A Software-Based Controller for Efficient Wireless Networks

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On the shoulder of giants.

SCIFI development

SCIFI (Sistema de Controle Inteligente para rede sem FIo) is an open platform for the centralized control of wireless networks.

It has gone through three one-year long development phases:

1. the kernel, which comprises the controller and the changes to APs running OpenWRT
2. the graphical interface and reports
3. the monitoring system

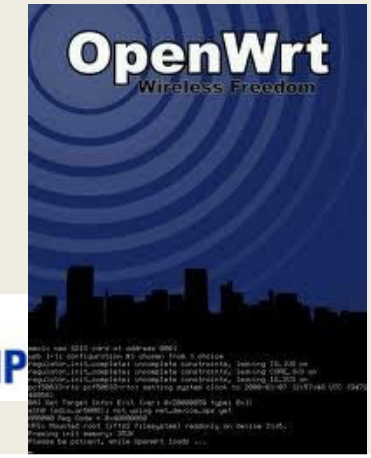
OpenWRT

It is a Linux for embedded systems

Allows customizing the Access Points.

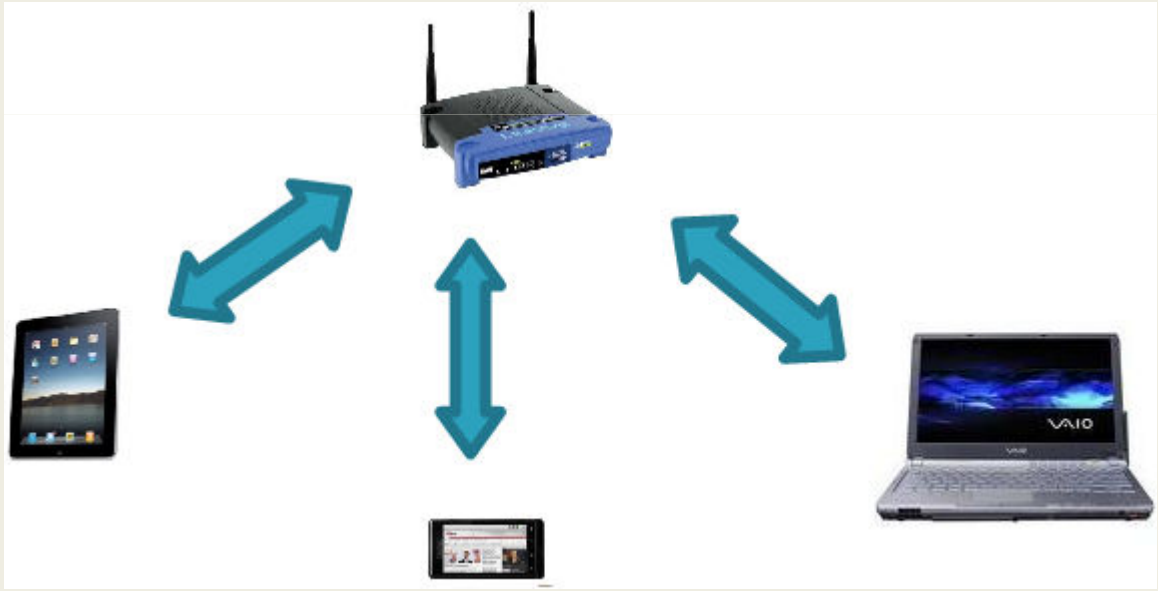
Opens the possibility of hardware independence (many vendors)

www.openwrt.org



Wireless Network Evolution

Hotspots

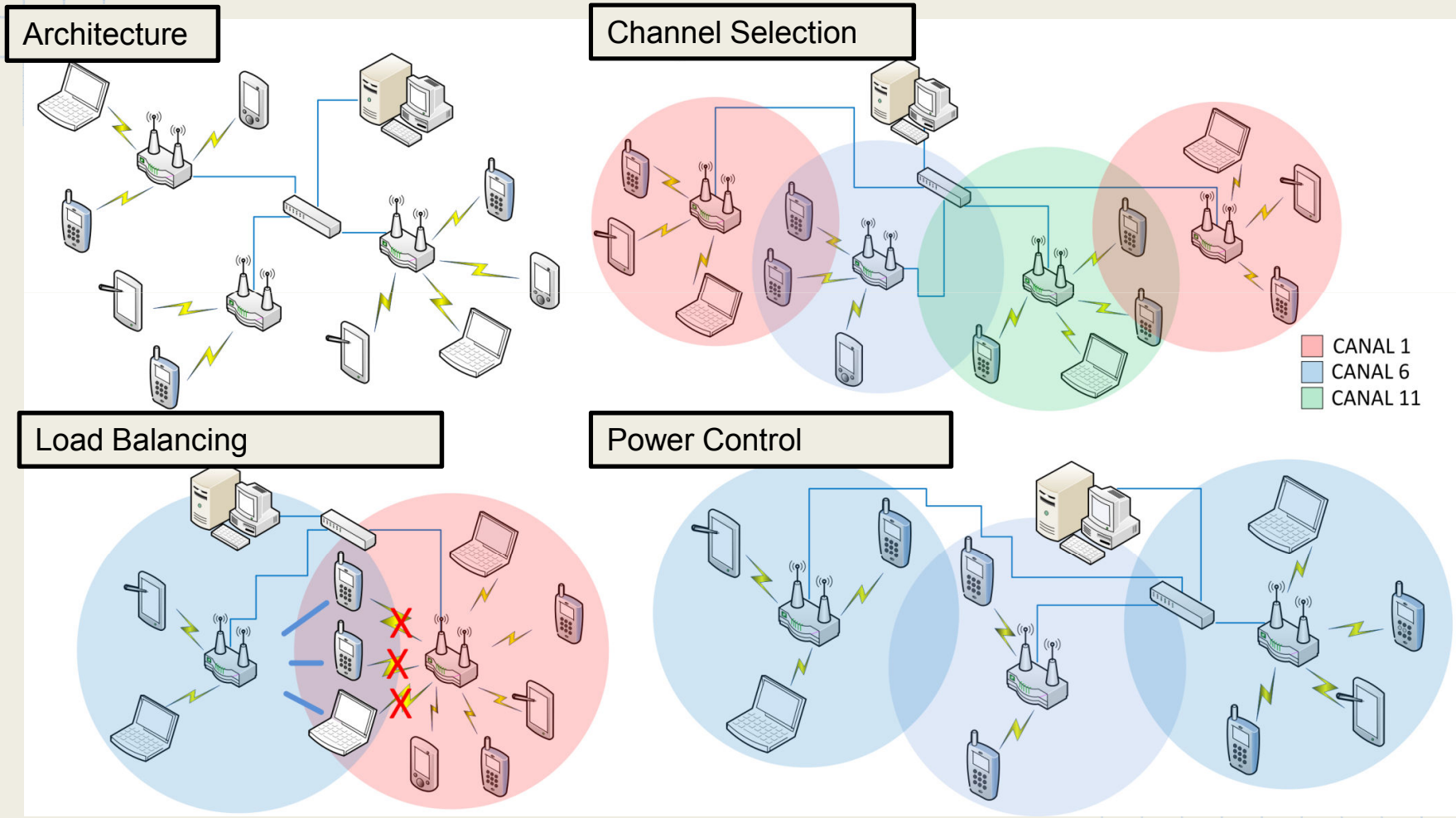


Corporate Networks

The Problem with Scale

- For large networks
  - Centralized management
  - Automatic/centralized configuration
  - Monitoring
- Solutions
  - Proprietary enterprise networks
    - Cisco, Aruba, Xirrus, Motorola
  - SCIFI
    - Open software
    - Low-cost SOHO APs
    - Automatic and dynamic configuration

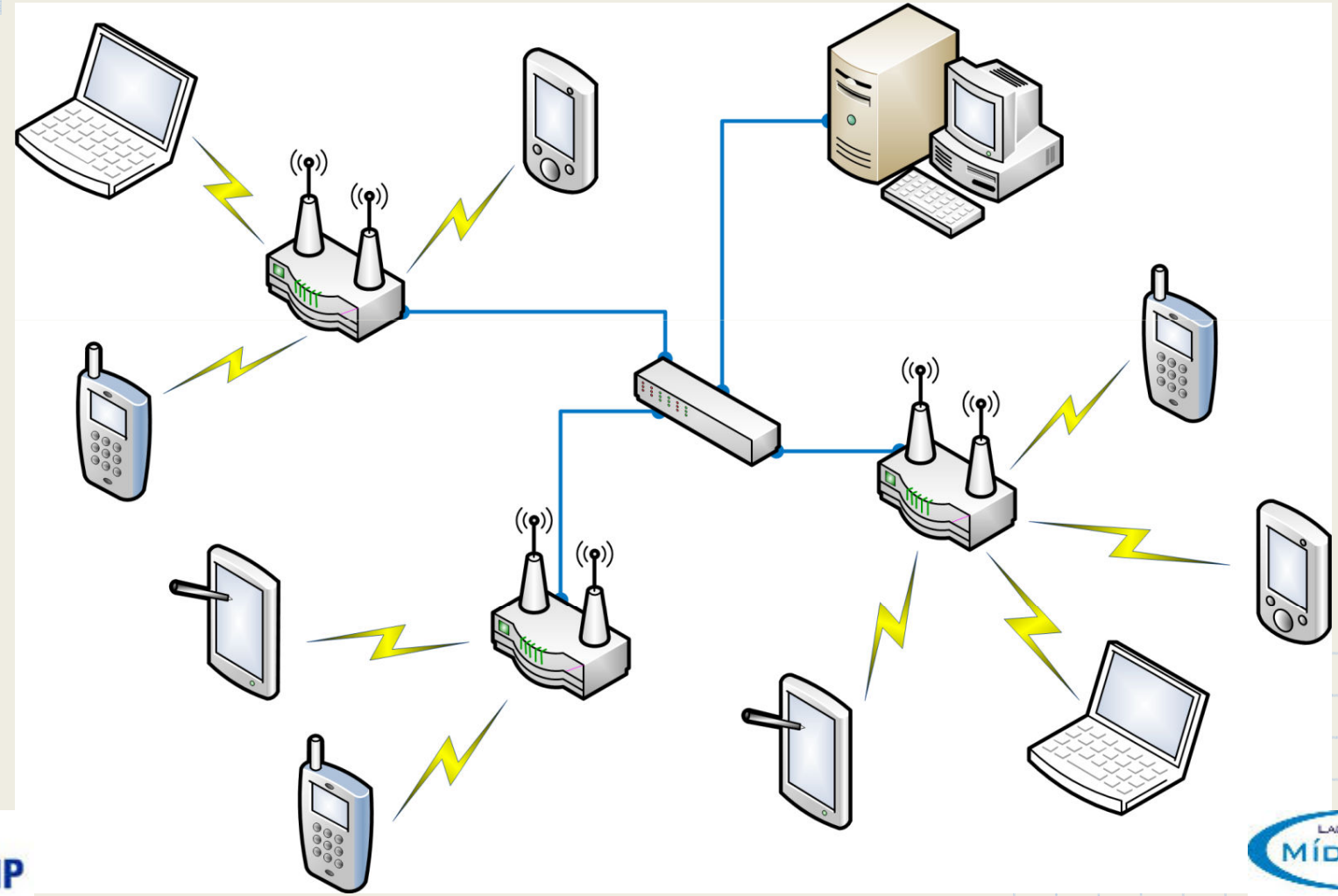
SCIFI


Architecture
Channel Selection
CANAL 1
CANAL 6
CANAL 11
Load Balancing
Power Control

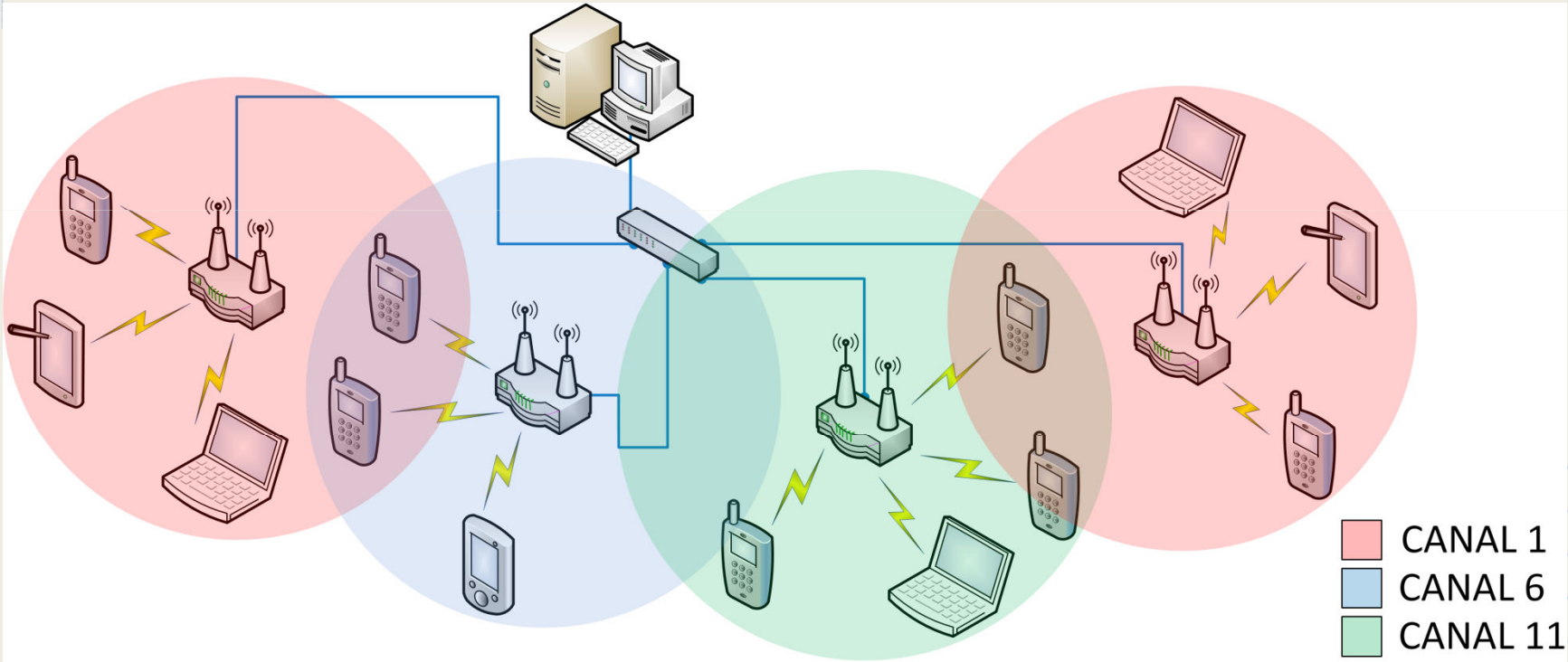
Paradigm shift

- Open source software – allows cooperative development, adapting to local needs
- Commodity hardware – low cost, many vendors, choice of best cost/benefit
- Easy to install - no site-survey
  - Maximize the number of APs – Low cost HW makes that feasible and increases the bandwidth available
  - Low cost APs do not support a large number of users. Thirty is a good compromise
  - Thirty users per AP allows 2Mbps for each – that is true even for expensive access points

Architecture

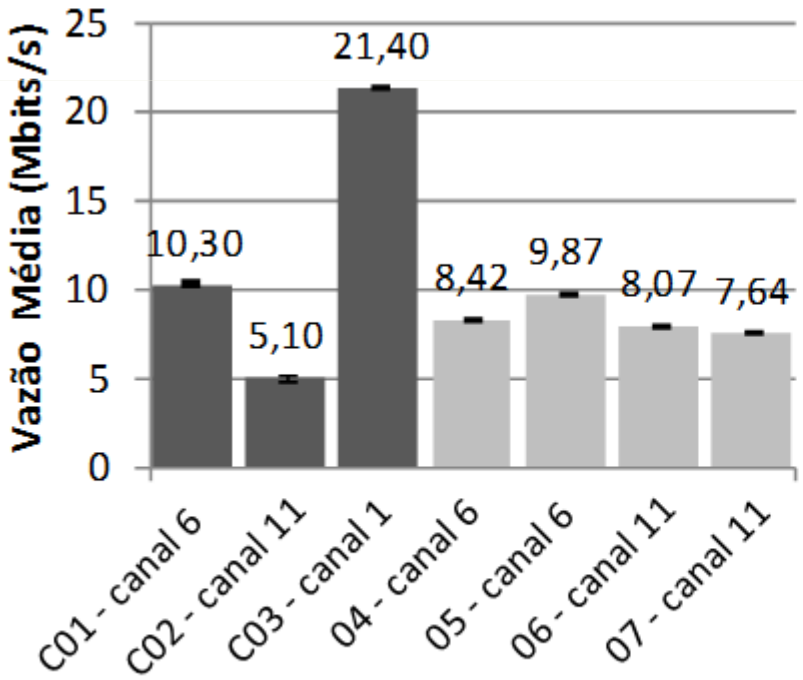


Channel Selection



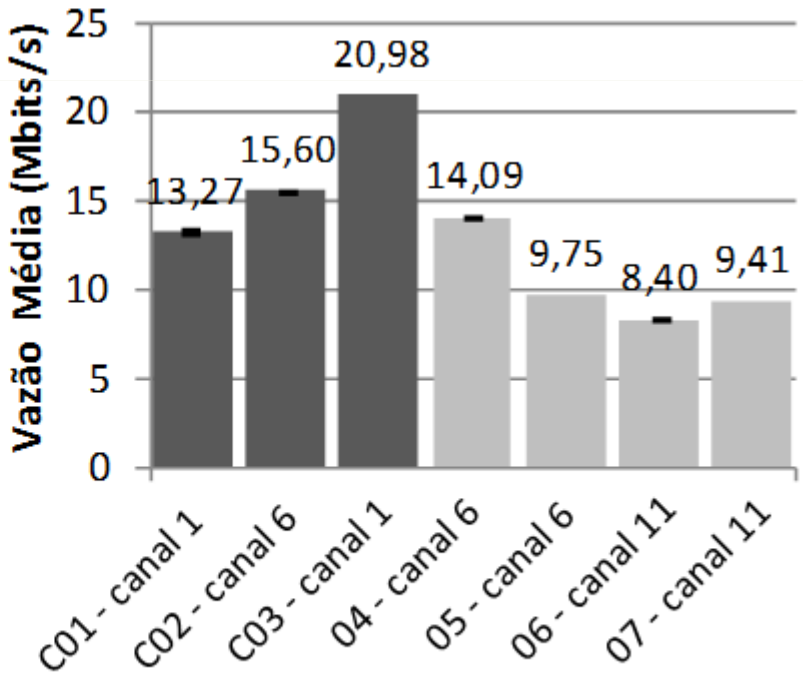
Improvements

(a) Vazão Média para cada ponto de acesso da rede configurada desconsiderando-se redes vizinhas interferentes.



Throughput per access point without SCIFI

(b) Vazão Média para cada ponto de acesso da rede configurada pelo controlador SCIFI.

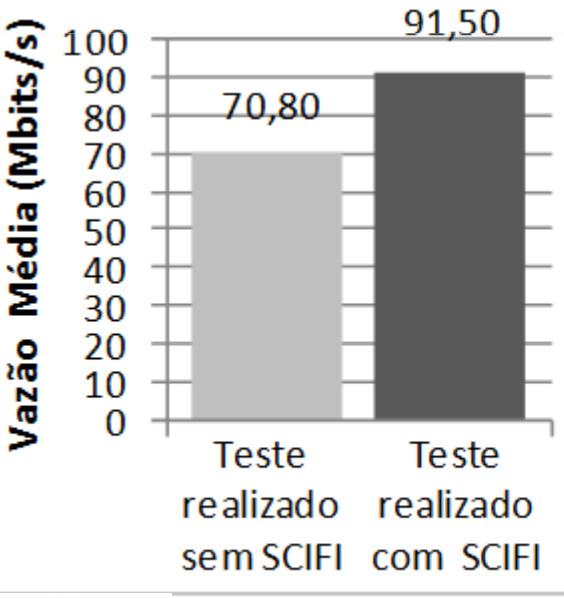


Throughput per access point with SCIFI

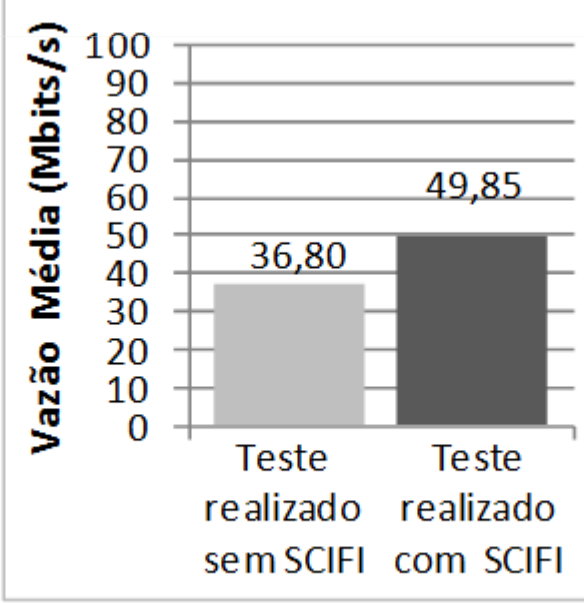
Good Neighbor

- Aggregate throughput (respectivelly: all APs, controlled APs, not controlled APs, each graph showing throughput without and with SCIFI)

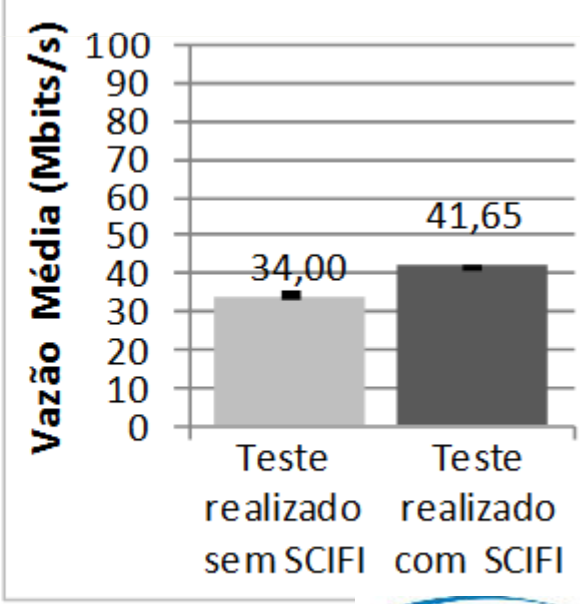
(a) Vazão Agregada Média da rede incluindo seus sete pontos de acesso.



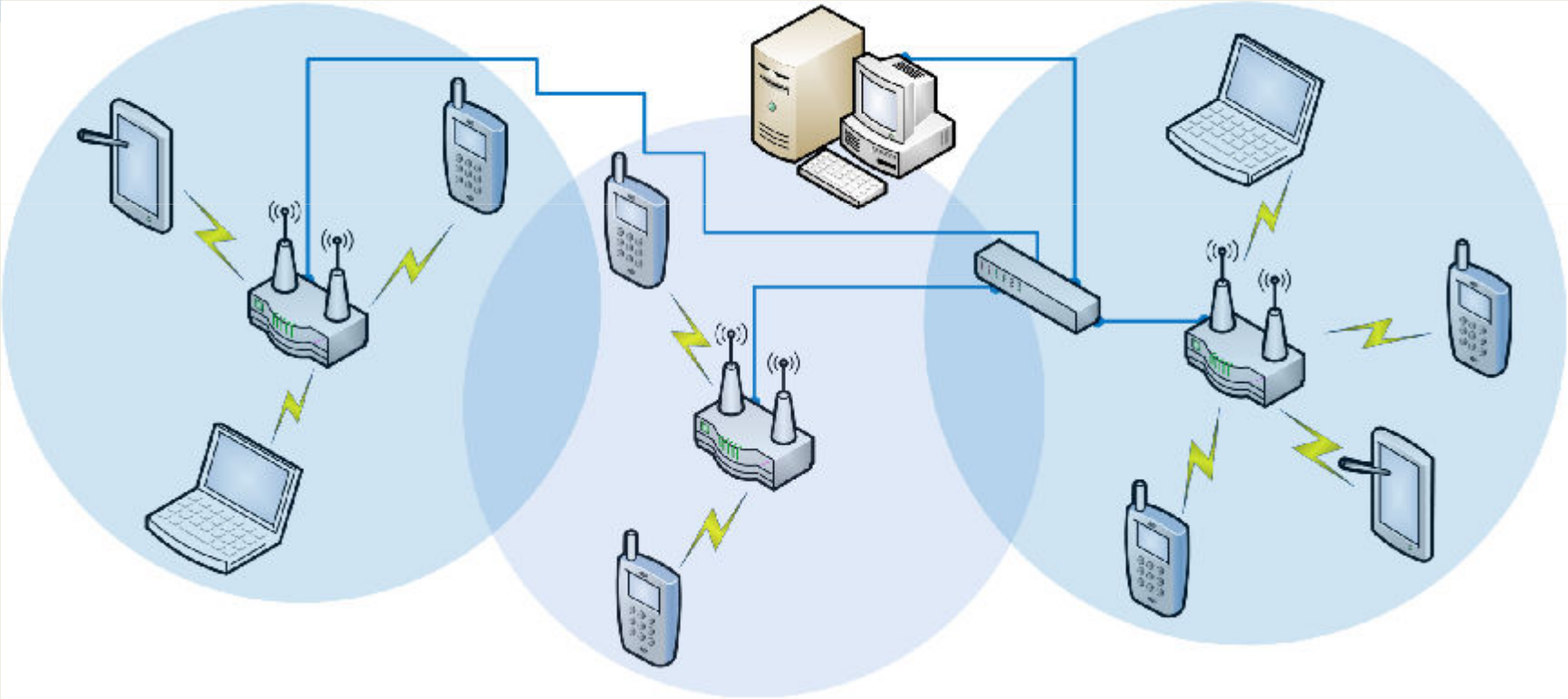
(b) Vazão Agregada Média dos três pontos de acesso controlados (C01, C02, C03)



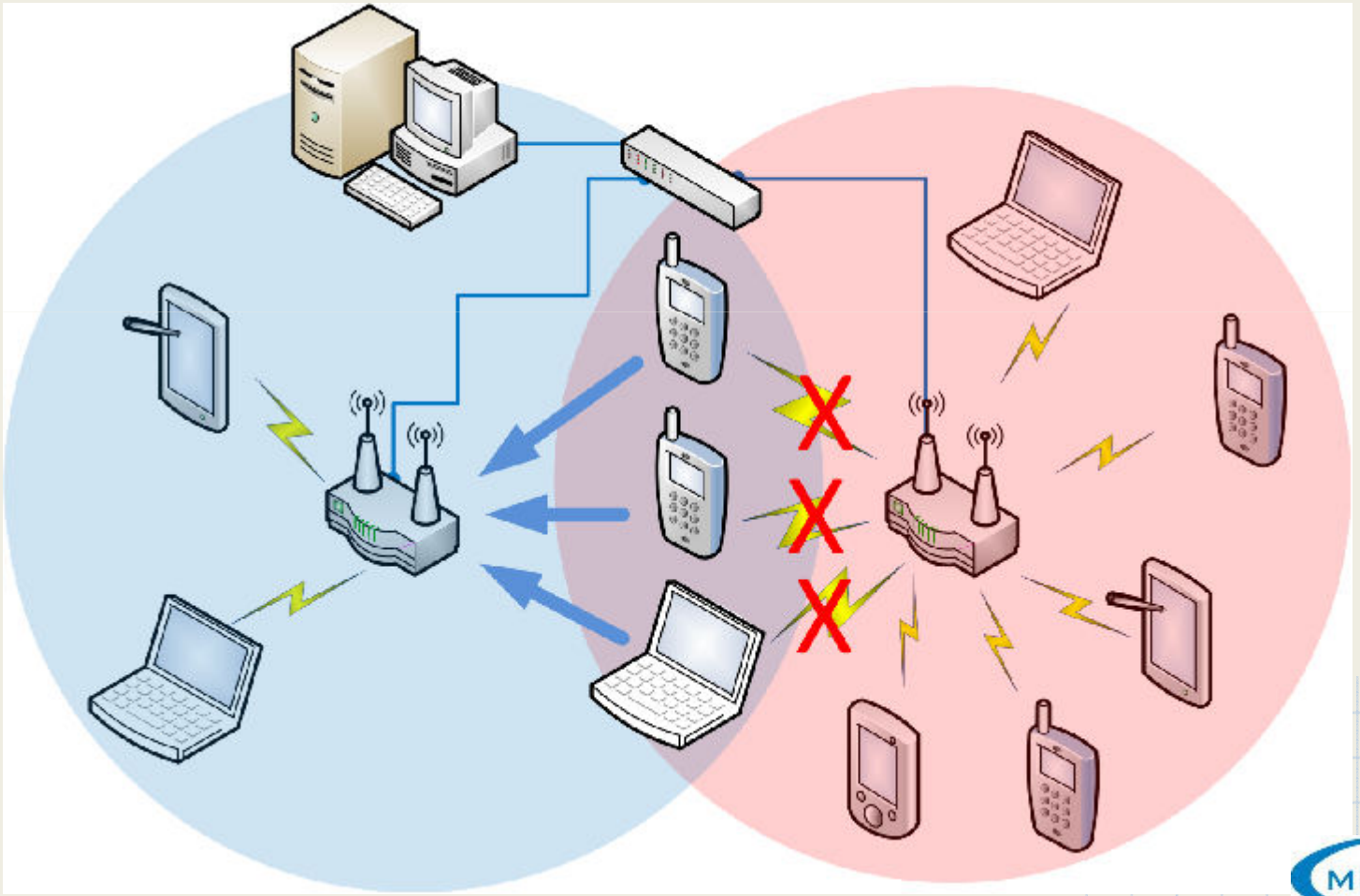
(c) Vazão Agregada Média dos quatro pontos de acesso não controlados (04, 05, 06 e 07)



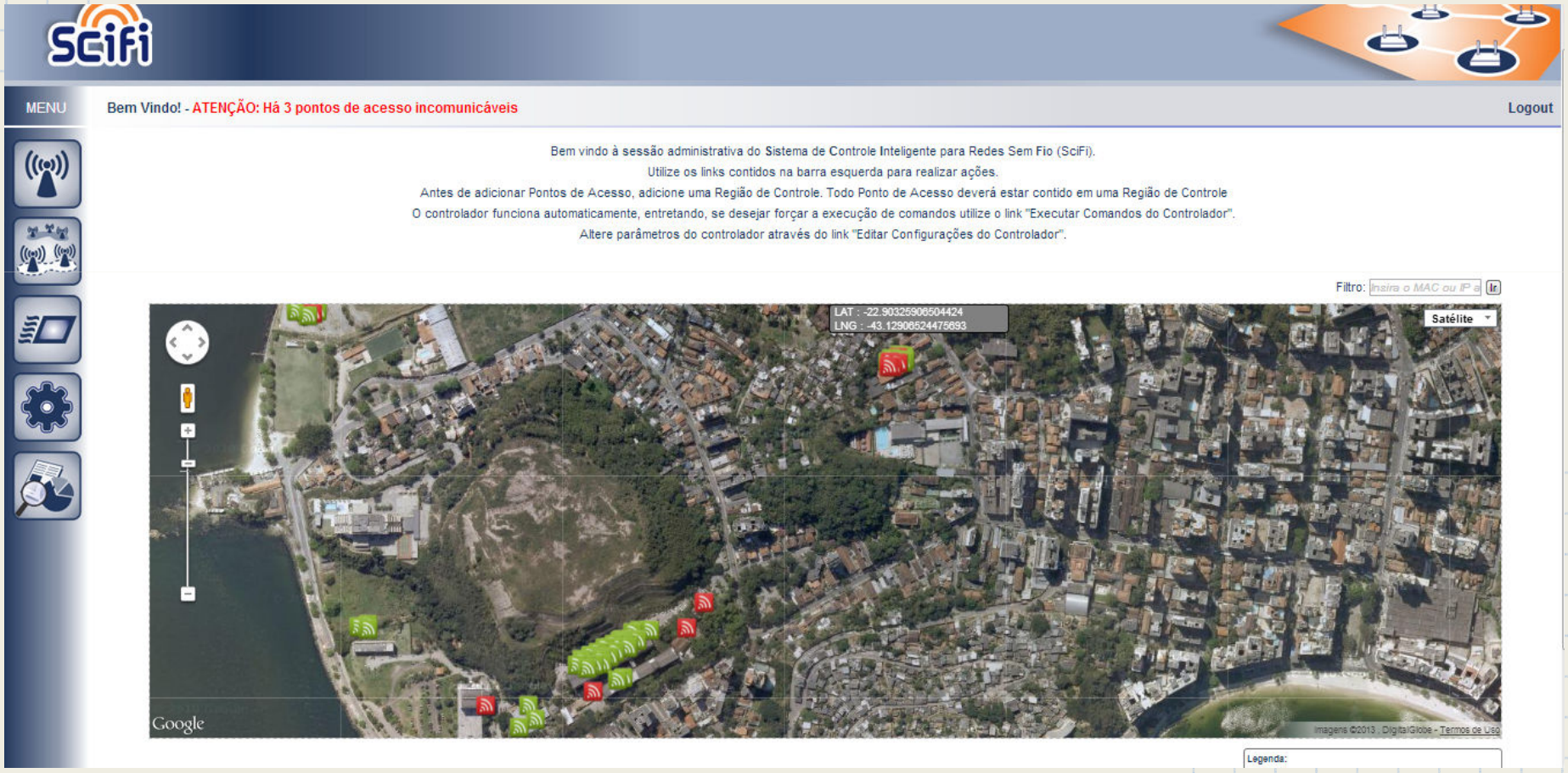
Power Control



Load Balancing



Management Interface



Management Interface

Management Interface

MENU

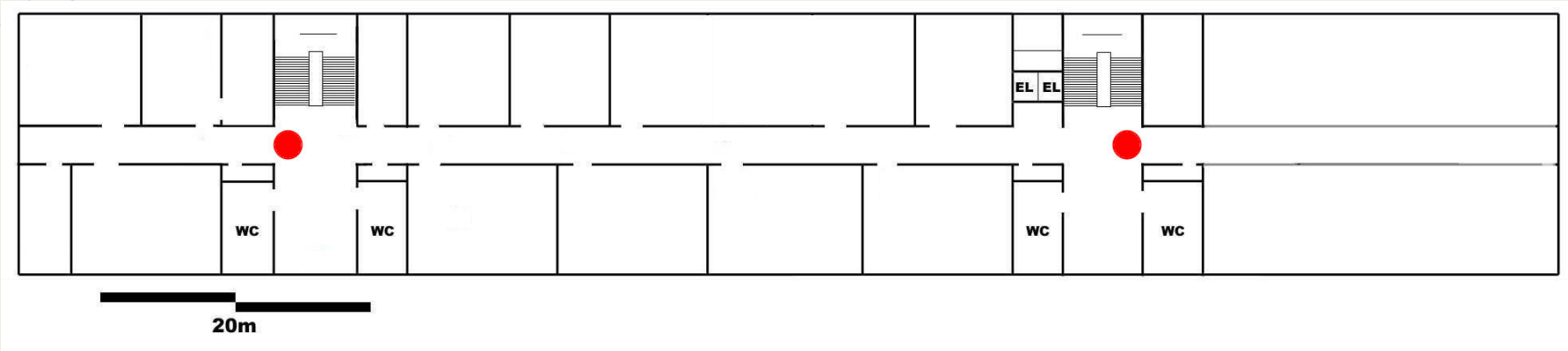
Visualizar Pontos de Acesso

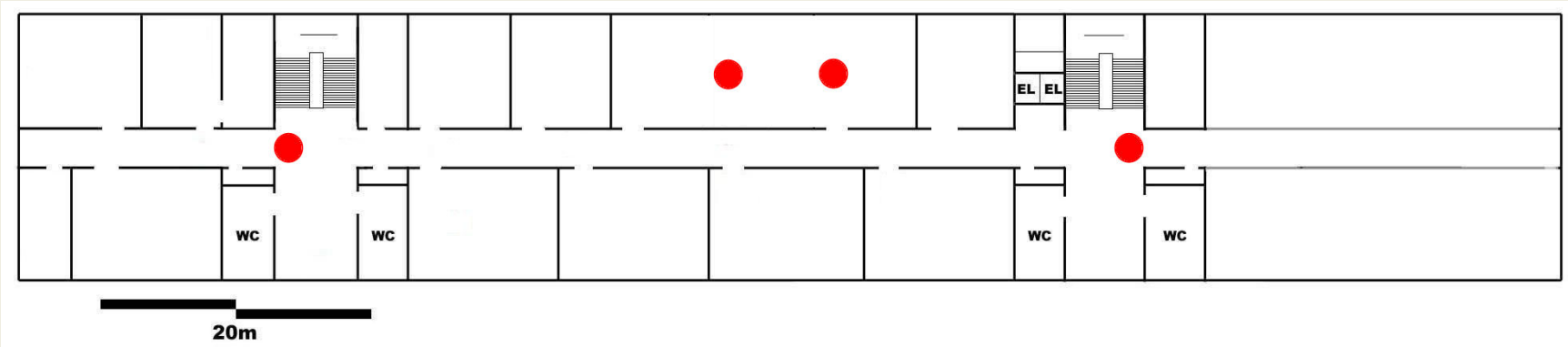
	MAC	IP	Localização	Região	Canal	Lista de Potências	Potência Atual	Número de Usuários	Status	Limite de Carga Baixa	Limite de Sobrecarga	Informação de Scan	Ações
1	00:27:22:[redacted]	10.0.0.10	Engenharia 5° Andar - Entrada Principal	Engenharia	1	{6,8,10,12,14,16,18,20}	6	0	Carga Baixa	10	25		
2	00:27:22:[redacted]	10.0.0.11	Engenharia 2° Andar - Entrada Principal	Engenharia	1	{6,8,10,12,14,16,18,20}	6	0	Carga Baixa	10	25		
3	00:27:22:[redacted]	10.0.0.12	Engenharia 2° Andar - Entrada Secundária	Engenharia	1	{6,8,10,12,14,16,18,20}	6	0	Carga Baixa	10	25		
4	00:27:22:[redacted]	10.0.0.13	Laboratório MídiaCom	Engenharia	11	{6,8,10,12,14,16,18,20}	20	0	Carga Baixa	10	25		
5	00:27:22:[redacted]	10.0.0.14	Engenharia 1° Andar - Entrada Secundária	Engenharia	1	{6,8,10,12,14,16,18,20}	6	0	Carga Baixa	10	25		
6	00:27:22:[redacted]	10.0.0.15	Auditório da Engenharia	Engenharia	6	{6,8,10,12,14,16,18,20}	6	1	Carga Baixa	10	25		
7	00:27:22:[redacted]	10.0.0.16	Auditório da Engenharia	Engenharia	1	{6,8,10,12,14,16,18,20}	6	0	Carga Baixa	10	25		
8	00:15:6D:[redacted]	10.0.0.19	Quiosque do Cláudio (Eng)	Engenharia	11	{6,8,10,12,14,16,18,20}	6	0	Carga Baixa	10	25		

Pilot

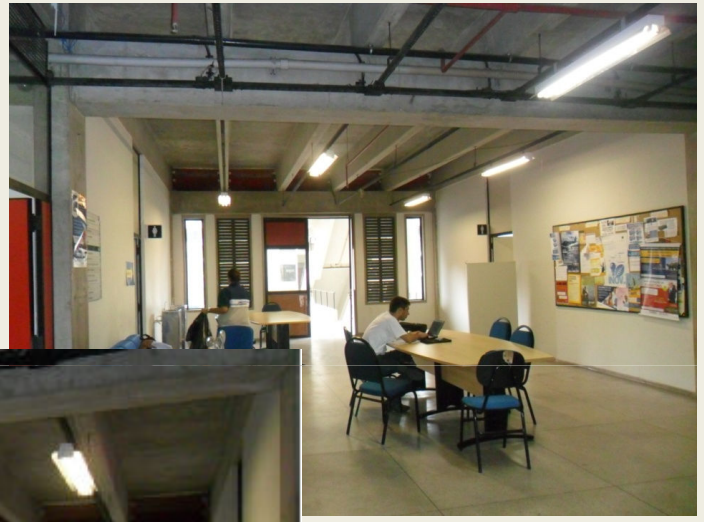
- UFF uses SCIFI for wireless coverage on its campi
  - Managed network
  - Less expensive than other similar solutions
  - More configurable than other software controller solutions
- Allows expansions
  - Access control
  - Security cameras
- Pilot at Praia Vermelha campus
  - Engineering, CS, Architecture, Physics

Indoor Network

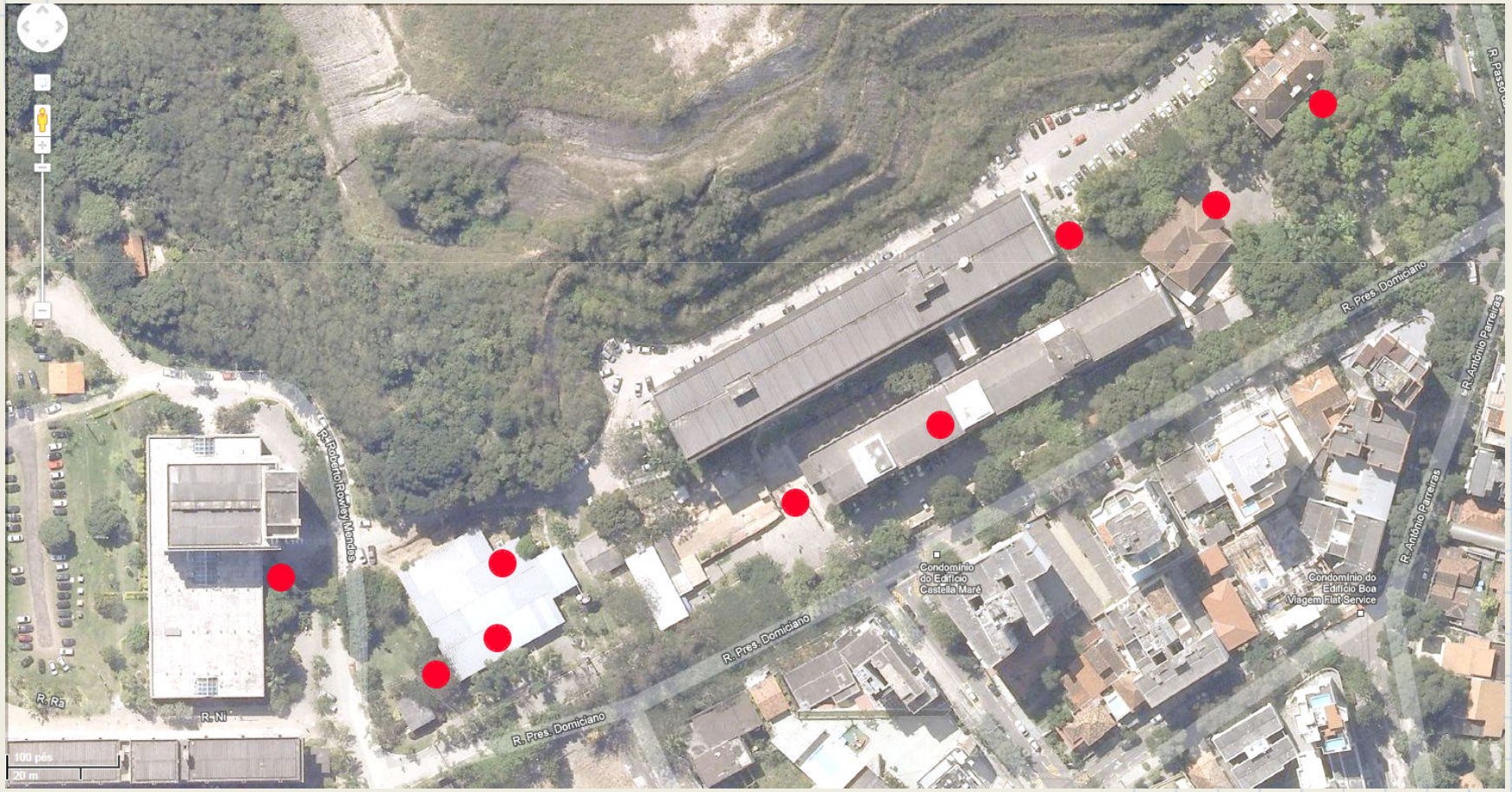




Photos



Outdoor Nework



Photos

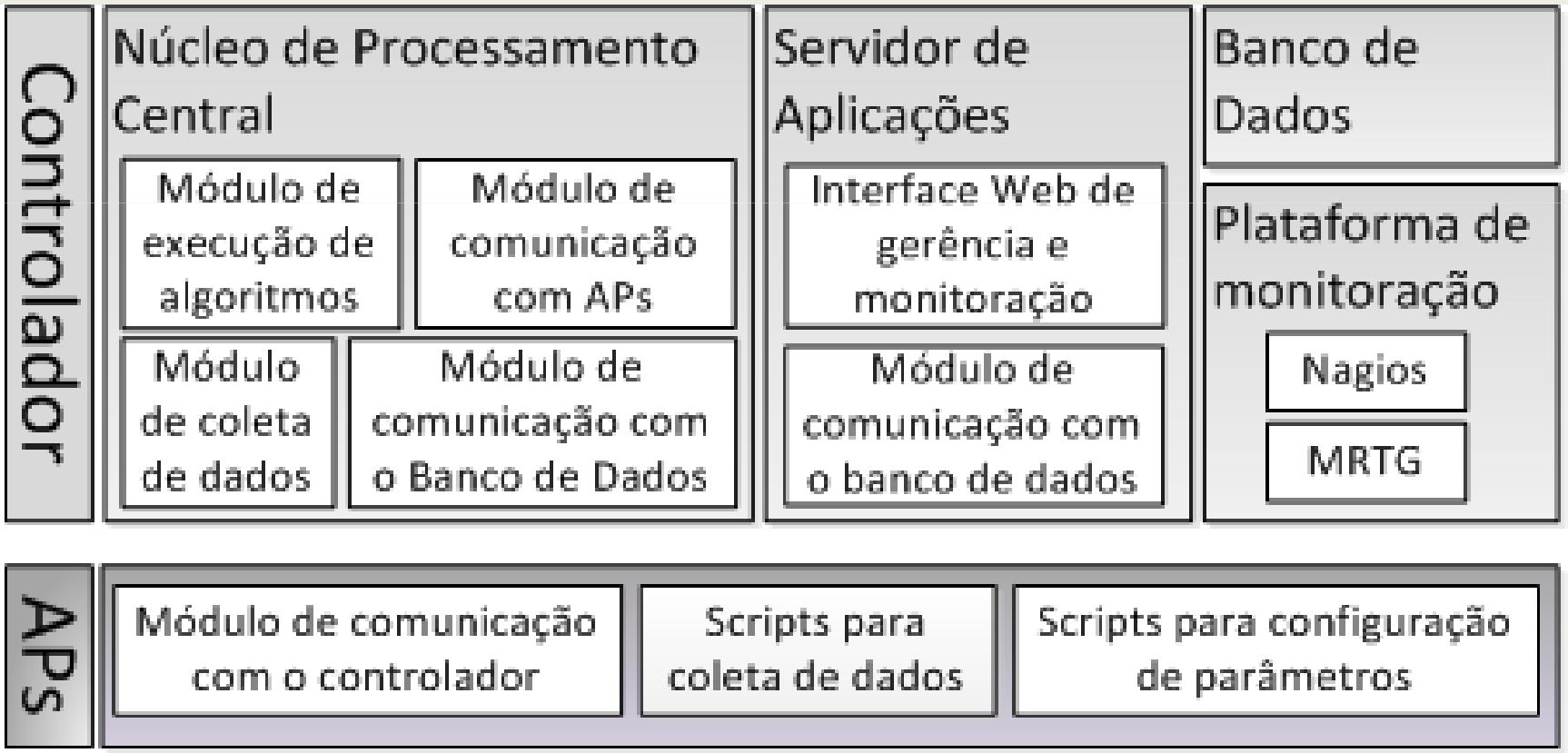
Development

Initial development was supported by RNP through work group calls

Some institutions that installed SCIFI, like Universidade Federal de Ouro Preto are helping with development

A lot has been done, but much work remains!

Block Diagram



GitHub

Software available at GitHub

https://github.com/Sci-Fi

We will be redesign SCIFI to make it more streamlined.

Help is welcome!

Conclusions

- SCIFI is a low cost solution for large scale wireless networks.
- Hardware independent (Ubiquiti, DLink, Linksys, TPlink) – many Aps are compatible with OpenWRT
- Easy to install
  - Number of APs is calculated from the number of simultaneous users divided by 30
  - Areas for escalability
  - Automatic and dynamic configuration

Obrigado!

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