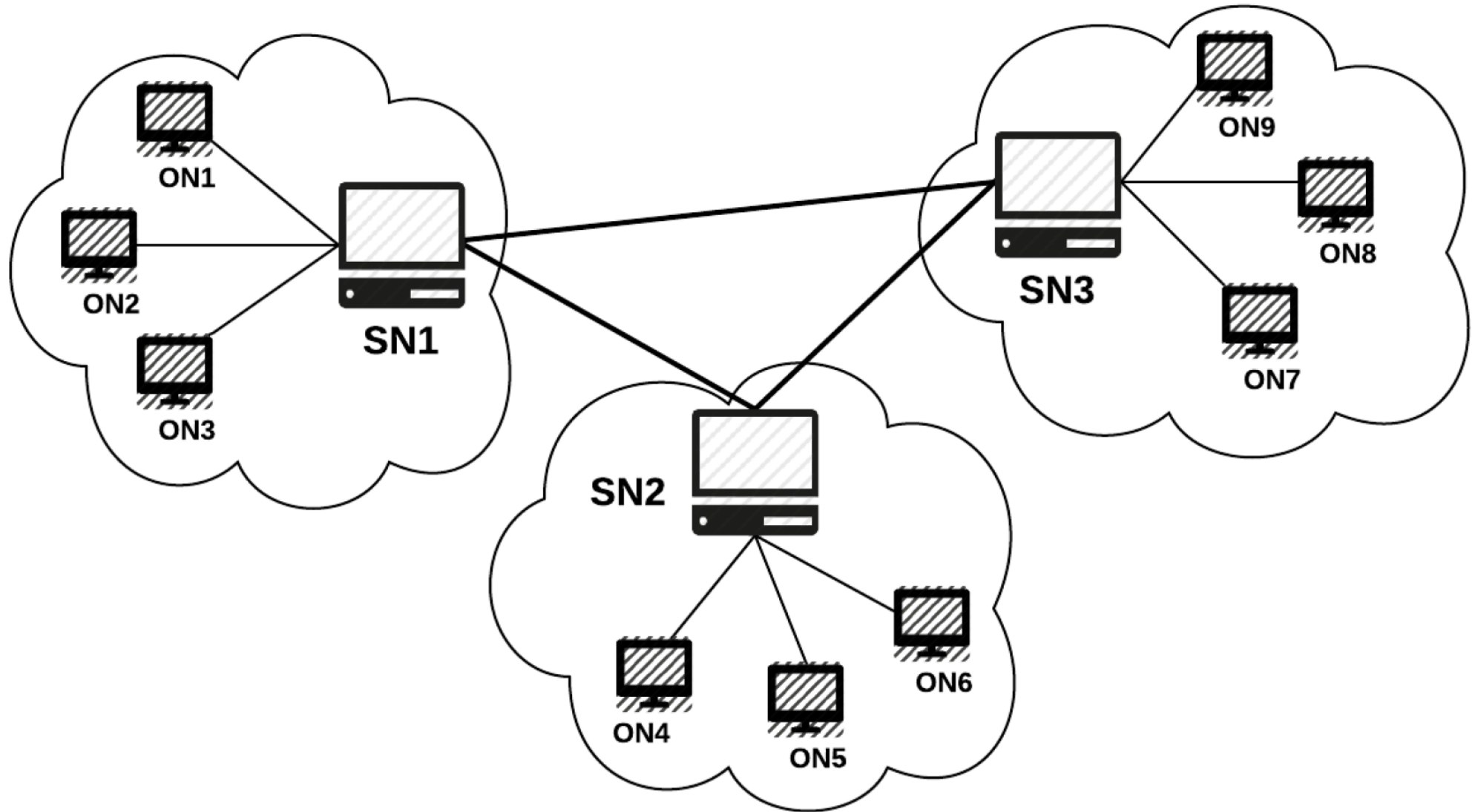
Community Cloud Scenarios



Local Community Cloud



Federated Community Clouds



How this all fits in?

Community Cloud Manager

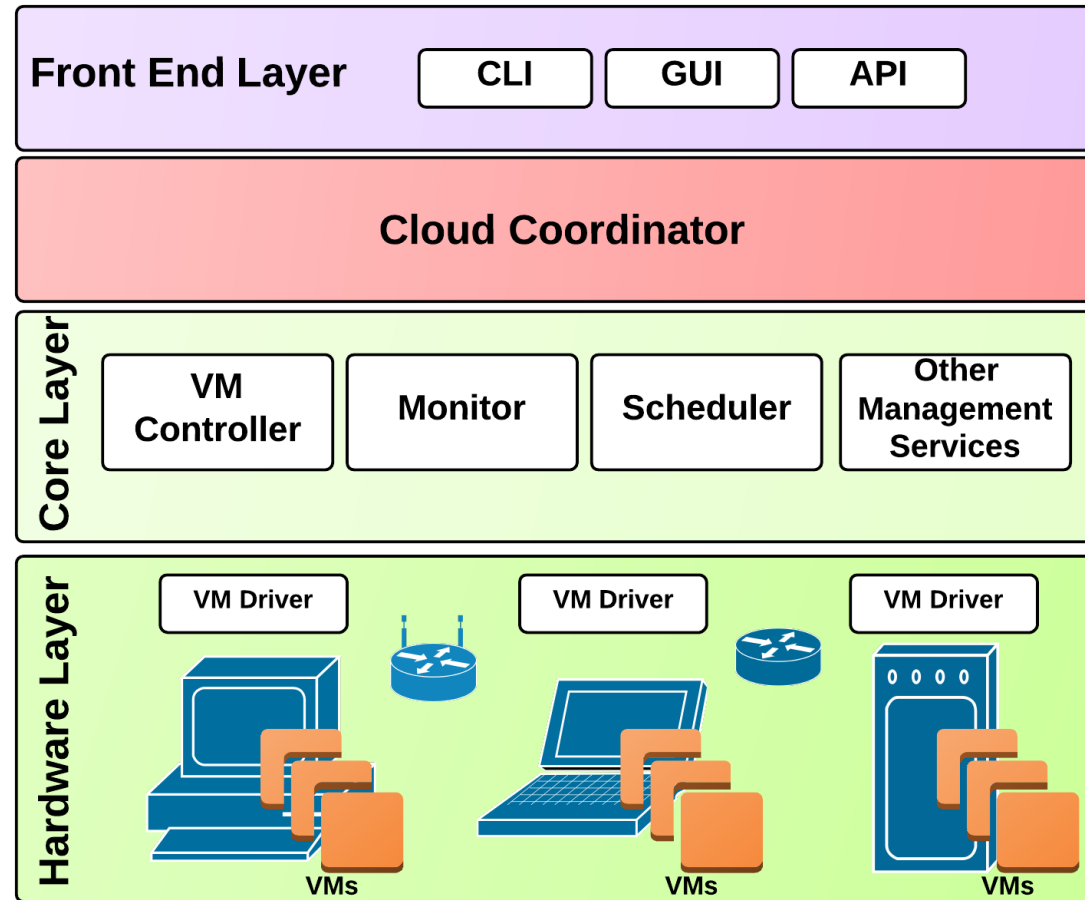
By extending



OpenNebula.org
The Open Source Toolkit for Cloud Computing

Incentive-based Resource
Assignment

Communication Middleware



Identify

Hardware &
Configurations

Realize

Cloud Scenarios

Evaluate

Simulation Experiments
Prototype

The Big Question?

How do community clouds compare to data centres?

Can they provide guaranteed quality for applications?

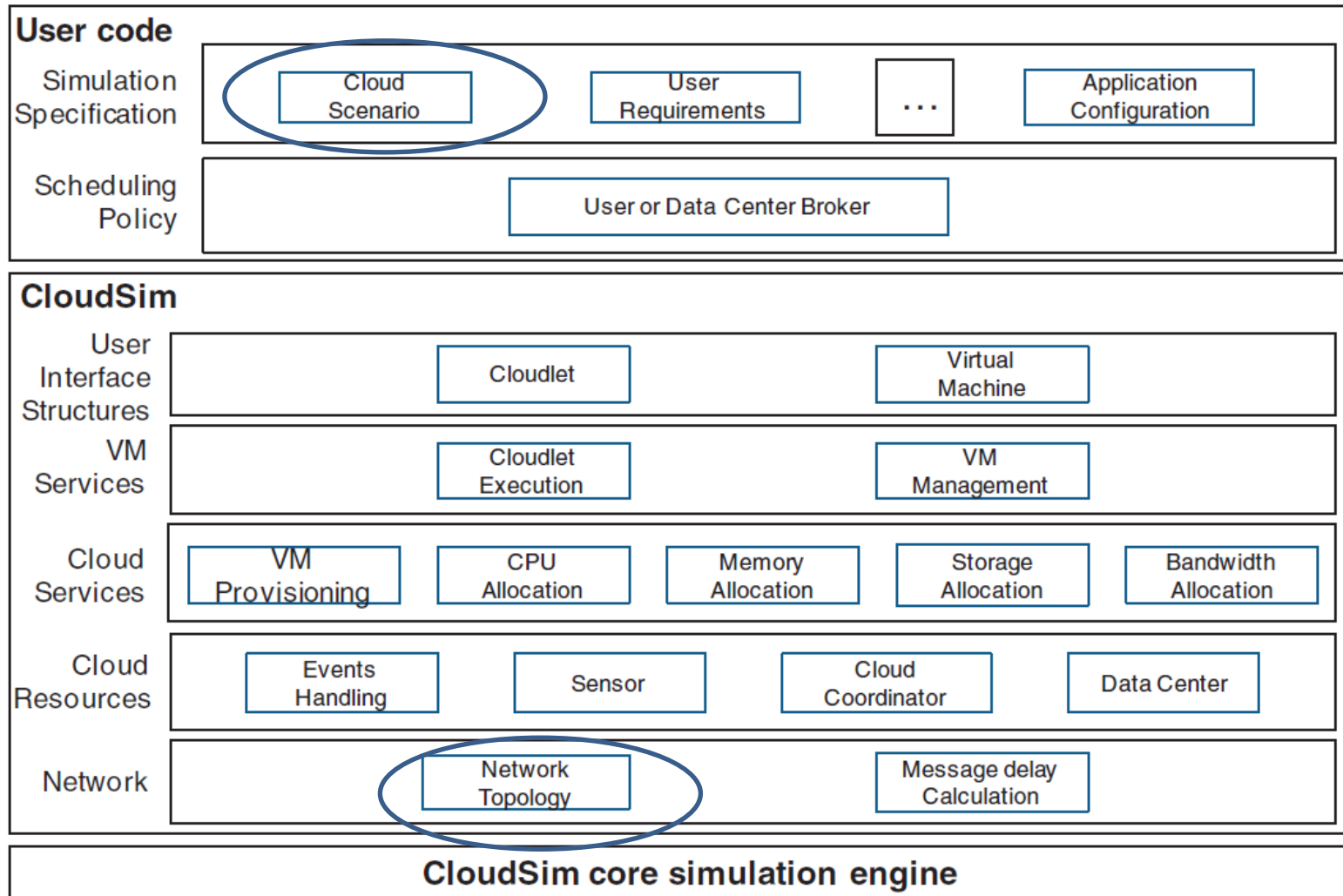
What kind of applications may be more suitable?

Experiment with total 100, 400 and 1000 nodes

Scenario	Data Centres	Nodes per Data Centre
Centralized Cloud	1	n
Federated Cloud	$\approx \sqrt{n}$	$\approx \sqrt{n}$
Decentralized Cloud	n	1



CloudSim



R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, "CloudSim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms," *Software: Practice and Experience*, vol. 41, no. 1, pp. 23–50, Jan. 2011.



Experimental Setup: Nodes

CHARACTERISTICS OF NODES IN DATA CENTRES

Attribute	Value
Architecture	x86
Operating System	Linux
Hypervisor	Xen
CPU	2,400 MIPS per VM
RAM	8 GB
Storage	80 GB
Bandwidth	100 Mbps
Hosted VMs	4
VM Scheduling	Time Shared
VM Migration	Not Allowed

Experimental Setup: Virtual Machines

CHARACTERISTICS OF VMS REQUESTED BY USERS

Attribute	Value
CPU Time	1,000 MI
Number of Cores	1
RAM	512 MB
Bandwidth	100 Mbps
VM Image Size	1 GB
Scheduling Policy	Dynamic Workload
Number of Requests	50 requests per minute

Results: Resource Utilization

Nodes	Data Centres	Nodes/Centre	CPU	RAM	Bandwidth
100	1	100	48.51	49.3	49.08
100	10	10	49.13	49.43	49.09
100	100	1	49.27	49.52	49.35
400	1	400	50.22	48.83	48.56
400	20	20	49.46	49.27	49.72
400	400	1	49.36	48.29	50.31
1000	1	1000	49.50	49.43	49.50
1000	30	30–35	49.41	49.36	49.57
1000	1000	1	50.12	48.94	48.42

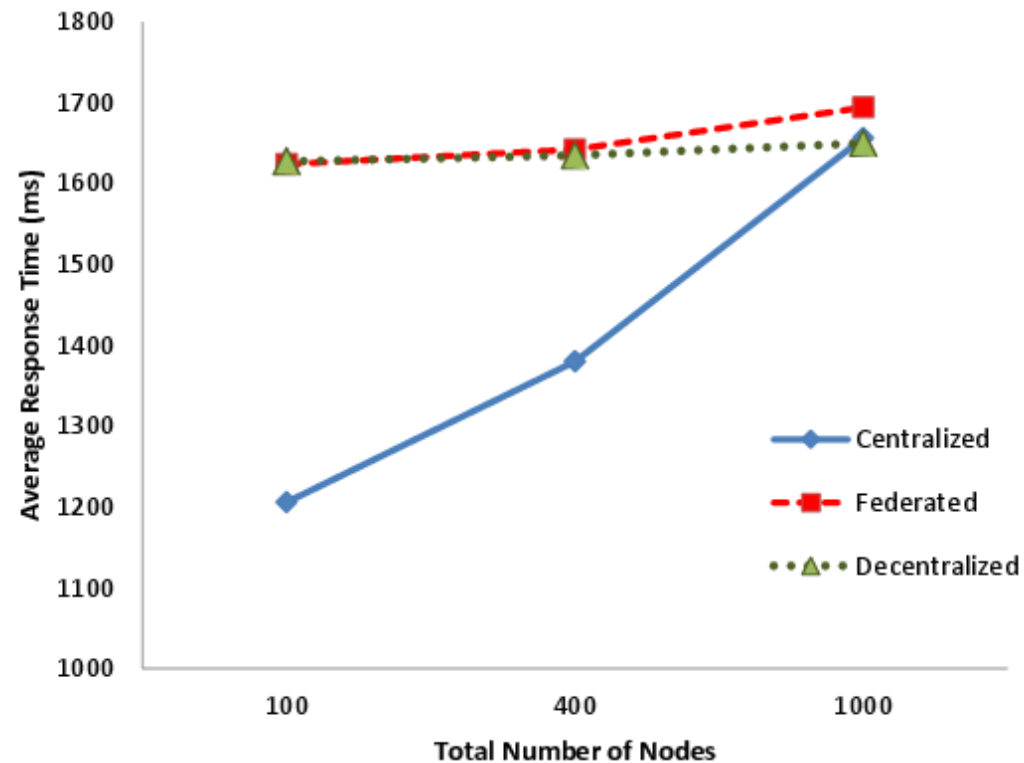


Response Time and Nodes

For fewer nodes, centralized cloud outperform as resources consolidated

Federated cloud lacks nodes to fulfill requests

For more nodes, overheads for centralized cloud impact tasks waiting time

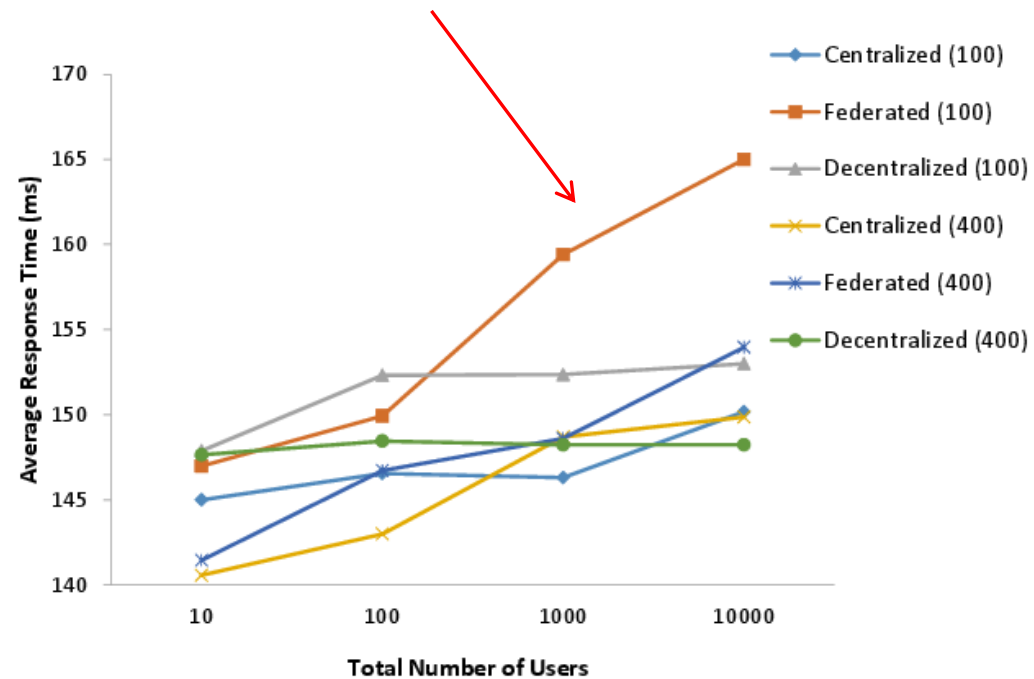


Response Time and Users

Federated cloud with 100 nodes performs poorly as only 10 nodes per cloud

Affected by availability and distribution of nodes

Impact of broker processes in cloud coordinator?



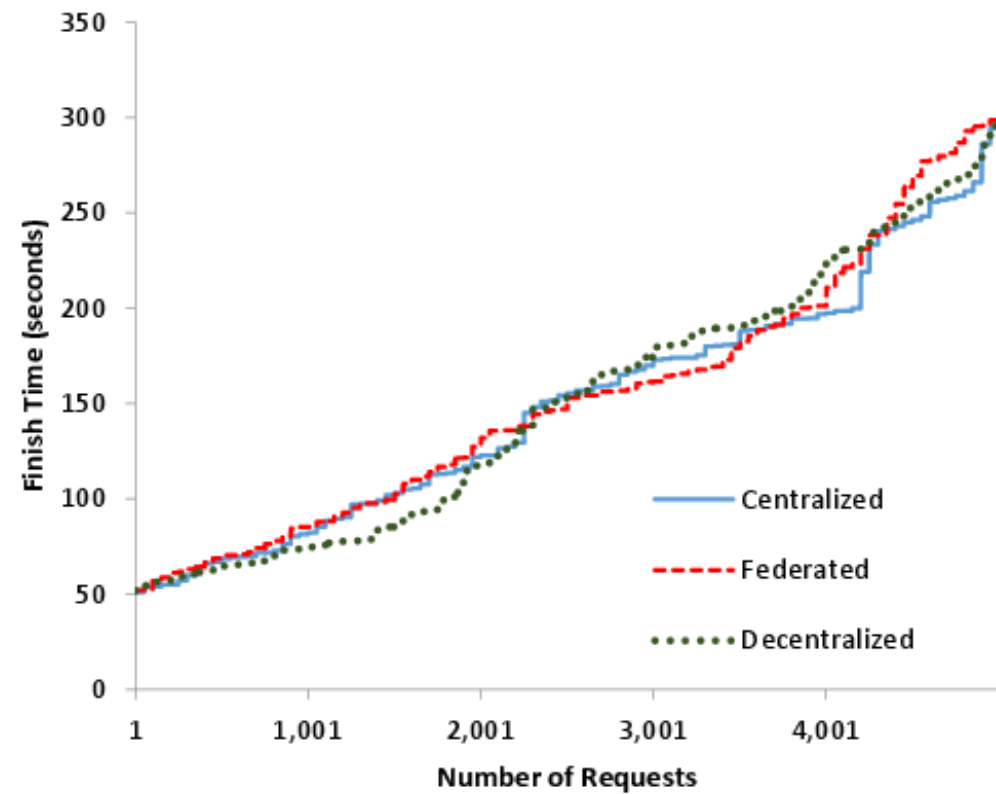
Requests Completion Time

Tasks of short duration and similar profile

Behaviour similar as total resources are same

No significant delays in the system

Tasks with different load and duration?



Outlook: Prototype

Home / Slices / Slices / Add slice

Add slice

Name: A unique name of this slice. A single non-empty line of free-form text with no whitespace surrounding it.

Description:

An optional free-form textual description of this slice.

Template: The template to be used by the slices of this slice (if they do not explicitly indicate one). Template link: (None)

Experiment data: File containing experiment data for slices (if they do not explicitly indicate one).

Exp. data SHA256: The SHA256 hash of the previous file, used to check its integrity. Compulsory when a file has been specified.

Set state: REGISTER The state set on this slice (per state) and its slices (if they do not explicitly indicate one). Possible values: register (initial), deploy start. See slice and silver states for the full description of set states and possible transitions.

Request VLAN VLAN number allocated to this slice by the server.

Expires on: Aug 24, 2013, 11:04 a.m. Expiration date of this slice. Automatically deleted once expires.

Group:

Advanced (Show)

Silvers

This slice must be saved before creating silvers.

VicBarriOsonaNord-ST	radio	10.138.4.65/27	Working	Up (92.49%)	RouterOSv5.x
VicBarriOsonaServer	server	10.138.4.66/27	Working	Up (24.67%)	
VicBarriOsonaGnrc1	generic	10.138.4.74/27	Working	Down (0.00%)	
VicBarriOsonaConfine	confine	10.138.4.67/27	Working	Down (0.30%)	

Add a new device:

- Wireless device, like a router, bridge, AP..
- Wireless device, like a router, bridge, AP..
 - Voip handset, telephone
 - Server computer
 - Firewall, private Network behind a NAT
 - ADSL router or device providing internet access
 - Network camera. Live view.
 - Any device that uses a public IP (PC, game console, laptop, pda..)
 - Node Confine/Clomunity

VicBarriOsonaNord-ST - VicBarriOsonaNord-ST-1		status	kms.	az.
11185-VicSeminari (VicSeminariST/VicSeminariVicBojons)		Working Up (99.82%)	2.367	354-N

Total: 2.367 kms.



node	1655 VicBarriOsona	VicBarriOsona
zone	Vic-6 (S) Santa Anna, Plaça Osona, Sanferm	Antic Camí a Taradell, 26
position (lat/lon)	Lat:41.915561 Lon:2.260303	15 meters above the ground
available for mesh & status	Yes	Working
graphs provided from	Take from parents	

contact information

email contact (available if you are logged in) · created by: MiquelM at 30/11/1999 - 1:10:00
by: MiquelM at Mon, 22/10/2012 11:00:00

View device VicBarriOsonaConfine

Node: VicBarriOsona - Device: VicBarriOsonaConfine

Location:

Graphs provided from: Take from parents

IP address & host: 10.138.4.67/27

Status & availability: Working

Contact information: email: miquel@guifi.net, phone: +34 938 000 000, created by: MiquelM at 30/11/1999 - 1:10:00, updated by: MiquelM at Mon, 22/10/2012 11:00:00

device graphs

traffic overview

links

Topology: 1 links, 0 kms.

interface	id	device	mode	ip address	vlan	routing	kms.	az.
ethernet0	62097	VicBarriOsonaConfine	eth	10.138.4.67/27	40	Working		

interfaces information

id	type	ip address	netmask	vlan
ethernet0	eth	10.138.4.67/27	255.255.255.224	40

1:1000 mode: CPU, Profile: Priority scheduling, Serial by email, PDF version

Future Work

Extended analysis with more nodes and longer time

Heterogeneous resources

Variable Network Bandwidth

Variable system load and resource availability

Topological network model of community networks

Role of broker between federated clouds

Conclusion

Identified scenarios from characteristics of CNs

Characterized behaviour of infrastructure service in community cloud through simulation

Network aware services are important

Reasonable quality of user experience a must

Community Clouds will be open, free and neutral

Will help in promoting community networks



Clommunity

A Community networking Cloud in a box

Thank you

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<http://clommunity-project.eu>



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