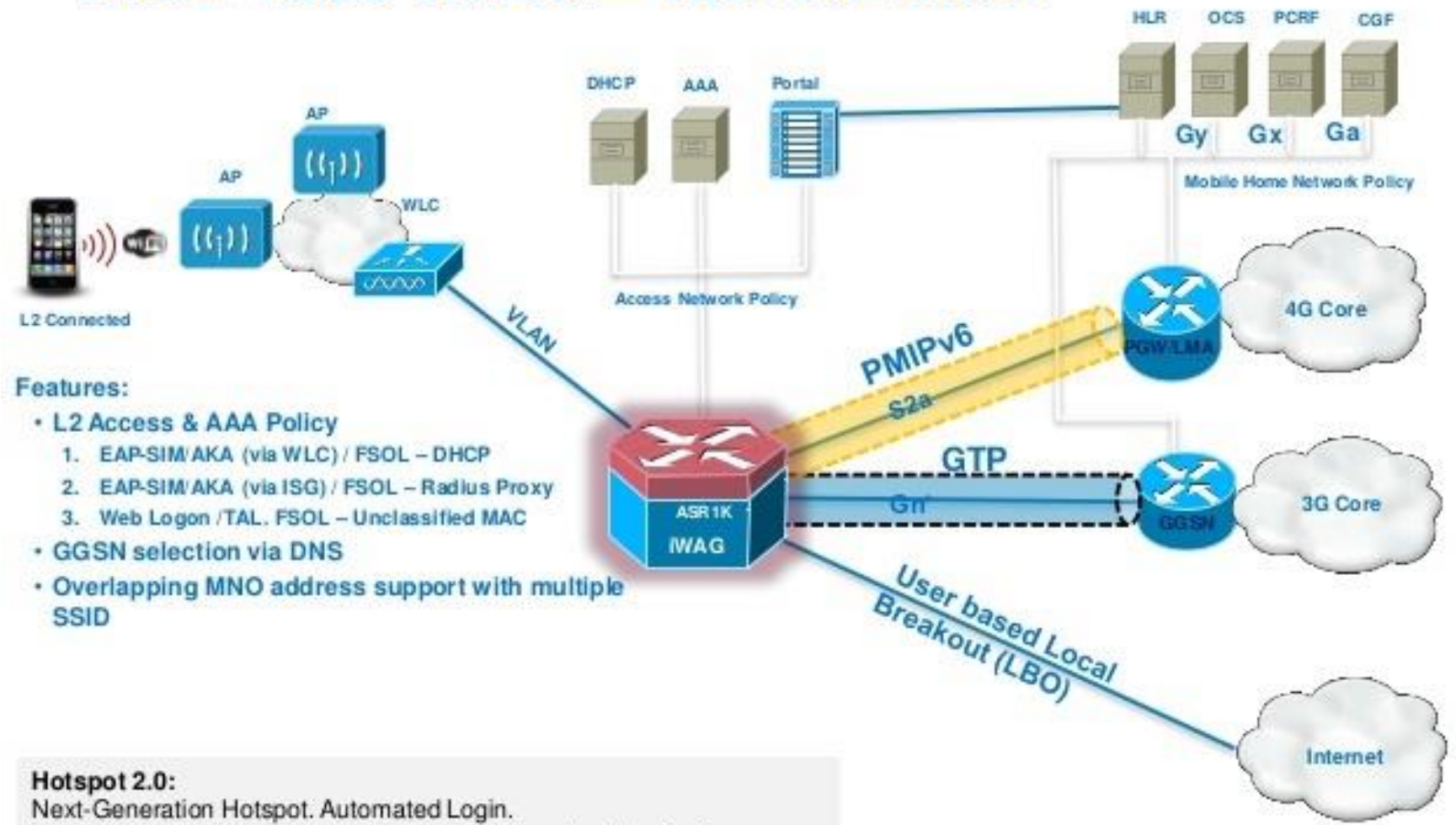


Построение WiFi сети на основе CAPsMAN и MikroTik Cloud Router

Dzmitry Buynovskiy (JLLC MTS, Belarus)

1 За основу сети взята общая концепция WiFi от компании Cisco

ASR 1000 IWAG – IOS XE 3.8S



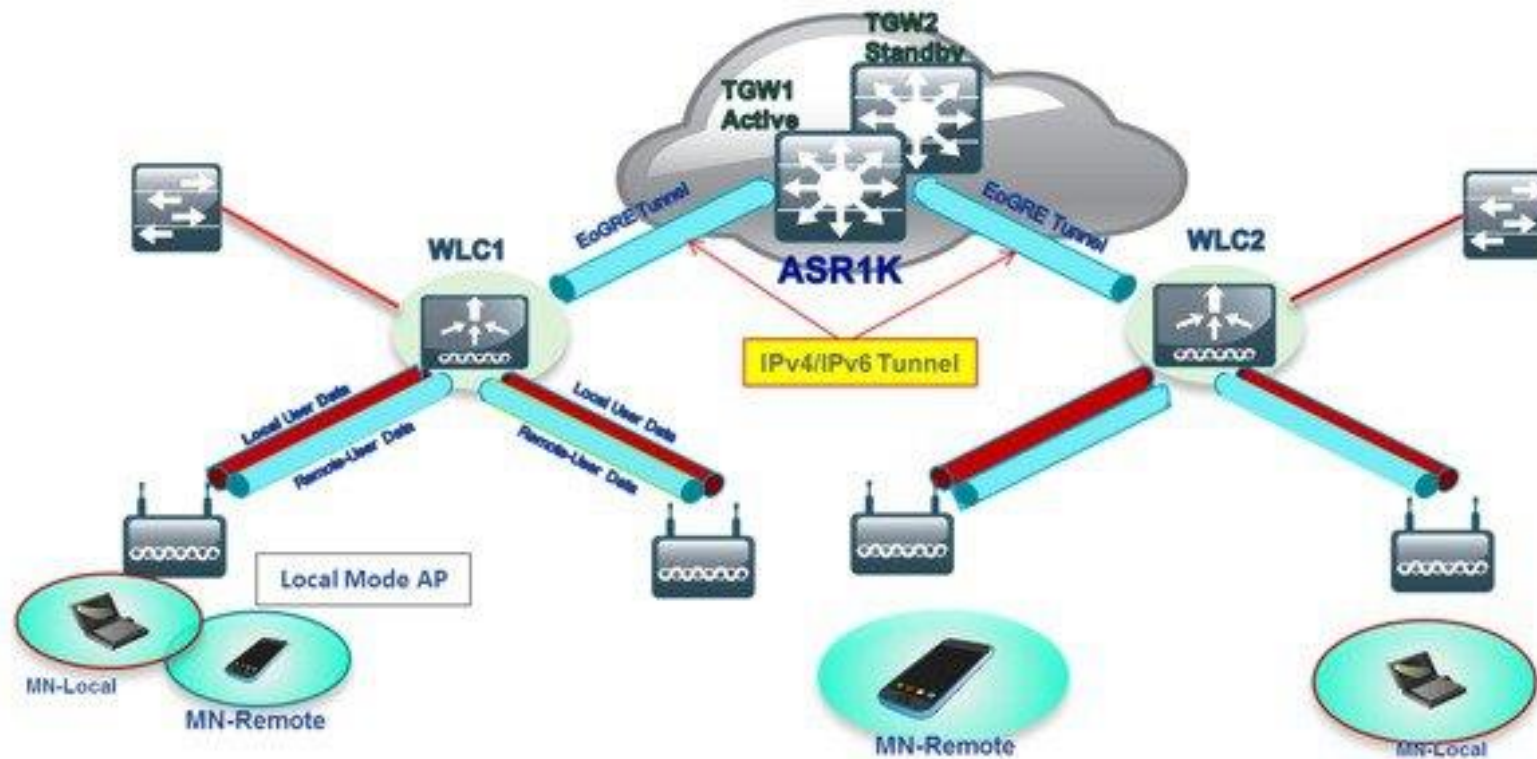
Features:

- L2 Access & AAA Policy
 1. EAP-SIM/AKA (via WLC) / FSOL – DHCP
 2. EAP-SIM/AKA (via ISG) / FSOL – Radius Proxy
 3. Web Logon /TAL, FSOL – Unclassified MAC
- GGSN selection via DNS
- Overlapping MNO address support with multiple SSID

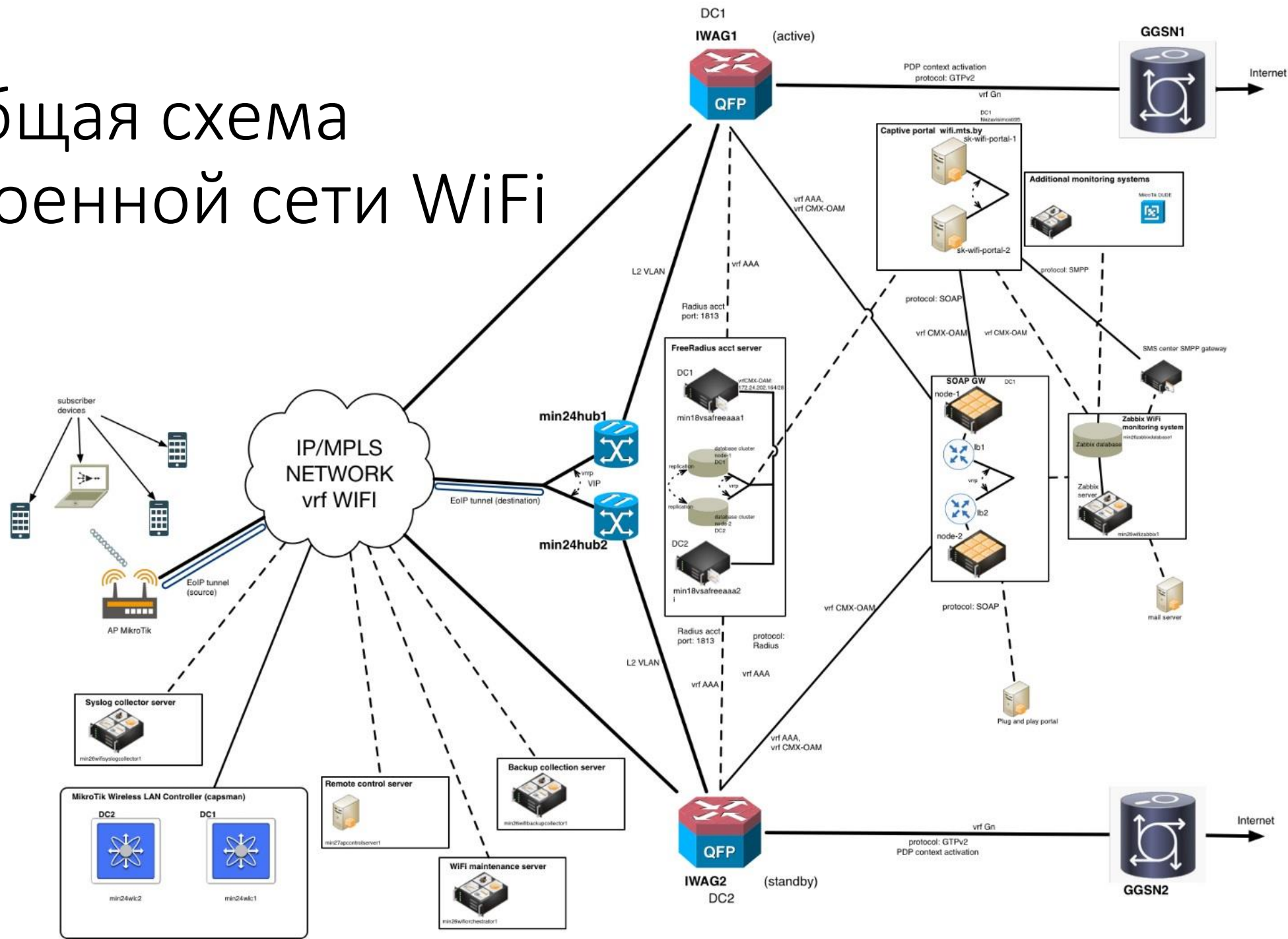
Hotspot 2.0:
Next-Generation Hotspot. Automated Login.
IEEE 802.11u, WPA2-Enterprise, and EAP-based authentication.
Wi-Fi Certified Passpoint™

1.1 Общая концепция решения Cisco

IPv4 or IPv6 EoGRE Tunnel From WLC



1.3 Общая схема построенной сети WiFi



1.4 MikroTik EoIP protocol для организации L2 среды

Interface <eoip_from_min24hub1_old4>

General | Loop Protect | Status | Traffic

Name: eoip_from_min24hub1_old4

Type: EoIP Tunnel

MTU: [dropdown]

Actual MTU: 1458

L2 MTU: 65535

MAC Address: FE:0C:A4:54:96:13

ARP: enabled

ARP Timeout: [dropdown]

Local Address: [dropdown]

Remote Address: 172.17.109.100

Tunnel ID: 18

IPsec Secret: [dropdown]

Keepalive: 00:00:10, 10

DSCP: inherit

Dont Fragment: no

Clamp TCP MSS

Allow Fast Path

OK Cancel Apply Disable Comment Copy Remove Torch

enabled running slave

No.	Time	Source	Destination	Protocol	Length	Info
28	0.457004	172.18.25.1	10.24.1.106	TCP	54	64773 → 8291 [ACK] Seq=73 Ack=9647 Win=16218 Len=0
29	0.488911	100.70.0.1	255.255.255.255	DHCP	384	DHCP ACK - Transaction ID 0xf3f98203
30	0.524039	0.0.0.0	255.255.255.255	DHCP	394	DHCP Discover - Transaction ID 0x57827096
31	0.524869	100.70.0.1	255.255.255.255	DHCP	384	DHCP Offer - Transaction ID 0x57827096
32	0.566911	fe:a5:cc:4f:4b:60	Spanning-tree-(for-...	STP	95	RST. Root = 32768/0/00:50:56:a5:7b:e7 Cost = 10 Port = 0x...
33	0.586892	0.0.0.0	255.255.255.255	DHCP	406	DHCP Request - Transaction ID 0x57827096

▷ Frame 29: 384 bytes on wire (3072 bits), 384 bytes captured (3072 bits)

▷ Ethernet II, Src: 00:d1:e6:e6:e6:e6 (00:d1:e6:e6:e6:e6), Dst: ac:ff:ff:00:00:00 (ac:ff:ff:00:00:00)

▷ Internet Protocol Version 4, Src: 172.24.211.11, Dst: 10.24.1.106

↳ Generic Routing Encapsulation (MIKROTIK EoIP)

- ↳ Flags and Version: 0x2001
 - 0... .. = Checksum Bit: No
 - .0... .. = Routing Bit: No
 - ..1. = Key Bit: Yes
 - ...0 = Sequence Number Bit: No
 - 0... .. = Strict Source Route Bit: No
 -000 = Recursion control: 0
 - 0000 0... = Flags (Reserved): 0
 -001 = Version: Enhanced GRE (1)
- Protocol Type: MIKROTIK EoIP (0x6400)
- Key: 0x01563c04

▷ Ethernet II, Src: USDepart_00:52:13 (00:00:5e:00:52:13), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

▷ Internet Protocol Version 4, Src: 100.70.0.1, Dst: 255.255.255.255

▷ User Datagram Protocol, Src Port: 67, Dst Port: 68

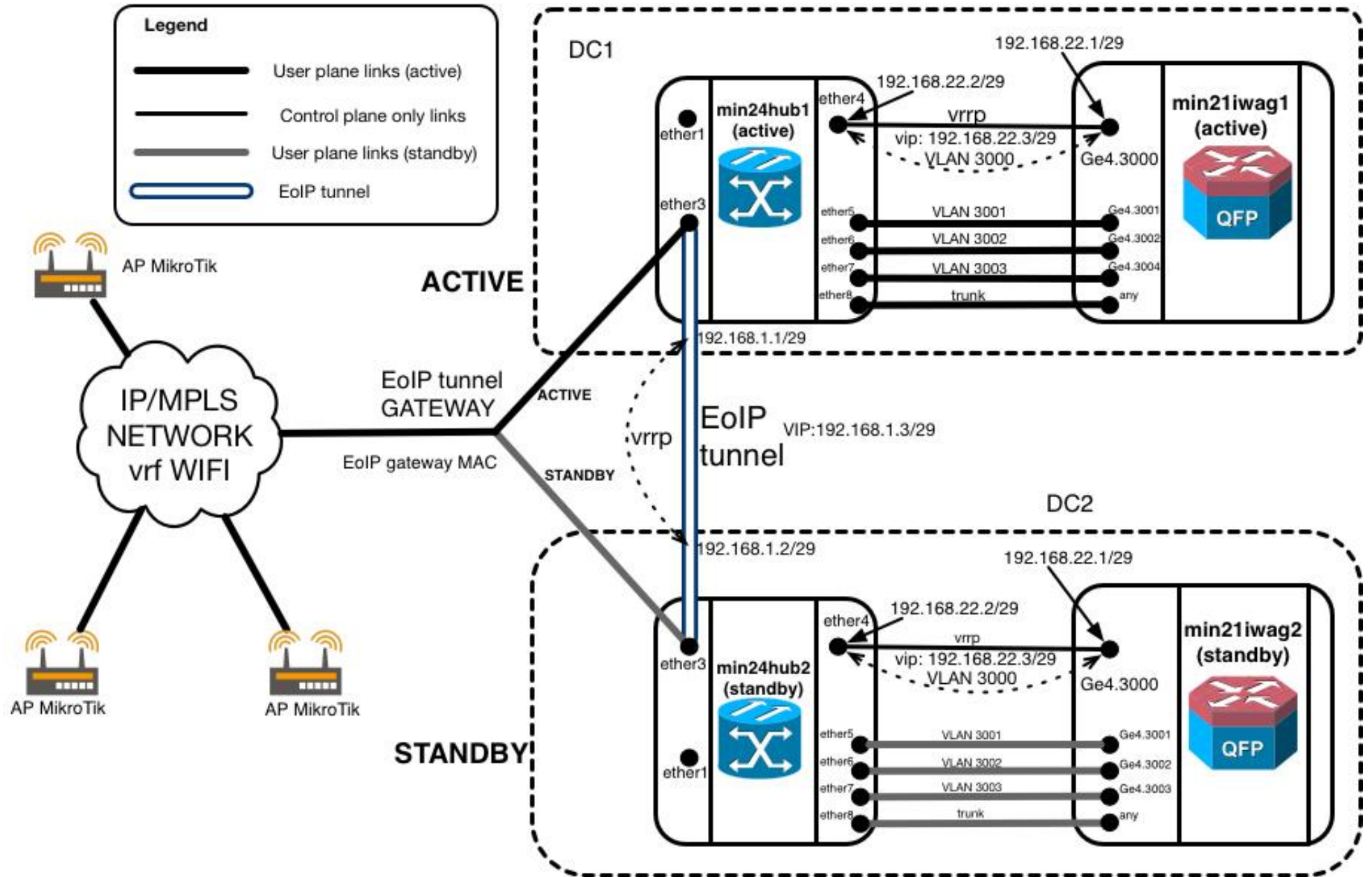
▷ Bootstrap Protocol (ACK)

```
0020 01 6a 20 01 64 00 01 56 3c 04 ff ff ff ff ff ff .j .d. .V <.....
0030 00 00 5e 00 52 13 08 00 45 00 01 48 6b ea 00 00 ..^..R... E..Hk...
0040 ff 11 ea 73 64 46 00 01 ff ff ff ff 00 43 00 44 ...sdF... ..C.D
0050 01 34 cf 77 02 01 06 00 f3 f9 82 03 00 00 80 00 .4.w.... ..
0060 64 46 0f 2c 64 46 0f 2c 00 00 00 00 00 00 00 dF.,dF., .....
0070 00 ec 0a be f7 ac 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

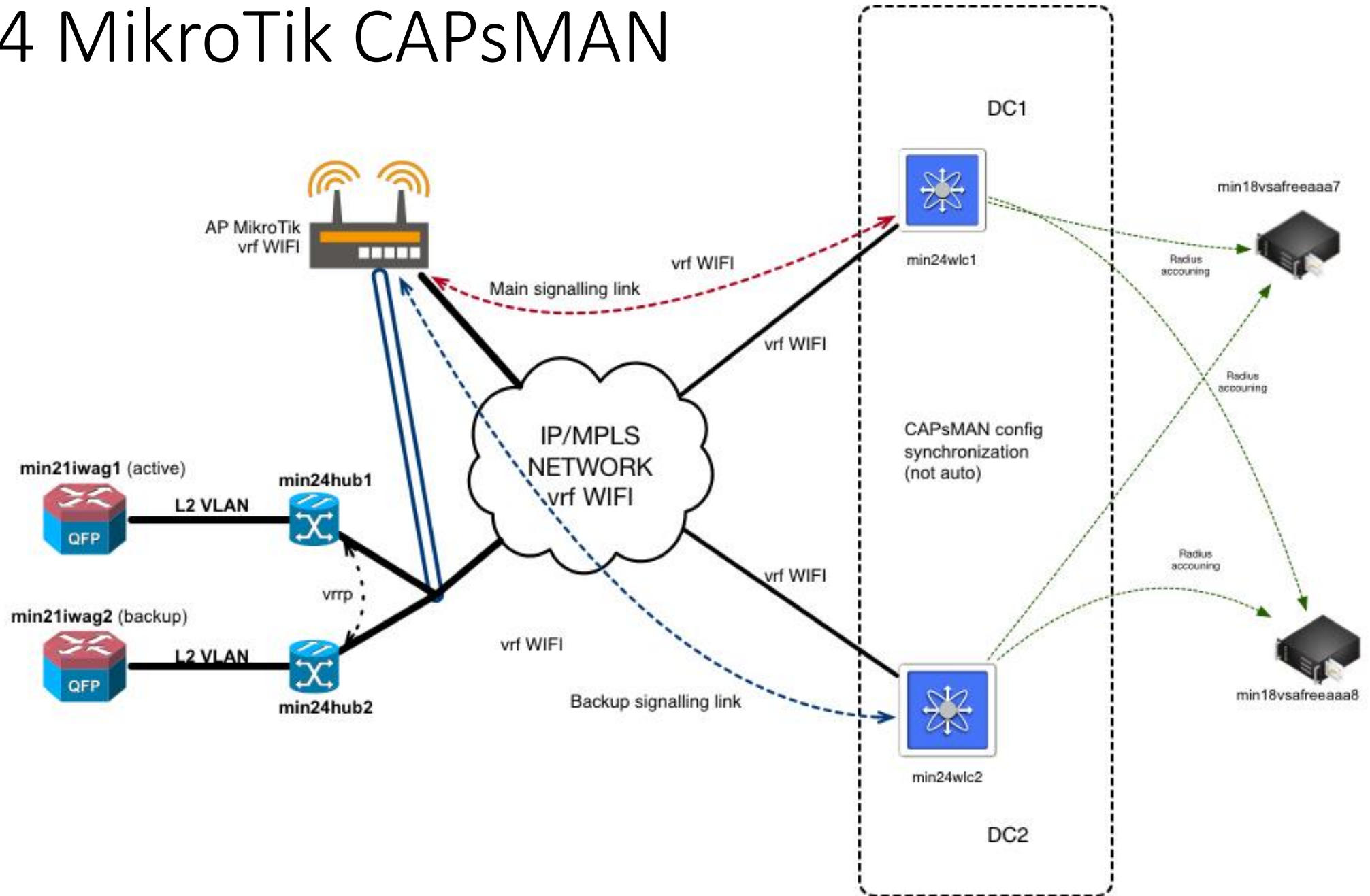
2 Масштаб построенной сети WiFi на MikroTik

- ~500 WiFi AP MikroTik
- ~1000 клиентов в ЧНН
- ~250 мбит/с в ЧНН
- 2 MikroTik CHR в качестве CAPsMAN
- 2 MikroTik CHR в качестве EoIP HUB
- 2 freeradius server
- Дополнительные узлы мониторинга и управления

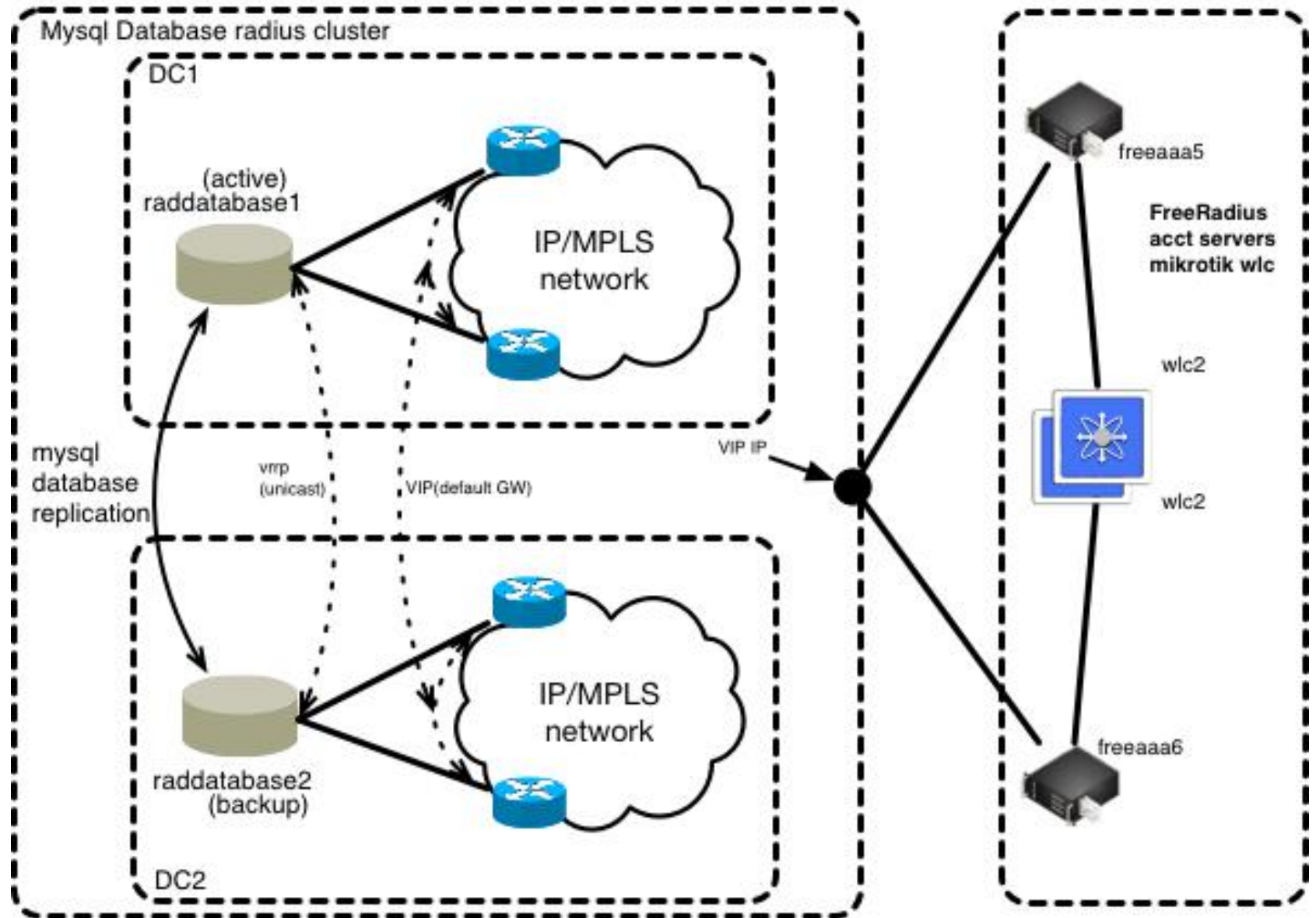
3 EoIP tunnel HUB



4 Mikrotik CAPsMAN



5 Radius accounting для сбора статистики



6 Мониторинг и управление

- Zabbix
- MikroTik DUDE

```
:local checkip [/ping 172.24.202.193 count=7]
:if (checkip = 0) do={
    log warning "IP not reachable";
    /system reboot;
    log warning "mikrotik rebooted";
} \
else={
    log info "OK";
}
```

7 Загрузка CPU и выделенные ресурсы

```
[dbuynovskiy@wlc1] > system resource print
```

```
uptime: 5w3d20h42m46s
```

```
version: 6.42.1 (stable)
```

```
build-time: Apr/23/2018 10:46:55
```

```
free-memory: 814.3MiB
```

```
total-memory: 975.8MiB
```

```
cpu: Intel(R)
```

```
cpu-count: 8
```

```
cpu-frequency: 2494MHz
```

```
cpu-load: 0%
```

```
free-hdd-space: 956.9MiB
```

```
total-hdd-space: 986.1MiB
```

```
write-sect-since-reboot: 20097992
```

```
write-sect-total: 20097993
```

```
architecture-name: x86_64
```

```
board-name: CHR
```

```
platform: MikroTik
```

```
[dbuynovskiy@wlc1] >
```

The screenshot displays the Mikrotik WinBox interface. On the left is a sidebar with navigation options like 'Quick Set', 'CAPsMAN', 'Interfaces', 'Wireless', 'Bridge', 'PPP', 'Mesh', 'IP', 'MPLS', 'OpenFlow', 'Routing', 'System', 'Queues', 'Files', 'Log', 'Radius', 'Tools', 'New Terminal', 'TR069', 'Dude', 'KVM', 'Make Supout.rif', 'Manual', and 'New WinBox'. The main window is titled 'Session Settings Dashboard' and shows 'Safe Mode' and 'Session: 172.24.223....'. A 'CPU' window is open, displaying a table of CPU statistics:

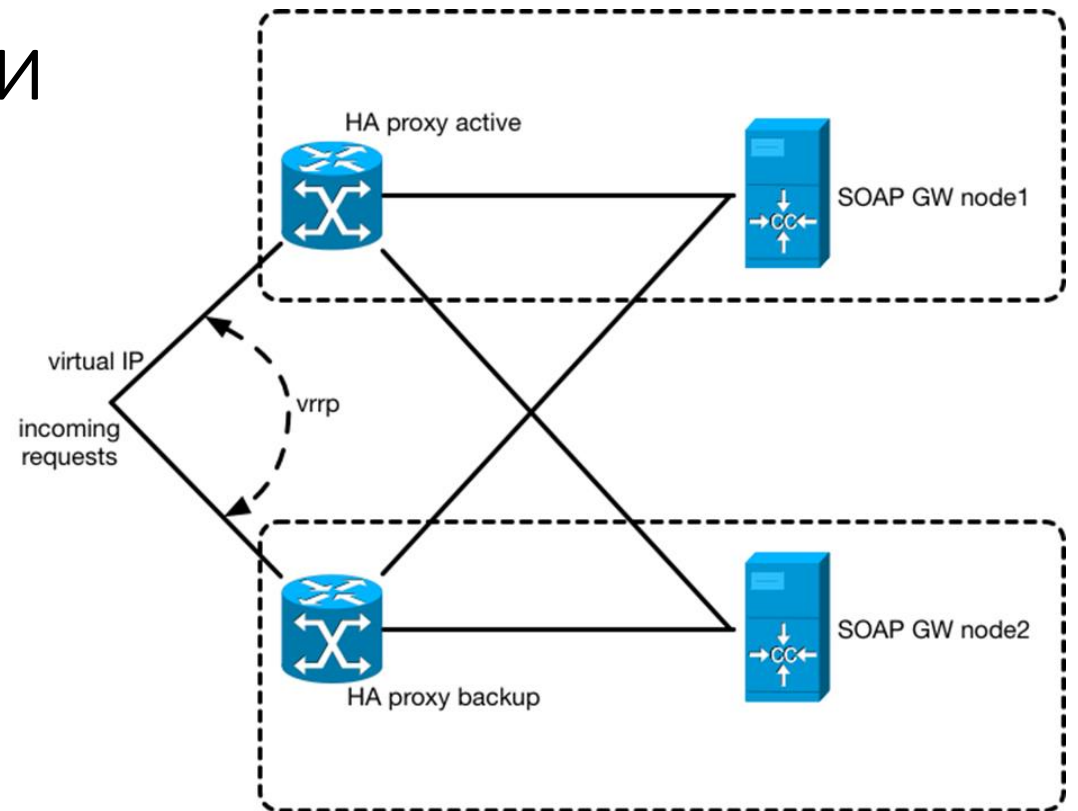
CPU	Load (%)	IRQ (%)	Disk (%)
cpu0	2	2	0
cpu1	0	0	0
cpu2	3	3	0
cpu3	2	2	0
cpu4	0	0	0
cpu5	3	3	0
cpu6	0	0	0
cpu7	8	8	0

Below the table, it indicates '8 items'. To the right, a 'Resources' window shows system statistics:

- Uptime: 8d 05:29:40
- Free Memory: 468.9 MiB
- Total Memory: 975.8 MiB
- CPU: Intel(R)
- CPU Count: 8
- CPU Frequency: 2494 MHz
- CPU Load: 1 %
- Free HDD Space: 697.9 MiB
- Total HDD Size: 986.1 MiB
- Sector Writes Since Reboot: 1 076 192
- Total Sector Writes: 1 076 193
- Architecture Name: x86_64
- Board Name: CHR
- Version: 6.42.3 (stable)
- Build Time: May/24/2018 09:20:22

8 Получение информации о пользователях с помощью MikroTik API и SOAP gateway

- Стабильность
- Скорость работы



```
726 MTik::verbose = false
727 mikrot_connection1 = MTik::Connection.new :host => controllers_ip, :user => 'user', :pass => 'password'
728 mikrot_connection1.get_reply( command '/caps-man/registration-table/getall') do |req, sentence|
729
730   req.reply.each do |reply|
731     if reply.key?('!re')
732       if reply['mac-address'] == subscribers_mac
733
734         access_point = reply['interface']
735         ssid_ap = reply['ssid']
736         tx_rate = reply['tx-rate']
737         rx_rate = reply['rx-rate']
738         rx_signal = reply['rx-signal']
739         uptime = reply['uptime']
740         packets = reply['packets']
741         bytes = reply['bytes']
742         tx_rate_set = reply['tx-rate-set']
743       end
744     end
745   end
end
```

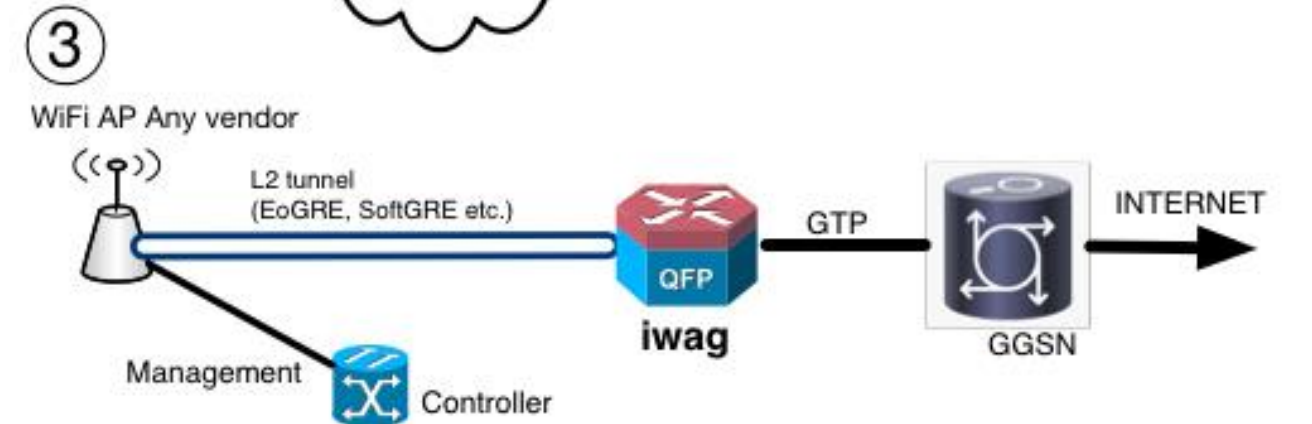
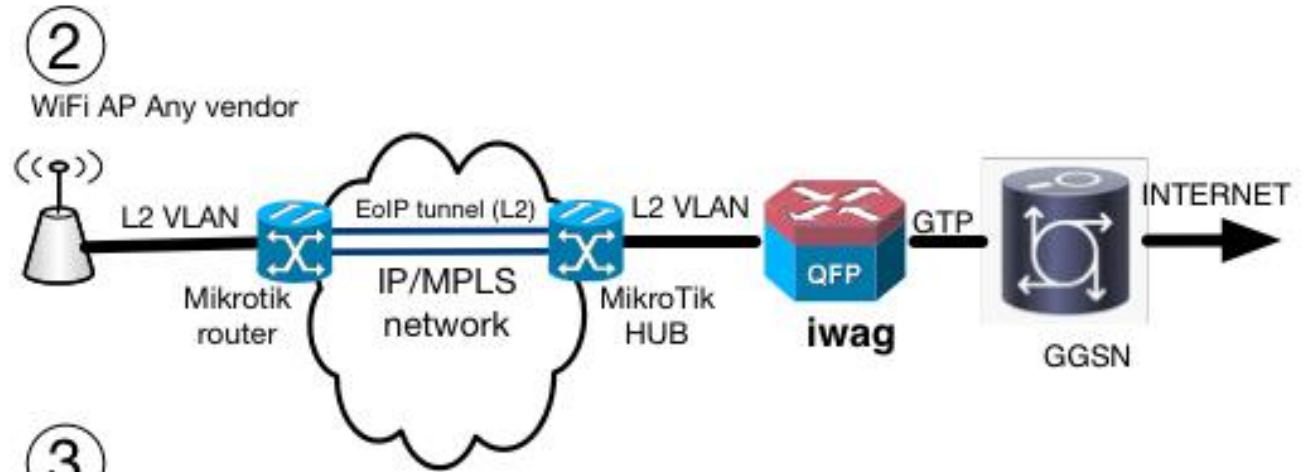
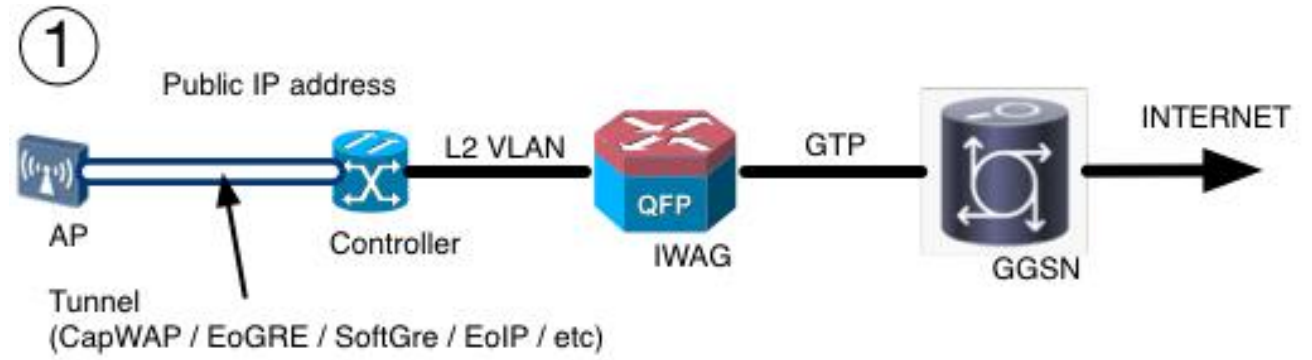
9 Проблемы при работе сети и способы их решения

- LTE Kit, SXT LTE проблема с форвардингом трафика
- Bridge RSTP problem
- WiFi AP modem interruptions
- Проблема с VRF
- Проблема с потерей пакетов
- Проблема с нестабильной обработкой трафика у WAP LTE Kit
- Отвалы точек от CAPsMAN

Все эти проблемы были решены,
либо найден обходной вариант

```
/interface bridge settings set use-ip-firewall=yes  
/ip firewall filter add chain=forward action=passthrough  
/ip firewall filter add chain=forward action=fasttrack-connectionx
```


10 Интеграция WiFi AP



Мои контакты

- Dzmitry Buynovskiy
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