

# Отказоустойчивый доступ в интернет

с использованием динамической и рекурсивной маршрутизации.

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MIKROTIK USER MEETING 15 МАРТА 2016, ИРКУТСК, РОССИЯ.

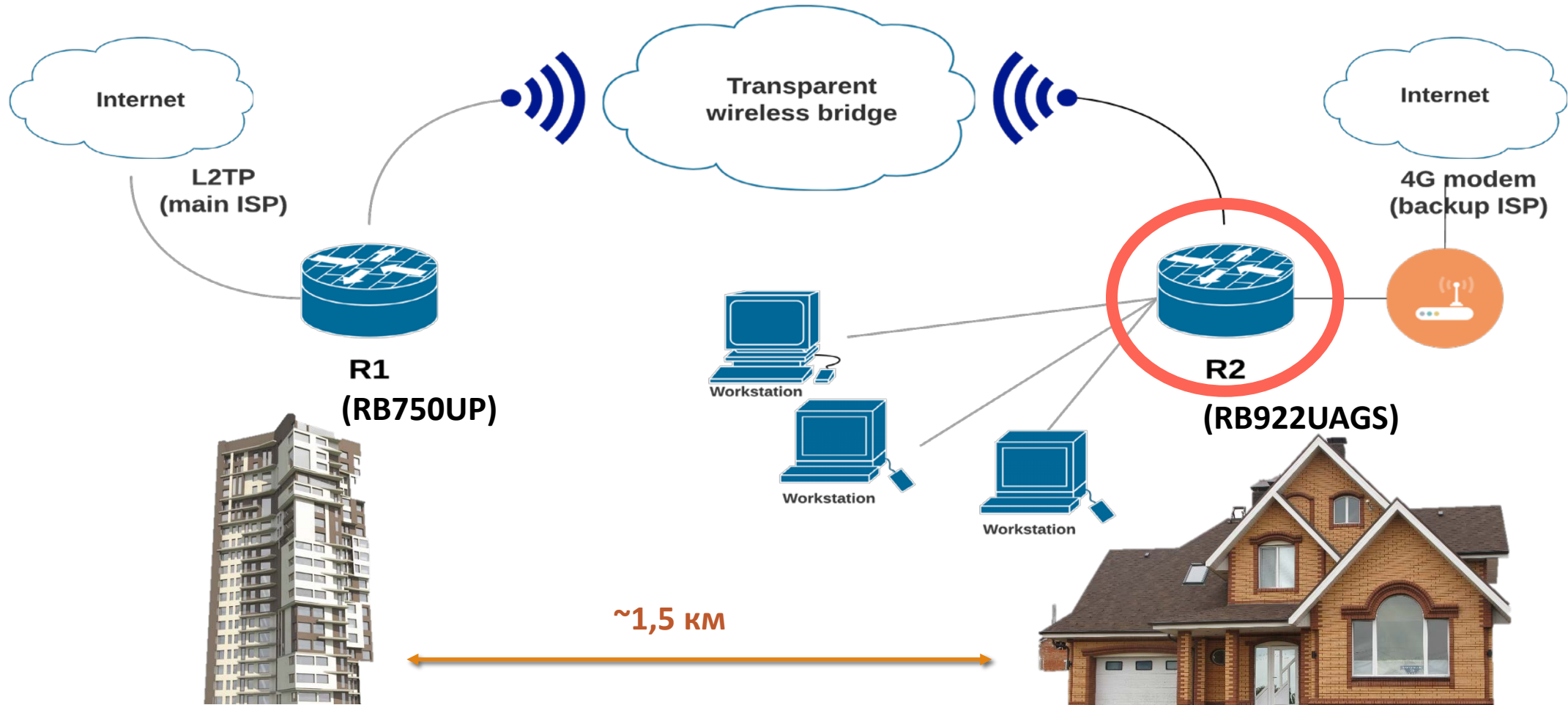
# Давайте знакомиться =)

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- Александр Романов, Нижний Новгород
- МТСНА, МТСРЕ
- 7 лет работы в одном из крупнейших провайдеров в отделе широкополосного доступа

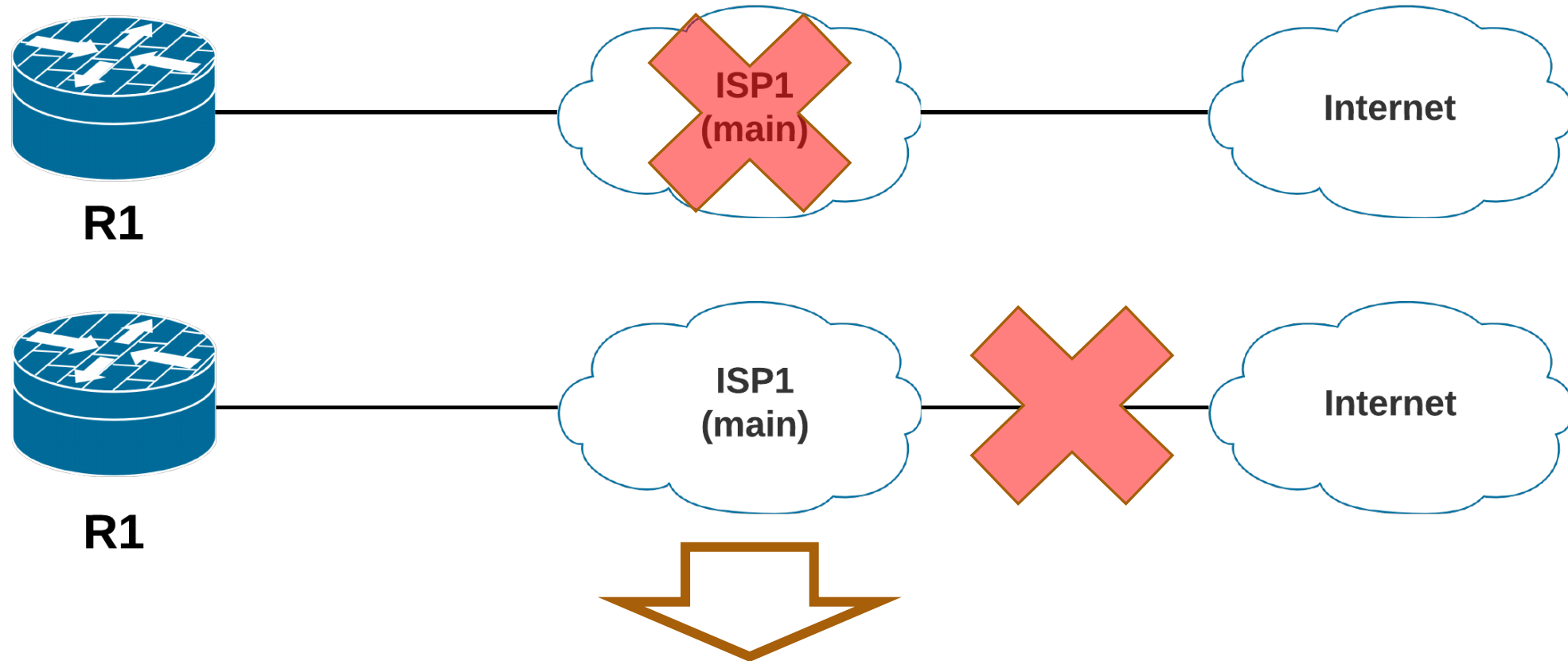
# Условие и постановка цели

## Отказоустойчивый доступ в интернет на R2





# Проблемы бывают двух типов

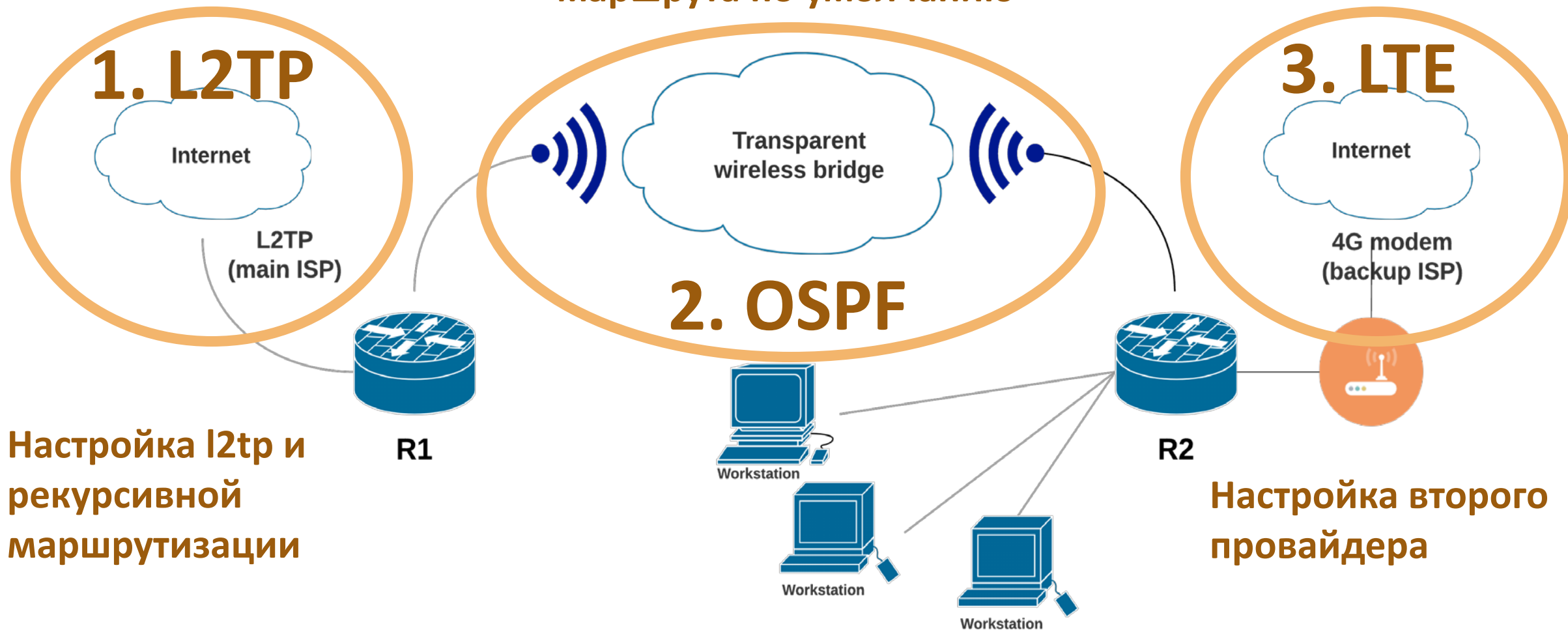


**Вынужденная мера – использование рекурсивной маршрутизации для проверки доступа в интернет**



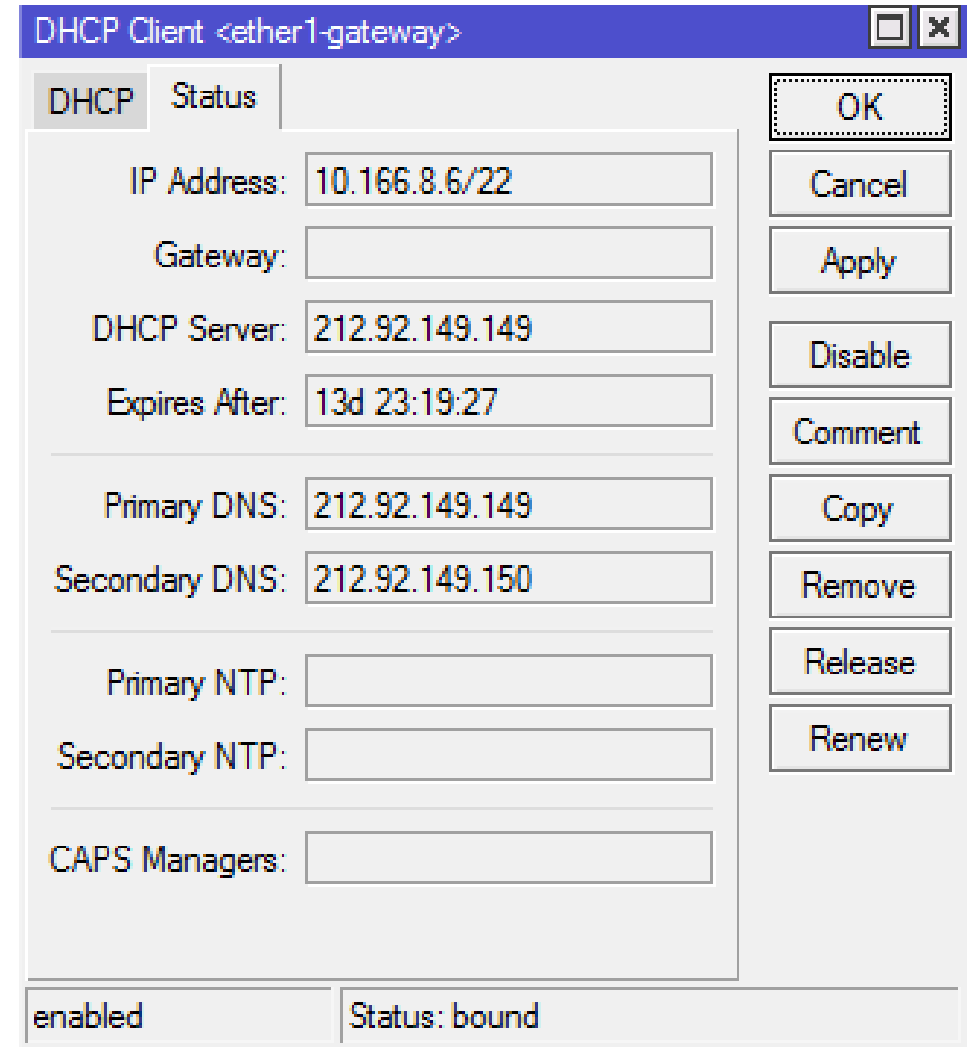
# Наша задача и этапы её решения:

Настройка OSPF с перераспределением маршрута по умолчанию



# Подготовка I2tr. Настройка интерфейса

- Интерфейс получает настройки по DHCP.
- Доступ в интернет осуществляется через I2tr-туннель.



The screenshot shows the DHCP Client configuration window for the interface 'ether1-gateway'. The window is titled 'DHCP Client <ether1-gateway>' and has two tabs: 'DHCP' and 'Status'. The 'DHCP' tab is active, showing the following configuration fields:

IP Address:	10.166.8.6/22
Gateway:	
DHCP Server:	212.92.149.149
Expires After:	13d 23:19:27
Primary DNS:	212.92.149.149
Secondary DNS:	212.92.149.150
Primary NTP:	
Secondary NTP:	
CAPS Managers:	

At the bottom of the window, there are two status indicators: 'enabled' and 'Status: bound'. On the right side of the window, there is a vertical stack of buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Release, and Renew.

# Подготовка I2tr. Настройка интерфейса

Провайдер использует DHCP-опцию 121 для установки маршрутов ко внутренним ресурсам. Так как MikroTik работает по стандартам, то при наличии этой опции не устанавливается маршрут по умолчанию.  
(RFC 3442)

The screenshot shows the 'DHCP Client' configuration window for the interface 'ether1-gateway'. The window has two tabs: 'DHCP' and 'Status'. The 'DHCP' tab is active, showing various configuration fields:

- IP Address: 10.166.8.6/22
- Gateway: (empty)
- DHCP Server: 212.92.149.149
- Expires After: 13d 23:19:27
- Primary DNS: 212.92.149.149
- Secondary DNS: 212.92.149.150
- Primary NTP: (empty)
- Secondary NTP: (empty)
- CAPS Managers: (empty)

On the right side of the window, there is a vertical column of buttons: OK, Cancel, Apply, Disable, Comment, Copy, Remove, Release, and Renew. At the bottom of the window, there are two status indicators: 'enabled' and 'Status: bound'.



# Подготовка I2tr. Настройка DHCP-client

- **Add Default Route = no**  
(Это не работает)

DHCP Client <ether1-gateway>

DHCP Status

Interface: ether1-gateway

Use Peer DNS

Use Peer NTP

DHCP Options: hostname

clientid

**Add Default Route: no**

Default Route Distance: 20

enabled Status: bound

OK

Cancel

Apply

Disable

Comment

Copy

Remove

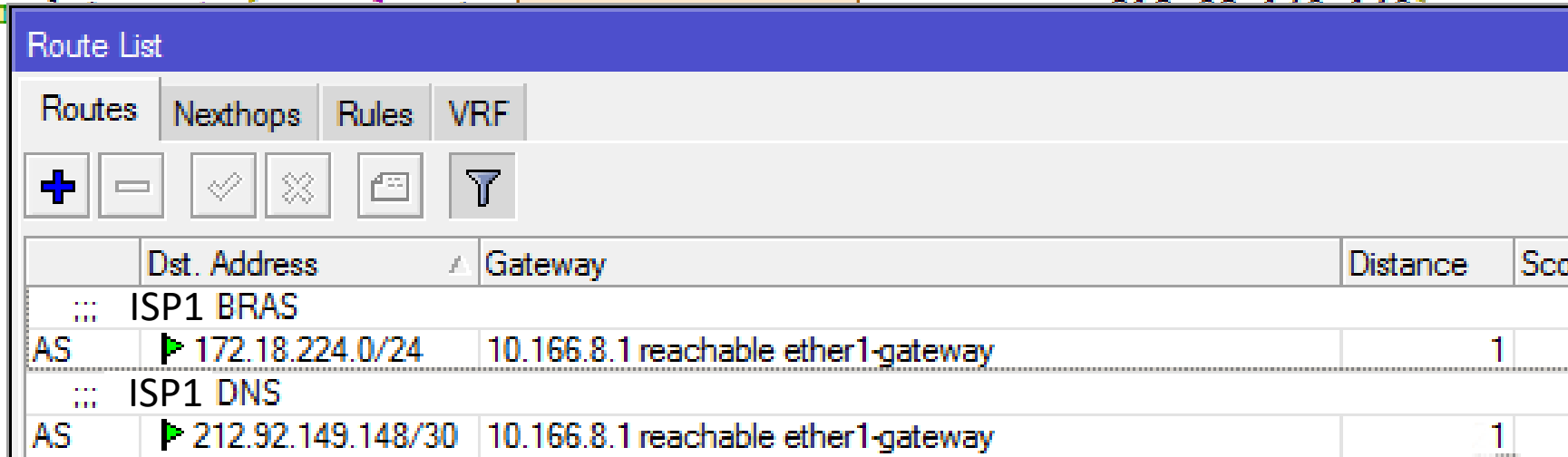
Release

Renew

# Подготовка l2tp. Настройка интерфейса

Создаём статические маршруты к DNS и L2TP серверам:

```
[admin@Moneron's home] > :put [:resolve tp. [redacted] e.ru server=212.92.149.149]
172.18.224.14
[admin@Moneron's home] > :put [:resolve tp. [redacted] e.ru server=212.92.149.149]
172.18.224.10
[admin@Moneron's home] > :put [:resolve tp. [redacted] e.ru server=212.92.149.149]
172.18.224.106
[admin@Moneron's home] > :put [:resolve tp. [redacted] e.ru server=212.92.149.149]
172.18.224.109
```



The screenshot shows the 'Route List' window in Mikrotik WinBox. It displays a table of static routes. The table has columns for 'AS', 'Dst. Address', 'Gateway', 'Distance', and 'Score'. There are two main sections: 'ISP1 BRAS' and 'ISP1 DNS'. Each section contains one route entry with a green arrow icon next to the destination address.

	Dst. Address	Gateway	Distance	Score
:::	ISP1 BRAS			
AS	▶ 172.18.224.0/24	10.166.8.1 reachable ether1-gateway	1	
:::	ISP1 DNS			
AS	▶ 212.92.149.148/30	10.166.8.1 reachable ether1-gateway	1	

# Настройка l2tp-client на R1

## L2TP-client:

Interface <ISP1>

General Dial Out Status Traffic

Connect To: ip. [redacted] .ru

User: [redacted]

Password: [redacted]

Profile: ISP1-Profile

Keepalive Timeout: 60

Use IPsec

IPsec Secret: [redacted]

Dial On Demand

Add Default Route

Default Route Distance: 0

OK Cancel Apply Disable Comment Copy Remove

## Результат:

Interface <ISP1>

General Dial Out Status Traffic

Last Link Down Time: [empty]

Last Link Up Time: Feb/02/2016 13:52:00

Link Downs: 0

Uptime: 1d 09:26:09

Encoding: [empty]

MTU: 1450

OK Cancel Apply Disable Comment Copy Remove

## Проверка доступности ресурсов с помощью ping:

```
[admin@Moneron's home] > ping ya.com count=5 interface= ISP1
SEQ HOST                               SIZE TTL TIME STATUS
 0 62.36.20.55                          56 238 77ms
 1 62.36.20.55                          56 238 77ms
 2 62.36.20.55                          56 238 77ms
 3 62.36.20.55                          56 238 77ms
 4 62.36.20.55                          56 238 77ms
sent=5 received=5 packet-loss=0% min-rtt=77ms avg-rtt=77ms max-rtt=77ms
```

# Настройка рекурсивной маршрутизации на R1

С помощью Winbox...

**1.** Route <8.8.8.8>

General | Attributes

a) Dst. Address: 8.8.8.8

b) Gateway: 127.0.2.1 reachable ISP1

Check Gateway:

Type: unicast

Distance: 1

c) Scope: 15

Target Scope: 10

**2.** Route <0.0.0.0/0>

General | Attributes

a) Dst. Address: 0.0.0.0/0

b) Gateway: 8.8.8.8 recursive via 127.0.2.1 ISP1

c) Check Gateway: ping

Type: unicast

Distance: 1

Scope: 30

d) Target Scope: 15

Routing Mark:

...или командной строки:

`/ip route`

`add check-gateway=ping distance=1 gateway=8.8.8.8 target-scope=15`

`add comment="Recursive gateway" distance=1 dst-address=8.8.8.8/32 gateway=127.0.2.1 scope=15`

# Настройка рекурсивной маршрутизации на R1

**1.**

Route <8.8.8.8>

General | Attributes

a) Dst. Address: 8.8.8.8

b) Gateway: 127.0.2.1 reachable ISP1

Check Gateway:

**2.**

Route <0.0.0.0/0>

General | Attributes

a) Dst. Address: 0.0.0.0/0

b) Gateway: 8.8.8.8 recursive via 127.0.2.1 ISP1

c) Check Gateway: ping

Type: unicast

PPP Profile <ISP1-Profile>

General | Protocols | Limits | Queue | Scripts

Name: ISP1-Profile

Local Address:

Remote Address: 127.0.2.1

Bridge:

OK  
Cancel  
Apply  
Comment  
Copy

Interface <ISP1>

General | Dial Out | Status | Traffic

Last Link Down Time:

Last Link Up Time: Feb/02/2016 13:52:00

Local Address:

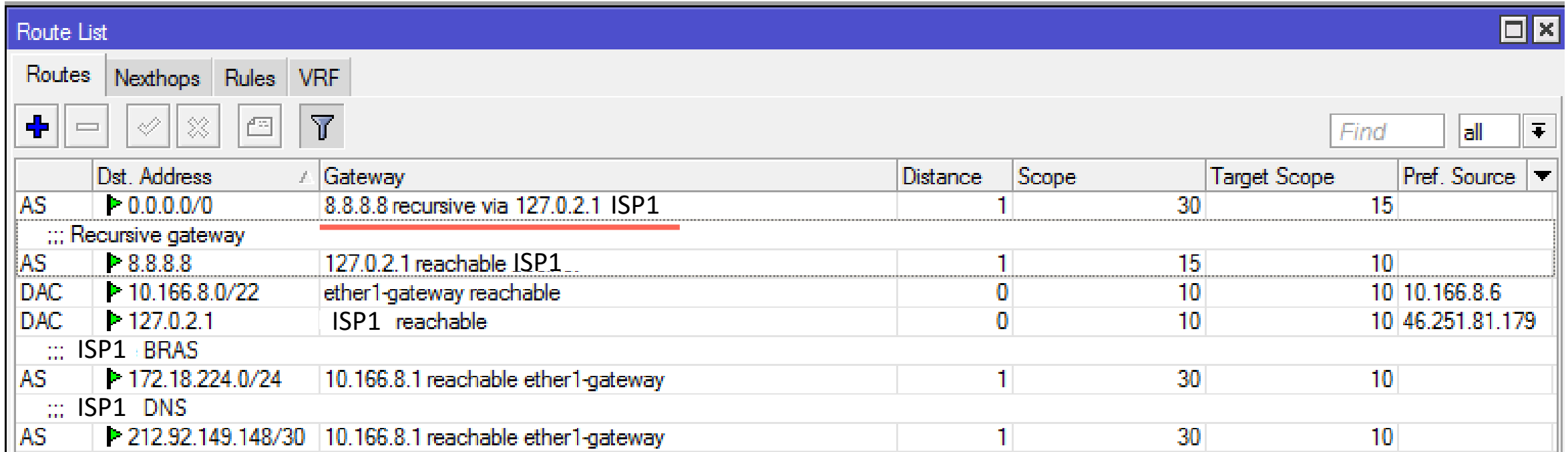
Remote Address: 127.0.2.1

enabled | running | slave | Status: connected

OK  
Cancel  
Apply

# Настройка рекурсивной маршрутизации на R1

## Итоговая таблица маршрутизации на R1:



The screenshot shows the 'Route List' window in Mikrotik WinBox. The window has a blue title bar and a toolbar with icons for adding, removing, and filtering routes. The main area displays a table of routes with columns for Dst. Address, Gateway, Distance, Scope, Target Scope, and Pref. Source. The routes are organized into sections: AS, Recursive gateway, ISP1 BRAS, and ISP1 DNS.

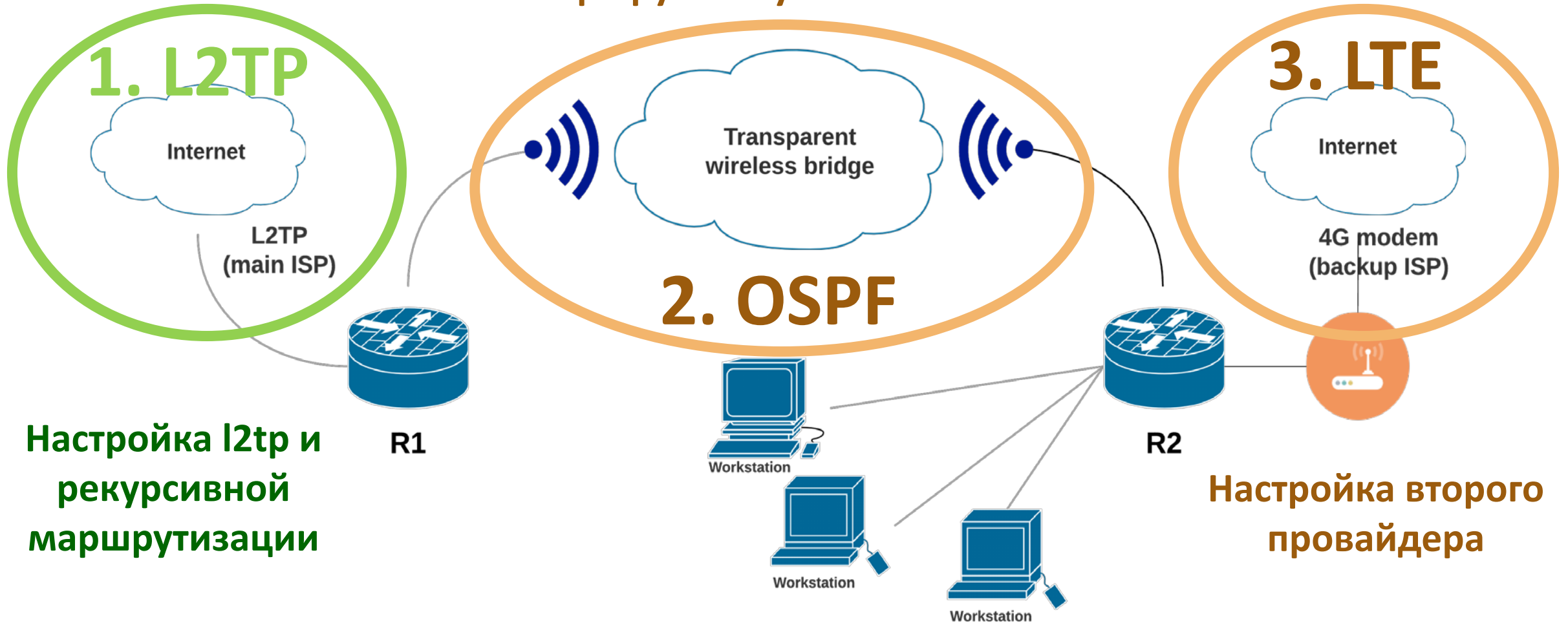
	Dst. Address	Gateway	Distance	Scope	Target Scope	Pref. Source
AS	0.0.0.0/0	8.8.8.8 recursive via 127.0.2.1 ISP1	1	30	15	
::: Recursive gateway						
AS	8.8.8.8	127.0.2.1 reachable ISP1	1	15	10	
DAC	10.166.8.0/22	ether1-gateway reachable	0	10	10	10.166.8.6
DAC	127.0.2.1	ISP1 reachable	0	10	10	46.251.81.179
::: ISP1 BRAS						
AS	172.18.224.0/24	10.166.8.1 reachable ether1-gateway	1	30	10	
::: ISP1 DNS						
AS	212.92.149.148/30	10.166.8.1 reachable ether1-gateway	1	30	10	

**Не забываем создать правило NAT!**

```
/ip firewall nat add chain=srcnat out-interface=ISP1 action=masquerade
```

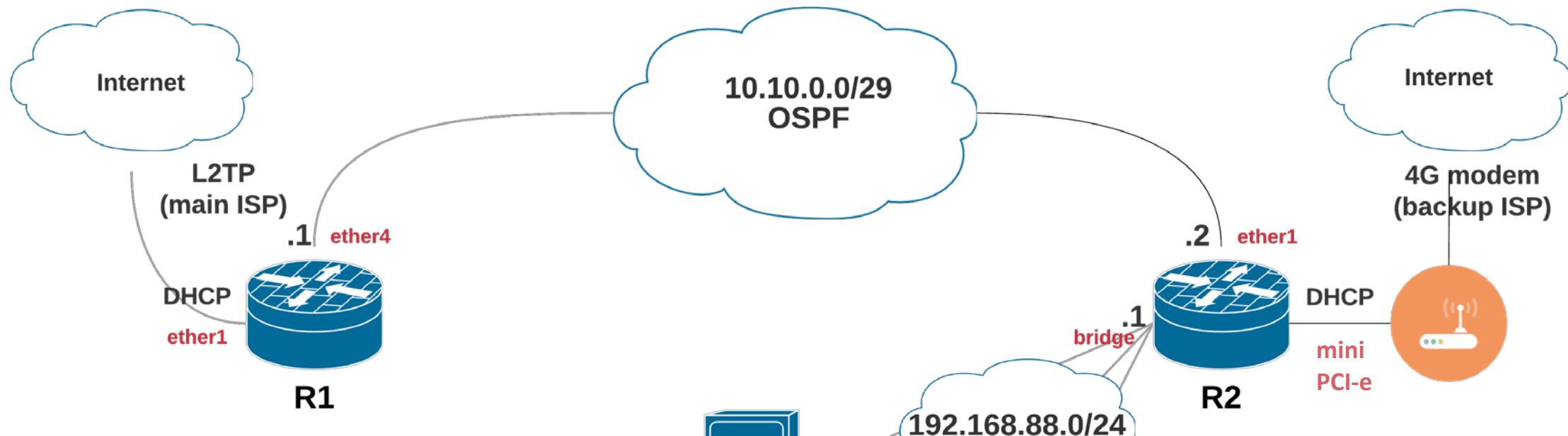
# Наша задача и постановка цели

Настройка OSPF с перераспределением маршрута по умолчанию

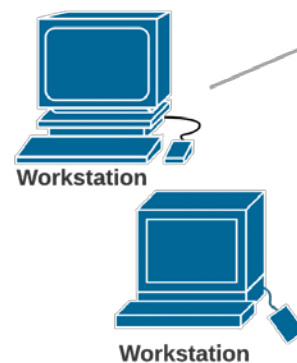




# Уточнённая схема сети с адресами и интерфейсами



Address List			
Address	Network	Interface	
::: OSPF link			
10.10.0.1/29	10.10.0.0	ether4	
D 10.166.8.6/22	10.166.8.0	ether1-gateway	
D 46.251.81.179	127.0.2.1	ISP1	



Address List			
Address	Network	Interface	
::: OSPF link			
10.10.0.2/29	10.10.0.0	ether1	
::: defconf			
192.168.88.1/...	192.168.88.0	bridge	

# Настройка OSPF:

## а) добавляем подсети

Routing –  
OSPF –  
Networks

На R1...

The screenshot shows the Mikrotik WinBox interface for configuring OSPF on a router (R1). The left sidebar contains a tree view with the following items: Switch, Mesh, IP, MPLS, Routing (1), System, Queues, Files, Log, Radius, Tools, New Terminal, Make Supout.rif, Manual, New WinBox, and Exit. The 'Routing' item is highlighted with a red dashed circle and the number '1.'. The 'OSPF' submenu is open, showing BFD, BGP, Filters, MME, OSPF (2), Prefix Lists, and RIP. The 'OSPF' item is highlighted with a red dashed circle and the number '2.'. The main window displays the OSPF configuration page with tabs for Instances, Networks (3), Areas, Area Ranges, Virtual Links, and Neighbors. The 'Networks' tab is active, showing a table with columns 'Network' and 'Area'. A red dashed circle and the number '3.' highlight the 'Networks' tab. Below the table, a red dashed circle and the number '4.' highlight the '+' button for adding a new network. A dialog box titled 'OSPF Network <10.10.0.0/29>' is open, showing the 'Network' field with the value '10.10.0.0/29' (5.) and the 'Area' dropdown set to 'backbone'. The 'OK' button (6.) is highlighted with a red dashed circle. Other buttons in the dialog include Cancel, Apply, Disable, Comment, Copy, and Remove. The status bar at the bottom of the dialog shows '1 item (1 enabled)'.

# Настройка OSPF:

## а) добавляем подсети

...и на R2

Routing –  
OSPF –  
Networks

Необходимо, чтобы  
роутер R1 знал о  
существовании нашей  
домашней подсети за  
роутером R2!

The screenshot displays two windows from a network configuration tool. The top window, titled 'Address List', contains a table with columns for 'Address', 'Network', and 'Interface'. It lists two OSPF links: one for 10.10.0.2/29 on interface 'ether1' and another for 192.168.88.1/24 on interface 'bridge'. The bottom window, titled 'OSPF', has tabs for 'Instances', 'Networks', 'Areas', 'Area Ranges', 'Virtual Links', and 'Neighbors'. The 'Networks' tab is active, showing a table with columns for 'Network' and 'Area'. Two networks are listed: 10.10.0.0/29 and 192.168.88.0/24, both assigned to the 'backbone' area. A red dashed box highlights the 192.168.88.1/24 entry in the 'Address List' window, and a red arrow points from this entry to the 192.168.88.0/24 entry in the 'OSPF' window.

Address	Network	Interface
::: OSPF link		
10.10.0.2/29	10.10.0.0	ether1
::: defconf		
192.168.88.1/24	192.168.88.0	bridge

Network	Area
10.10.0.0/29	backbone
192.168.88.0/24	backbone

# Настройка OSPF:

## б) настраиваем интерфейсы

# На R1...

Заметка:

- BFD – вспомогательный протокол. Позволяет обнаружить проблему линка в разы быстрее, чем средствами OSPF

The screenshot shows the OSPF configuration interface with several windows and elements highlighted:

- 1.** The "Interfaces" tab is selected in the main OSPF window.
- 2.** The "ether4" interface is selected in the table below the tabs.
- 3.** The "Copy" button is highlighted in the "OSPF <ether4>" window.
- 4.** The "Use BFD" checkbox is checked in the "New OSPF" window.
- 5.** The "OK" button is highlighted in the "New OSPF" window.

The "OSPF <ether4>" window shows the following configuration:

Interface:	ether4
Cost:	10
Priority:	1
Authentication:	none
Authentication Key:	
Authentication Key ID:	1
Network Type:	broadcast
Instance ID:	0
<input type="checkbox"/> Passive	
<input type="checkbox"/> Use BFD	

The "New OSPF" window shows the following configuration:

Interface:	ether4
Cost:	10
Priority:	1
Authentication:	none
Authentication Key:	
Authentication Key ID:	1
Network Type:	broadcast
Instance ID:	0
<input type="checkbox"/> Passive	
<input checked="" type="checkbox"/> Use BFD	

# Настройка OSPF:

## в) настраиваем интерфейсы

...и на R2

Заметка:

- BFD – вспомогательный протокол. Позволяет обнаружить проблему линка в разы быстрее, чем средствами OSPF

The image shows a network configuration interface for OSPF. At the top, there is a window titled 'OSPF' with tabs for 'Interfaces', 'Instances', 'Networks', 'Areas', 'Area Ranges', 'Virtual Links', 'Neighbors', and 'NBMA Neighbors'. Below the tabs is a toolbar with icons for adding, deleting, and filtering. A table lists the configured interfaces:

	Interface	Cost	Priority	Authentic...	Authenticatio...	Network Type	Instance	Area
D	bridge	10	1	none	*****	broadcast	default	backbone
D	ether1	10	1	none	*****	broadcast	default	backbone

Below the table are two configuration dialog boxes. The left one is titled 'OSPF <ether1>' and shows fields for Interface (ether1), Cost (10), Priority (1), Authentication (none), Authentication Key, Authentication Key ID (1), Network Type (broadcast), and Instance ID (0). It has checkboxes for 'Passive' and 'Use BFD'. The right one is titled 'New OSPF' and shows the same fields, but with 'Use BFD' checked and highlighted by a red dashed box.

# Настройка OSPF: с) настраиваем instances

Заметка:

- Тип опции (1 или 2) не имеет значения **в данном случае.**

**R1:**

Name	Router ID	Running
* default	0.0.0.1	yes

OSPF Instance <default>

General Metrics MPLS Status

Name: default

Router ID: 0.0.0.1

Redistribute Default Route: if installed (as type 1)

Redistribute Connected Routes: no

Redistribute Static Routes: no

**R2:**

Name	Router ID	Running
* default	0.0.0.2	yes

OSPF Instance <default>

General Metrics MPLS Status

Name: default

Router ID: 0.0.0.2

Redistribute Default Route: never

Redistribute Connected Routes: no

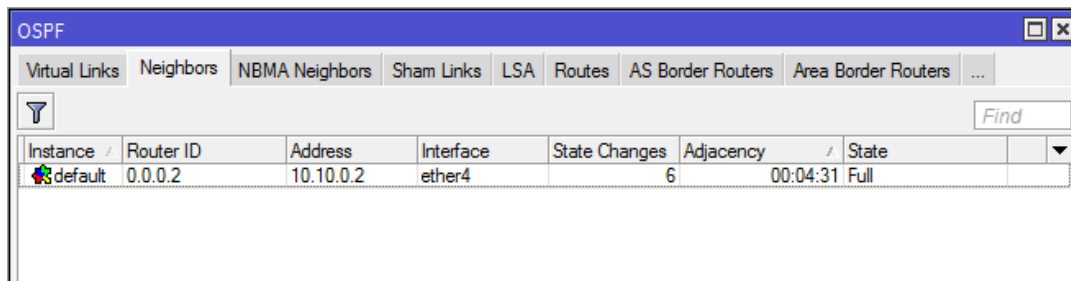
Redistribute Static Routes: no

# Настройка OSPF: d) результат:

R1:

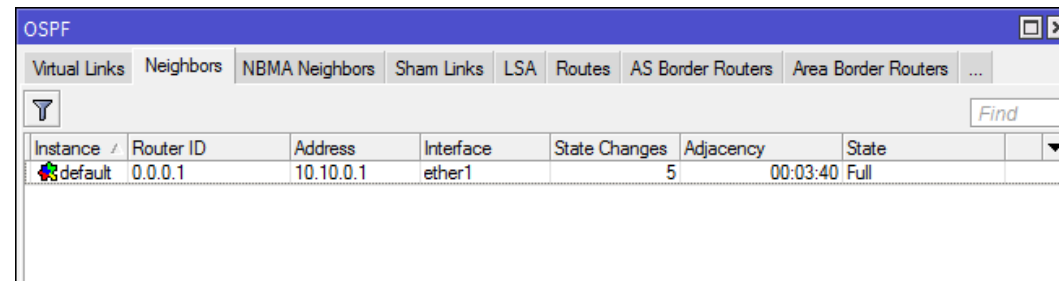
R2:

Routing –  
OSPF –  
Neighbors:



OSPF Neighbors window for R1. The table shows one neighbor with Router ID 0.0.0.2, Address 10.10.0.2, Interface ether4, State Changes 6, Adjacency 00:04:31, and State Full.

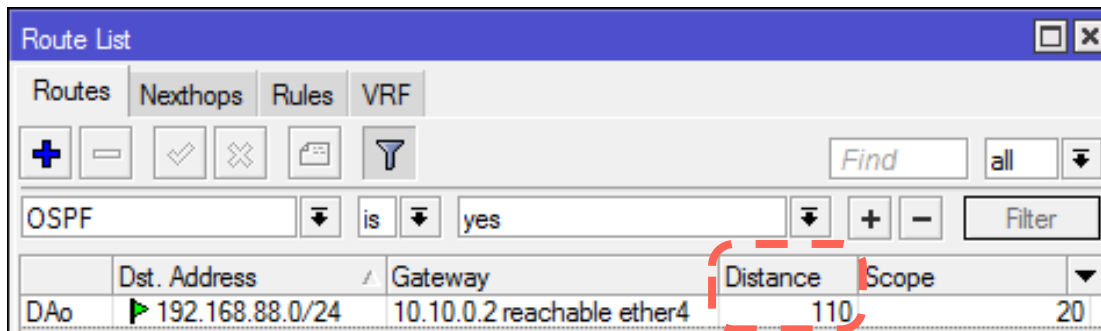
Instance	Router ID	Address	Interface	State Changes	Adjacency	State
default	0.0.0.2	10.10.0.2	ether4	6	00:04:31	Full



OSPF Neighbors window for R2. The table shows one neighbor with Router ID 0.0.0.1, Address 10.10.0.1, Interface ether1, State Changes 5, Adjacency 00:03:40, and State Full.

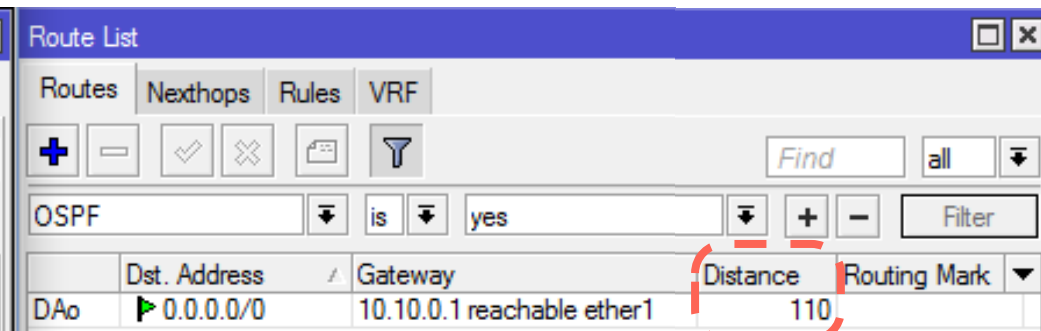
Instance	Router ID	Address	Interface	State Changes	Adjacency	State
default	0.0.0.1	10.10.0.1	ether1	5	00:03:40	Full

IP –  
Routes:



Route List window for R1. The table shows a route for Dst. Address 192.168.88.0/24, Gateway 10.10.0.2 reachable ether4, Distance 110, and Scope 20. The Distance 110 is circled in red.

Dst. Address	Gateway	Distance	Scope
192.168.88.0/24	10.10.0.2 reachable ether4	110	20



Route List window for R2. The table shows a route for Dst. Address 0.0.0.0/0, Gateway 10.10.0.1 reachable ether1, Distance 110, and Routing Mark. The Distance 110 is circled in red.

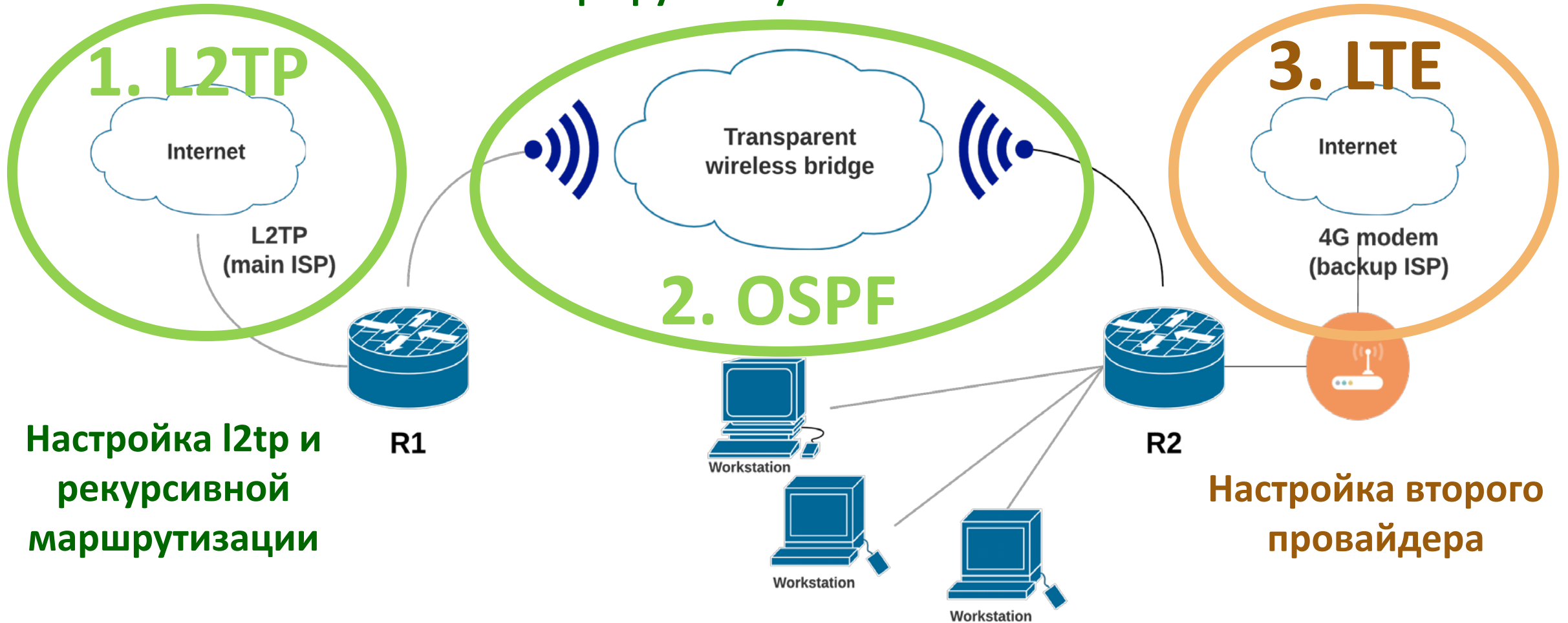
Dst. Address	Gateway	Distance	Routing Mark
0.0.0.0/0	10.10.0.1 reachable ether1	110	

Внимание: у всех OSPF маршрутов  
**distance=110**, мы не можем изменить это.



# Наша задача и этапы выполнения

## Настройка OSPF с перераспределением маршрута по умолчанию



Настройка l2tp и рекурсивной маршрутизации

Настройка второго провайдера

# Настроим резервный канал: LTE-modem

## DHCP-client:

Use P...	Add D...	IP Address	Expires After	Status
yes	yes	192.168.42.5...	00:52:41	bound

DHCP Client <lte1>

Interface: lte1

Use Peer DNS

Use Peer NTP

DHCP Options: hostname

clientid

Add Default Route: yes

Default Route Distance: 130

enabled Status: bound

## Итоговая таблица маршрутизации на R2:

Route List				
Routes	Nexthops	Rules	VRF	
+	-	✓	✗	🔍
	Dst. Address	Gateway	Distance	
DS	0.0.0.0/0	192.168.42.129 reachable lte1	130	
DAo	0.0.0.0/0	10.10.0.1 reachable ether1	110	
DAC	10.10.0.0/29	ether1 reachable	0	
DAC	192.168.42.0/...	lte1 reachable	0	
DAC	192.168.88.0/...	bridge reachable	0	

**Не забываем создать правило NAT для второго провайдера:**

```
/ip firewall nat add action=masquerade \  
chain=srcnat out-interface=lte1
```

# Что мы в итоге настроили?

## На роутере R1

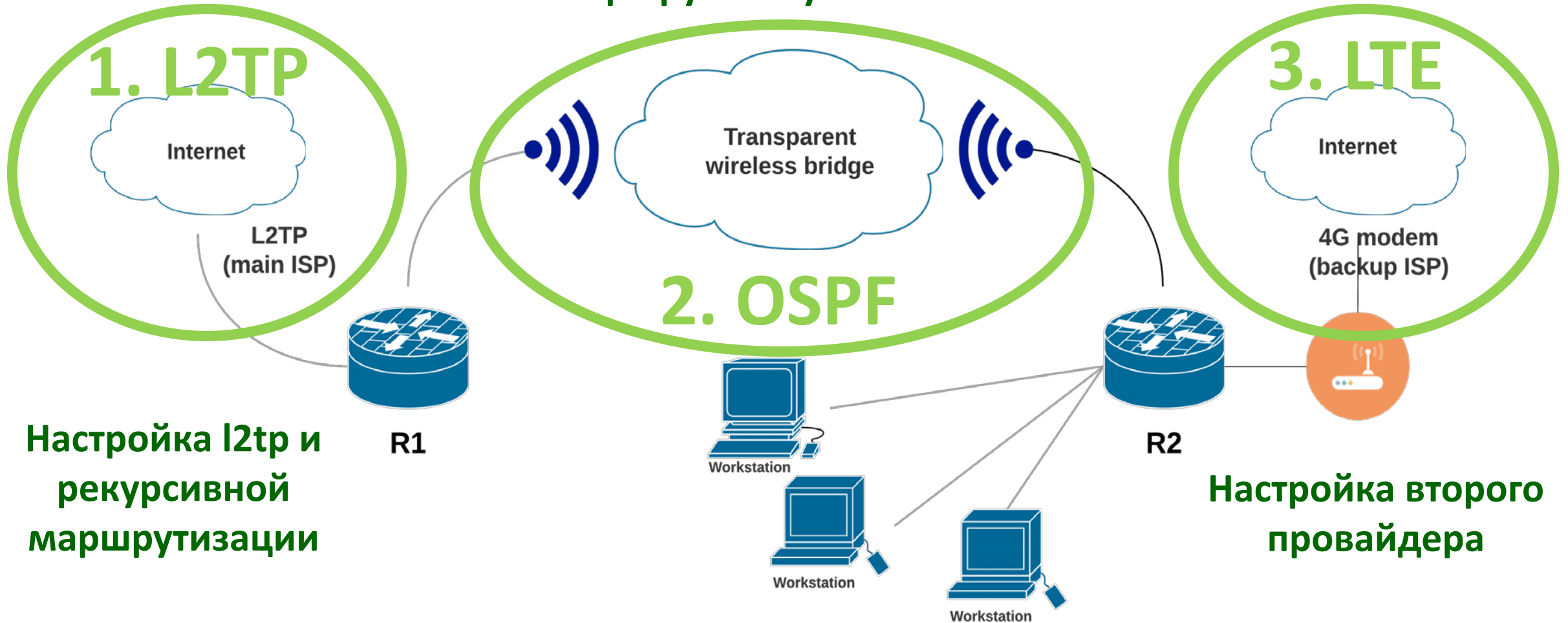
- Решили проблему с 121 DHCP option
- Решили проблему с динамическим Remote Address
- Настроили рекурсивную маршрутизацию через туннель с проверкой доступности интернета с помощью `check gateway=ping`
- Настроили OSPF с включенным BFD на беспроводном линке и перераспределением маршрута по умолчанию.

## На роутере R2

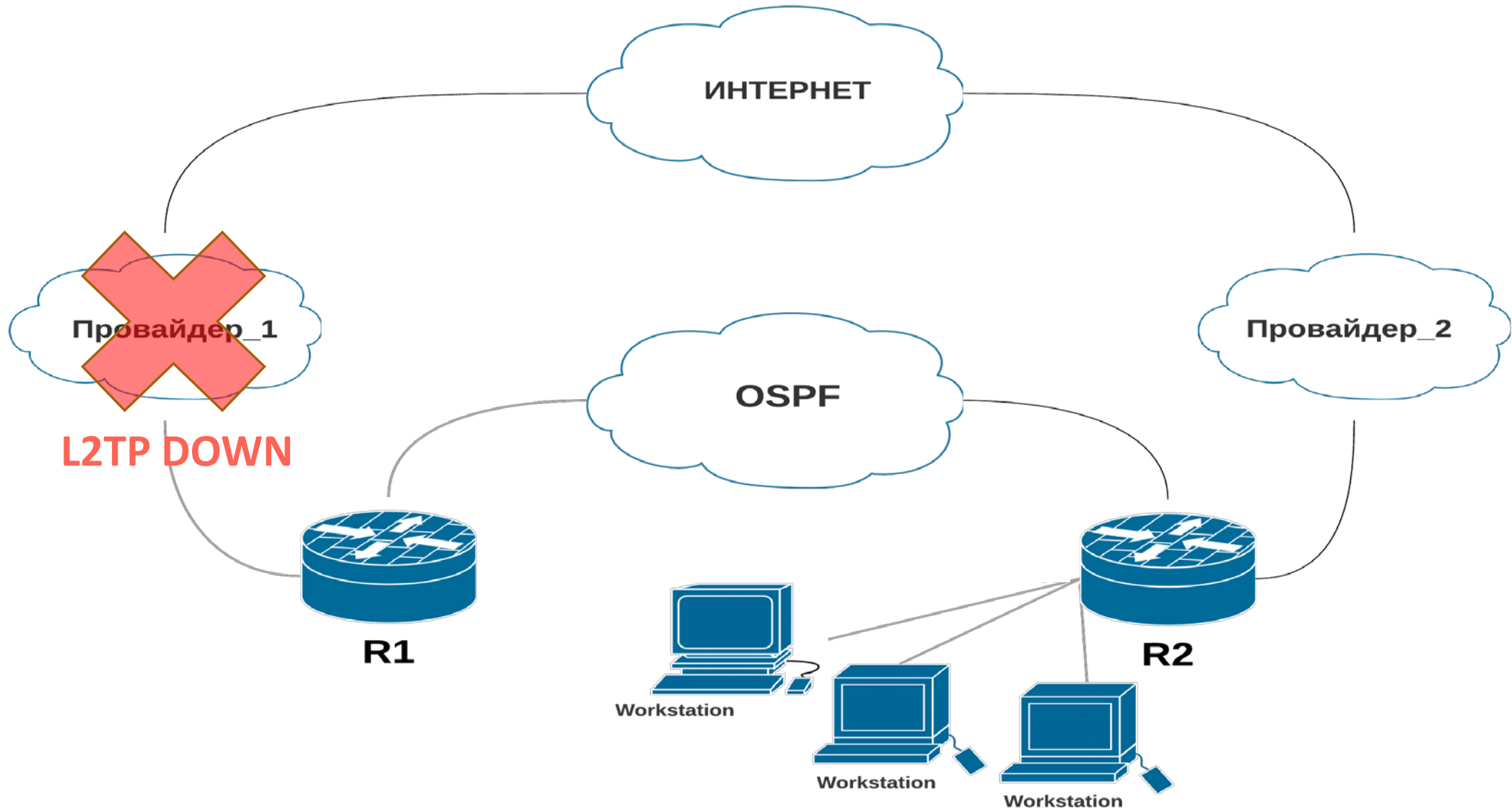
- Настроили OSPF с включенным BFD на беспроводном линке.
- Настроили резервный канал с плавающим маршрутом по умолчанию (`floating route`)

# Наша задача и постановка цели

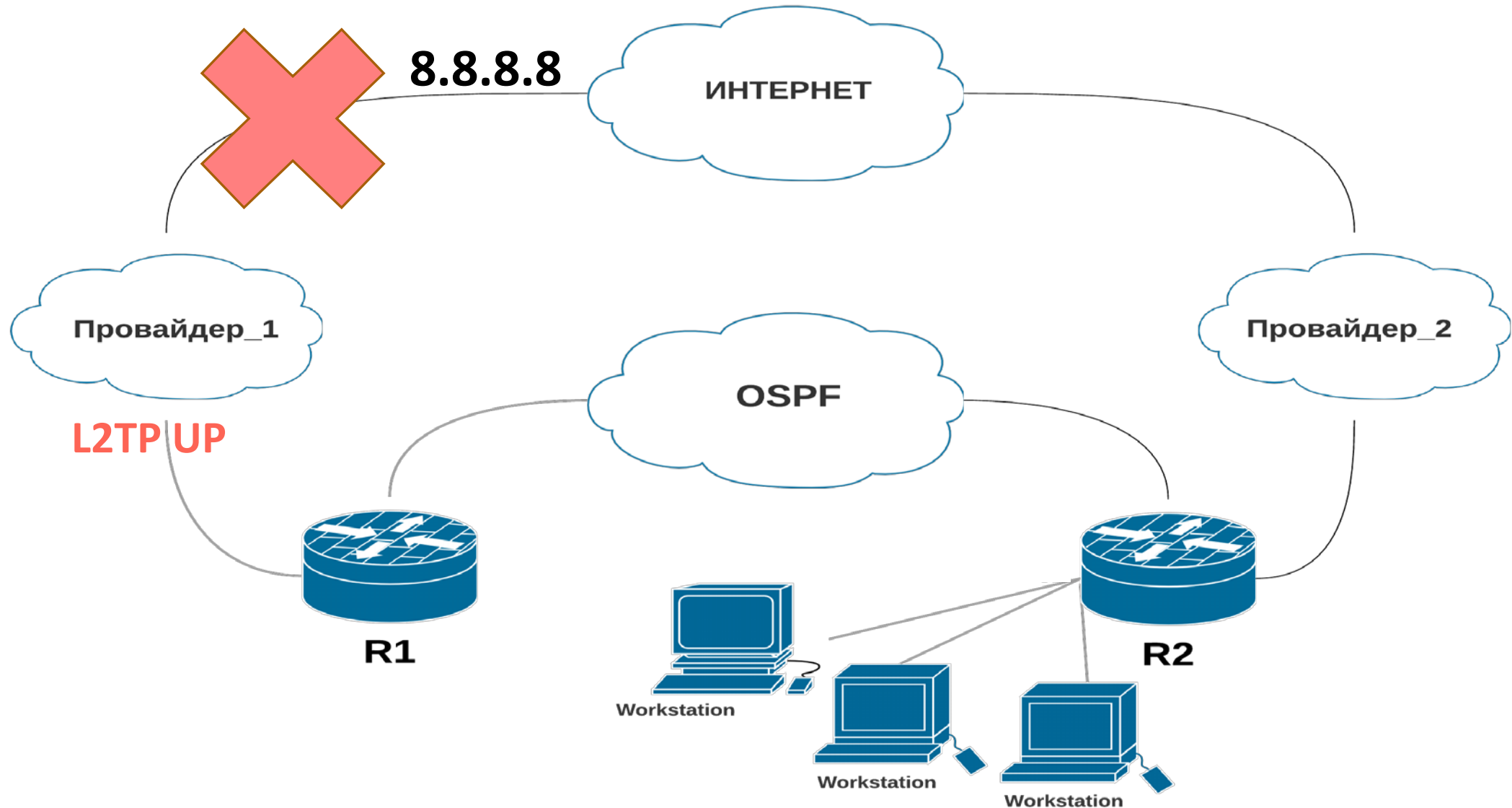
Настройка OSPF с перераспределением маршрута по умолчанию



# Проверка работоспособности 1.



# Проверка работоспособности 2.



# Вопросы?



# Спасибо за внимание!