



IPv6 Dual Stack & 6in4 Tunnel untuk W/LFH

Webinar Informatika WIN Seri 3



About me

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Outline

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2. IPv4 vs IPv6
3. Introduksi IPv6
4. Transisi dari IPv4 ke IPv6
5. 6in4 Tunnel
6. Topologi Dual Stack & 6in4 Tunnel untuk WFH
7. Lab Implementasi Dual Stack & 6in4 Tunnel
8. Kesimpulan
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1. IPv4 dan IPv6 Terkini

- IPv4 hampir habis terpakai namun tetap eksis
- IPv6 merupakan jawaban atas masalah pada IPv4
- Didesain sebagai penerus dari IPv4
- Pengembangannya dimulai pada 1996 & dituliskan spesifikasinya dalam RFC 2460 di tahun 1998
- IPv6 dapat bekerja berdampingan dengan IPv4
- Pengguna internet dapat memakai mekanisme transisi dari IPv4 ke IPv6

IPv4 & IPv6 Statistics

RIR v4 IPs Left

AfriNIC	1,976,695
APNIC	3,824,638
ARIN	0
LACNIC	250,763
RIPE	0

v6 ASNs

23% (13,993/58,955)

v6 Ready TLDs

98% (1,521/1,547)

v6 Glues

154,606

v6 Domains

10,375,261

0

days remaining
IANA exhausted

HURRICANE ELECTRIC
INTERNET SERVICES

2. IPv4 vs IPv6

	IPv4	IPv6
Address space	32 bits	128 bits
Possible addresses	2^{32}	2^{128}
Address format	192.0.2.1	2001:db8:3:4:5:6:7:8
Header length	20bytes	40bytes
Header fields	14	8
IPsec	optional	SHOULD*

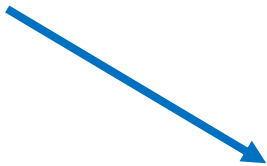
*Persyaratan Node IPv6 (RFC6434) menyatakan bahwa semua node IPv6 **HARUS** mendukung IPsec

3. Introduksi IPv6

Notasi Alamat (RFC5952)

- IPv6 terdiri dari 8 field, masing-masing sejumlah 16 bit
- Ditulis dalam angka hexadecimal (basis bilangan 16 : 0 – 9,a,b,c,d,e,f)
- Dipisah dengan tanda titik dua “:”

2001 : 0db8 : 1234 : 5678 : 9abc : def0 : 1234 : 5678



0010 0000 0000 0001

2 0 0 1

3. Introduksi IPv6

2001:0db8:0be0:75a2:0000:0000:0000:0001

Angka 0 di depan bisa dihilangkan

2001:db8:be0:75a2:0:0:0:1

menggunakan Zero Compression dengan notasi “::”

2001:db8:be0:75a2::1

2001:0db8:0000:0000:0010:0000:0000:0001

2001:db8::10:0:0:1 or **2001:db8:0:0:10::1**

kedua notasi valid, yang pertama (warna biru) direkomendasikan

4. Transisi dari IPv4 ke IPv6

- Jaringan IPv4 ke/dari IPv6 tidak dapat dioperasikan secara langsung
- Didefinisikan dalam RFC4213:
 1. Dual IP layer Operation
menggunakan kedua versi IP bersamaan
 2. Tunneling of IPv6 over IPv4
memanfaatkan infrastruktur IPv4
yang ada untuk membawa traffic IPv6.

The Problem

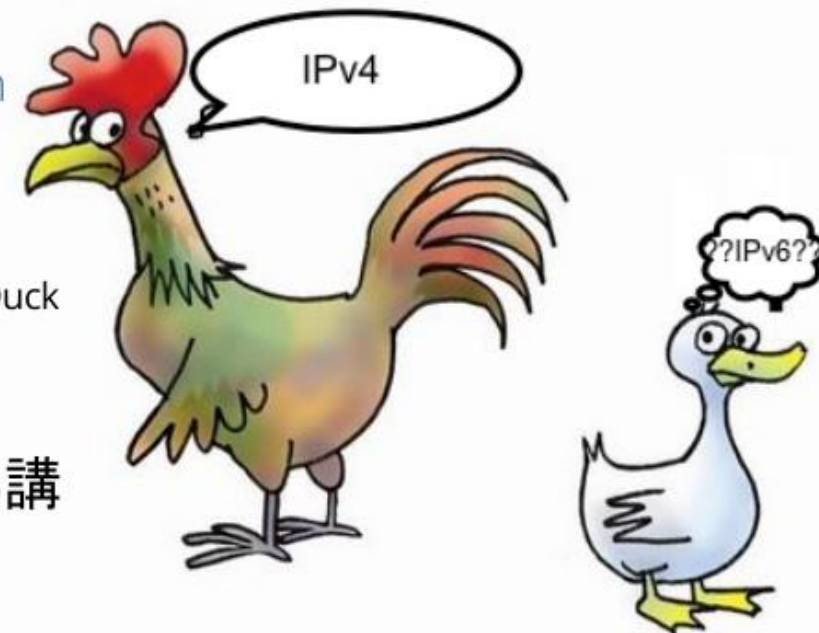
雞同鴨講

Chicken Talks Duck

Or maybe

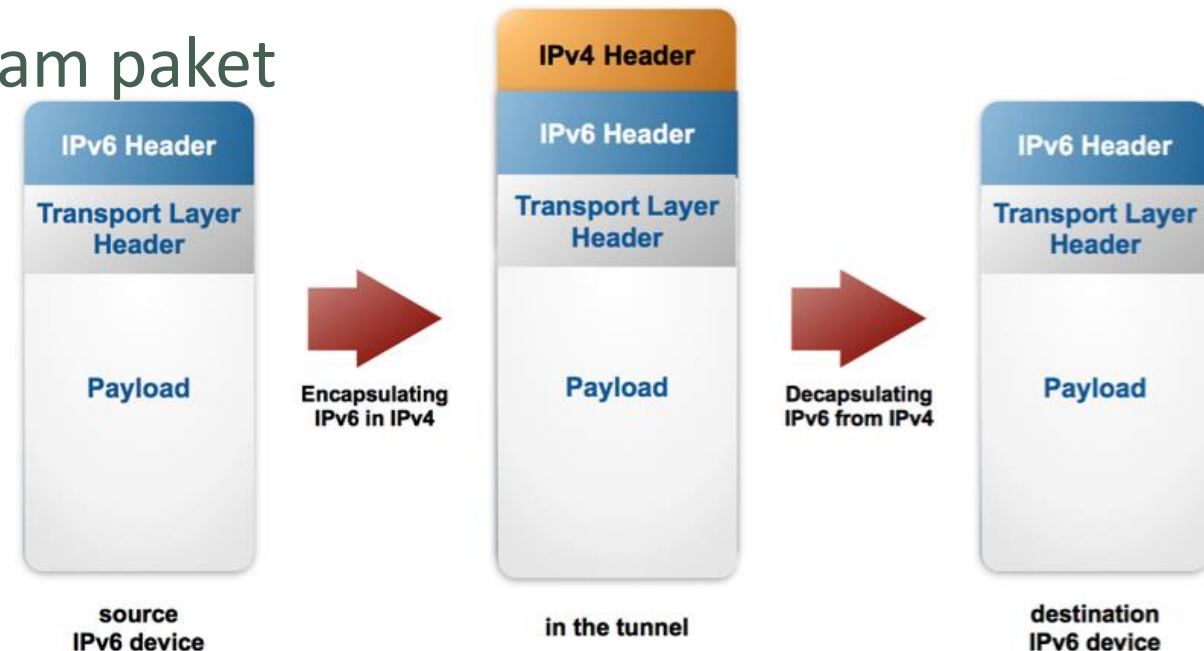
IPv4同IPv6講

IPv4 talk IPv6?



5. 6in4 Tunnel

- Memanfaatkan infrastruktur routing IPv4 yang ada untuk membawa traffic IPv6
- Mengenkapsulasi datagram IPv6 dalam paket IPv4
- Tunneling dapat digunakan pada:
 - Router-to-Router
 - Host-to-Router (dan sebaliknya)
 - Host-to-Host
- Mekanisme ini kadang-kadang disebut "manual tunnels", "static tunnels", "protocol 41 tunnels", atau "6in4".



IPv6 datagram in IPv4 (RFC 4213)

image source :

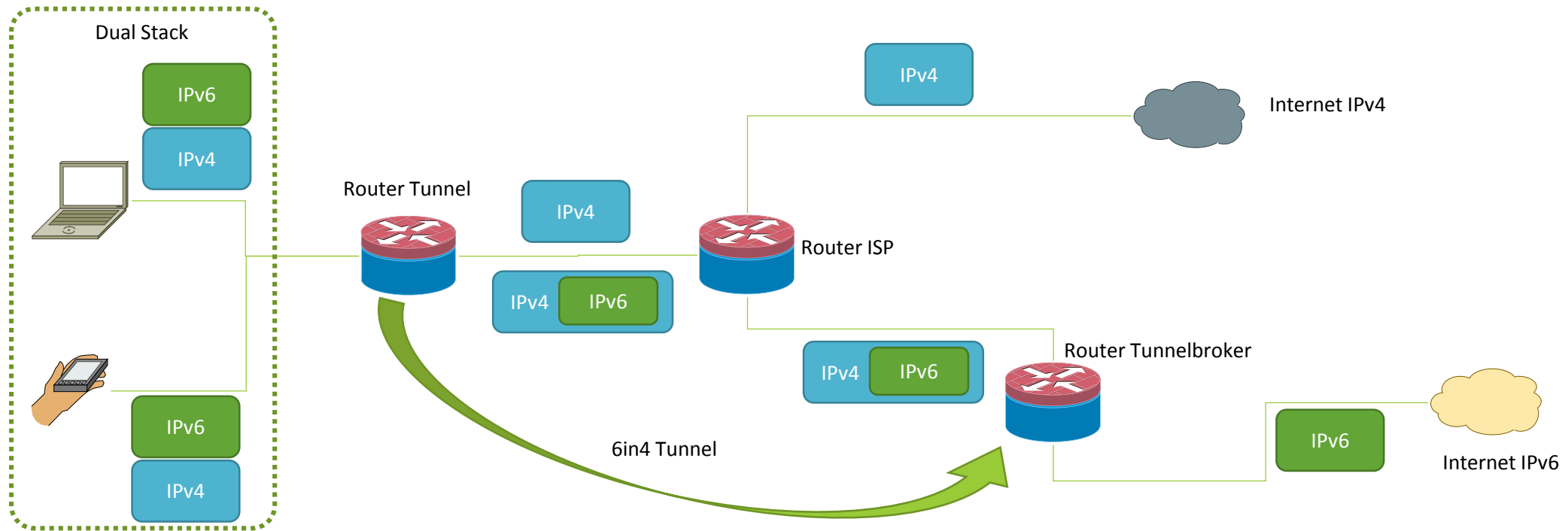
<https://www.ripe.net/publications/ipv6-info-centre/deployment-planning/images/transitionmechanismstunnelling.png>

5. 6in4 Tunnel

- 6in4 tunnel bersifat statis (in nature)
- Dapat bekerja di belakang NAT, tetapi tidak dirancang untuk kompatibilitas NAT (disebutkan dalam <https://tools.ietf.org/html/rfc7059#section-5.2>)
- **Protokol 6in4 tidak memiliki fitur keamanan**
Untuk mengamankan koneksi, gunakan **Firewall** dan / atau **IPSec** (RFC4891) untuk melindungi Jaringan Anda

6. Topologi Dual Stack & 6in4 Tunnel untuk WFH

- Memanfaatkan teknologi transisi IPv4 ke IPv6 dengan Dual Stack dan 6in4 Tunnel
- Dual stack di Client
- 6in4 Tunnel ke layanan Tunnel broker (<https://tunnelbroker.net/>)



7. Implementasi

- I. Cek IP Public address pada router di rumah
- II. Daftar layanan tunel 6in4 di tunnelbroker.net
- III. Setting Router Tunnel untuk IPv4
- IV. Setting Tunnel 6in4
- V. Setting Router Tunnel untuk advertise IPv6 ke client
- VI. Uji koneksi

7. Implementasi

I. Cek IP Public address pada router di rumah

192.168.1.1/menu.html

Logout

Status

Network

Security

Application

Management

Device Information

Wireless Status

Wan Status

Wan Status

Lan Status

Optical Info

VoIP Status

Status » Wan Status » Wan Status

On this page, you can query the state of WAN interface.

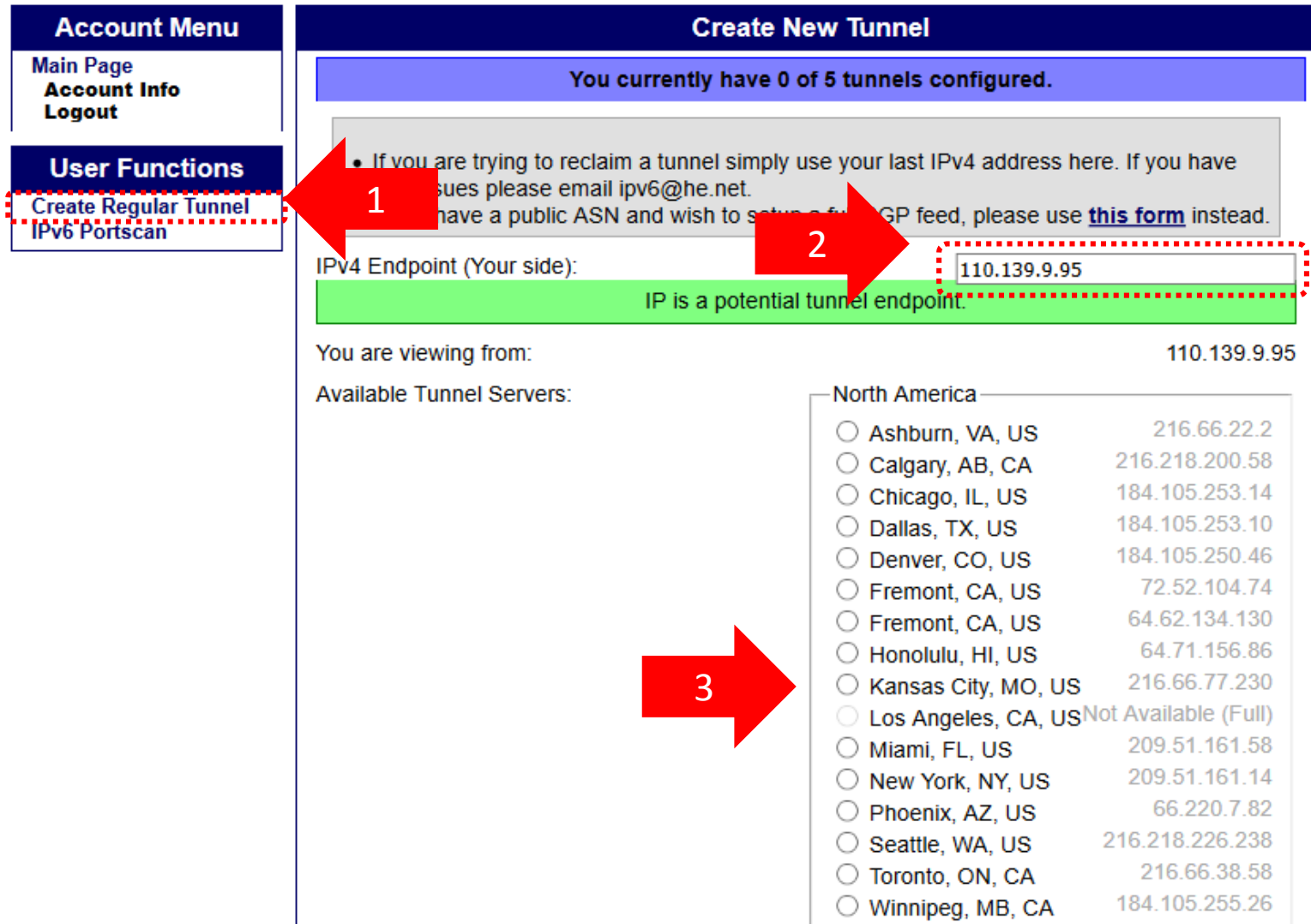
WAN State

Index	State	Mode	IP Type	IP	Mask	DNS	VLAN/Priority	Connection Type
1	Up	TR069_VOIP	DHCP	10.100.208.226	255.255.255.0	10.0.0.164	529/5	Route
2	Up	INTERNET	PPPoE	110.139.9.95	.255	118.98.44.100	2997/0	Route



7. Implementasi

- II. Daftar layanan tunel 6in4 di tunnelbroker.net
1. Setelah melakukan proses login, buat sebuah Regular Tunnel.
2. Isikan Endpoint nya IP yang di peroleh pada langkah I (Tunnelbroker akan memeriksa kelayakannya)
3. Pilih server tunnel terdekat (untuk Indonesia ada di Singapura atau Hongkong)



Account Menu

- Main Page
- Account Info
- Logout

User Functions

- Create Regular Tunnel
- IPv6 Portscan

Create New Tunnel

You currently have 0 of 5 tunnels configured.

• If you are trying to reclaim a tunnel simply use your last IPv4 address here. If you have issues please email ipv6@he.net. If you have a public ASN and wish to setup a full BGP feed, please use [this form](#) instead.

IPv4 Endpoint (Your side):

IP is a potential tunnel endpoint.

You are viewing from: 110.139.9.95

Available Tunnel Servers:

North America

<input type="radio"/> Ashburn, VA, US	216.66.22.2
<input type="radio"/> Calgary, AB, CA	216.218.200.58
<input type="radio"/> Chicago, IL, US	184.105.253.14
<input type="radio"/> Dallas, TX, US	184.105.253.10
<input type="radio"/> Denver, CO, US	184.105.250.46
<input type="radio"/> Fremont, CA, US	72.52.104.74
<input type="radio"/> Fremont, CA, US	64.62.134.130
<input type="radio"/> Honolulu, HI, US	64.71.156.86
<input type="radio"/> Kansas City, MO, US	216.66.77.230
<input type="radio"/> Los Angeles, CA, US	Not Available (Full)
<input type="radio"/> Miami, FL, US	209.51.161.58
<input type="radio"/> New York, NY, US	209.51.161.14
<input type="radio"/> Phoenix, AZ, US	66.220.7.82
<input type="radio"/> Seattle, WA, US	216.218.226.238
<input type="radio"/> Toronto, ON, CA	216.66.38.58
<input type="radio"/> Winnipeg, MB, CA	184.105.255.26

7. Implementasi

- II. Daftar layanan tunel 6in4 di tunnelbroker.net
4. Berikan deskripsi tunnel yang dibuat
5. Copas ke notepad, informasi ini akan digunakan pada Router tunnel

Tunnel Details

IPv6 TunnelExample ConfigurationsAdvanced

Tunnel ID: 584014

Creation Date:

Description:

IPv6 Tunnel Endpoints

Routed IPv6 Prefixes

DNS Resolvers

rDNS Delegations

Delete Tunnel

May 6, 2020

TunnelWFH

216.218.221.42

2001:470:35:59d::1/64

110.139.9.95

2001:470:35:59d::2/64

2001:470:36:59c::/64

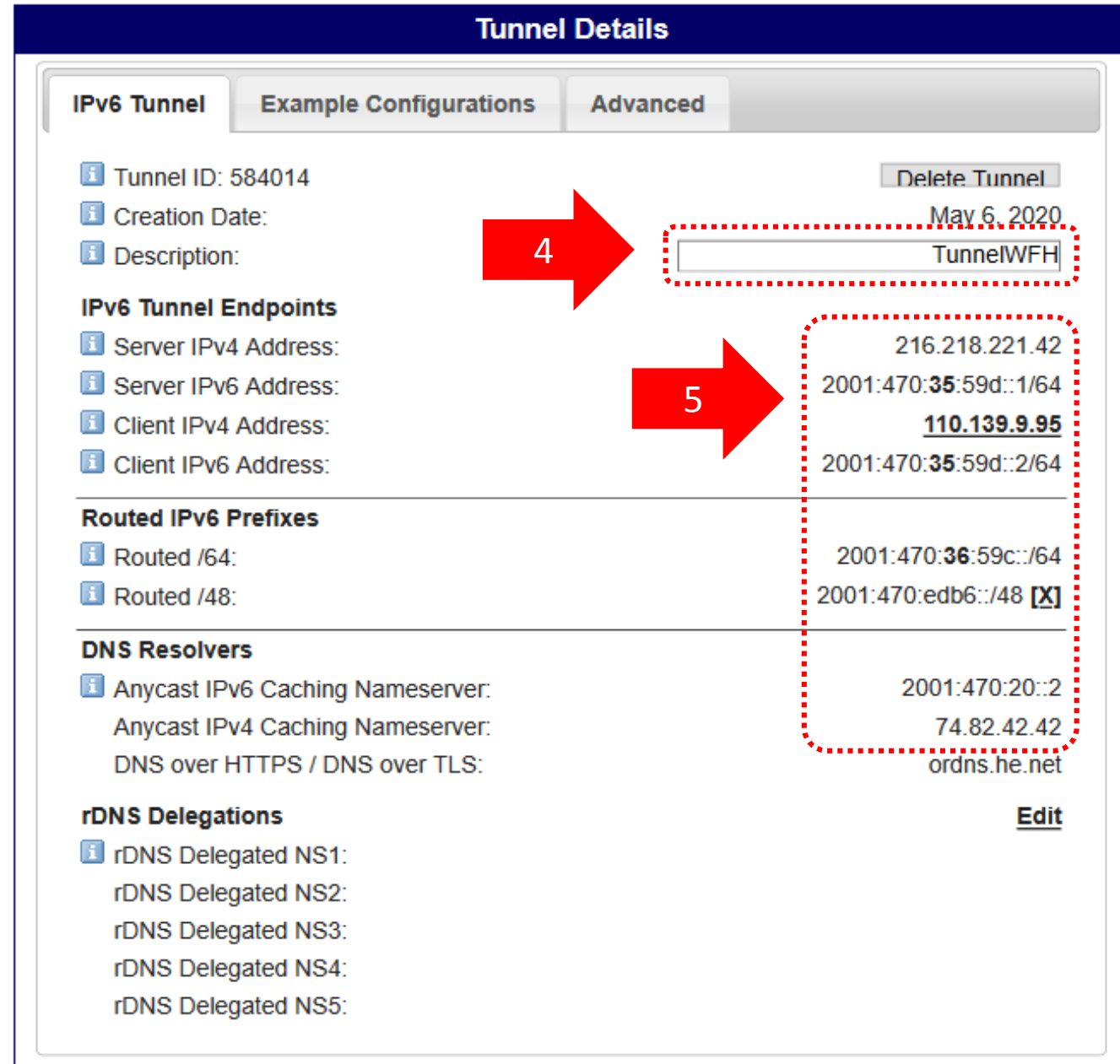
2001:470:edb6::/48 [X]

2001:470:20::2

74.82.42.42

ordns.he.net

Edit



7. Implementasi

III. Setting Router Tunnel untuk IPv4

1. IP Address Interface
2. Routing
3. Firewall
4. DNS

Servers:

Dynamic Servers:

Address List			
<div> </div> <div>Find</div>			
	Address	Network	Interface
	192.168.88.254/24	192.168.88.0	ether1
D	192.168.100.12/24	192.168.100.0	wlan1

Route List		
<div> </div> <div>Find all</div>		
	Dst. Address	Gateway
DAS	0.0.0.0/0	192.168.100.1 reachable wlan1
DAC	192.168.88.0/24	ether1 reachable
DAC	192.168.100.0/...	wlan1 reachable

Firewall							
<div>Filter Rules NAT Mangle Raw Service Ports Connections Address Lists</div> <div> Reset Counters Reset All Counters</div>							
#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. I	
0	masquerade	srcnat					

7. Implementasi

IV. Setting Tunnel 6in4

Address List			
<div><div><div></div><div></div><div></div><div></div><div></div><div></div></div><div>Find</div></div>			
	Address	Network	Interface
	192.168.88.254/24	192.168.88.0	ether1
D	192.168.100.12/24	192.168.100.0	wlan1

IPv6 Tunnel Endpoints

- Server IPv4 Address: 216.218.221.42
- Server IPv6 Address: 2001:470:35:59d::1/64
- Client IPv4 Address: 110.139.9.95
- Client IPv6 Address: 2001:470:35:59d::2/64

Interface List

Interface

Interface List

Ethernet

EoIP Tunnel

IP Tunnel

GRE Tunnel

VLA

Detect Internet

	Name	Type	Actual MTU	L2 MTU	Tx
R	6to4-tunnel1	6to4 Tunnel	1480	65535	
R	ether1	Ethernet	1500	1598	
	ether2	Ethernet	1500	1598	
R	wlan1	Wireless (Atheros AR9...	1500	1600	

Interface <6to4-tunnel1>

General

Status

Traffic

Name: 6to4-tunnel1

Type: 6to4 Tunnel

MTU:

Actual MTU: 1480

L2 MTU: 65535

Local Address: 192.168.100.12

Remote Address: 216.218.221.42

OK

Cancel

Apply

Disable

Comment

Copy

Remove



Torch

7. Implementasi

V. Setting Router Tunnel untuk advertise IPv6 ke client

1. IPv6 Address





Routed IPv6 Prefixes

-  Routed /64: 2001:470:36:59c::/64
-  Routed /48: 2001:470:edb6::/48 [X]

DNS Resolvers

-  Anycast IPv6 Caching 2001:470:20::2

IPv6 Tunnel Endpoints

-  Server IPv4 Address: 216.218.221.42
-  Server IPv6 Address: 2001:470:35:59d::1/64
-  Client IPv4 Address: 110.139.9.95
-  Client IPv6 Address: 2001:470:35:59d::2/64

New IPv6 Address

Address: 2001:470:36:59c::1/64

From Pool: ▼

Interface: ether1 ⌵

☐ EUI64

☒ Advertise

New IPv6 Address

Address: 2001:470:35:59d::2/64

From Pool: ▼

Interface: 6to4-tunnel1 ⌵

☐ EUI64





☐ Advertise

7. Implementasi

V. Setting Router Tunnel untuk advertise IPv6 ke client

2. IPv6 Routing

IPv6 Tunnel Endpoints

 Server IPv4 Address: 216.218.221.42
 Server IPv6 Address: 2001:470:35:59d::1/64
 Client IPv4 Address: 110.139.9.95
 Client IPv6 Address: 2001:470:35:59d::2/64

New IPv6 Route

General Attributes

Dst. Address: ::/0

Gateway: 2001:470:35:59d::1

Check Gateway:

Type: unicast

IPv6 Route List

	Dst. Address	Gateway
AS	2000::/3	2001:470:35:59d::1 reachable 6to4-tunnel1
DAC	2001:470:35:59d::/64	6to4-tunnel1 reachable
DAC	2001:470:36:59c::/64	ether1 reachable

7. Implementasi

V. Setting Router Tunnel untuk advertise IPv6 ke client

3. Neighbor Detection (ND)

ND <all>

Interface: ▼

RA Interval: s

RA Delay: s

MTU: ▼

Reachable Time: ▼ s

Retransmit Interval: ▼ s

RA Lifetime: ▲ s

Hop Limit: ▼

☒ Advertise MAC Address

☒ **Advertise DNS**

☐ Managed Address Configuration

☐ Other Configuration

7. Implementasi

1 Address List

Address	Network	Interface
192.168.88.254/24	192.168.88.0	ether1
192.168.100.12/24	192.168.100.0	wlan1

2 IPv6 Route List

Dst. Address	Gateway
2000::/3	2001:470:35:59d::1 reachable 6to4-tunnel1
2001:470:35:59d::/64	6to4-tunnel1 reachable
2001:470:36:59c::/64	ether1 reachable

3 Firewall Filter Rule

#	Action	Chain	Src. Address	Dst. Address	Proto...	Src. Port	Dst. Port	In. In
0	masquerade	srcnat						

4 Static Route

Servers: 2001:4860:4860::8888, 2001:4860:4860::8844, 1.1.1.1, 8.8.8.8

Static Servers: 192.168.100.1

Allow Remote Requests: ☒

Packet Size: 4096

Server Timeout: 2.000 s

Total Timeout: 10.000 s

Current Queries: 100

TCP Sessions: 20

Cache Size: 2048 KiB

5 Interface <6to4-tunnel1>

Name: 6to4-tunnel1

Type: 6to4 Tunnel

MTU: 1480

L2 MTU: 65535

Local Address: 192.168.100.12

Remote Address: 216.218.221.42

IPsec Secret:

Keepalive:

DSCP: 10

Dont Fragment: no

☒ Clamp TCP MSS

enabled running slave

6 IPv6 Address List

Address	From Pool	Interface
2001:470:35:59d::2/64		6to4-tunnel1
2001:470:36:59c::1/64		ether1
fe80::3:c0a8:640c/64		6to4-tunnel1
fe80::4e5e:cff:fe7e:6700/64		ether1
fe80::4e5e:cff:fe7e:6702/64		wlan1

7 IPv6 Route List

Dst. Address	Gateway
0.0.0.0/0	192.168.100.1 reachable wlan1
192.168.88.0/24	ether1 reachable
192.168.100.0/...	wlan1 reachable

7. Implementasi

VI. Uji koneksi

- Cek IP Laptop
- Ping
- Buka situs IPv6

The screenshot displays a Windows desktop environment with several overlapping windows:

- Web Browser (Chrome):** Shows the WhatsApp web interface at <https://web.whatsapp.com>. The contact list includes "Lab CN&S xFIKTI Unmul" with members Anton, Gubtha, Hario, Medi Taruk, Putut Pamilih, Reza, and You.
- Network Connection Details:** A window showing the network configuration for the active connection. The details are as follows:

Property	Value
DHCP Enabled	Yes
IPv4 Address	192.168.88.25
IPv4 Subnet Mask	255.255.255.0
Lease Obtained	07 May 2020 09:24:00
Lease Expires	07 May 2020 09:34:00
IPv4 Default Gateway	192.168.88.254
IPv4 DHCP Server	192.168.88.254
IPv4 DNS Servers	1.1.1.1 8.8.8.8
IPv4 WINS Server	
NetBIOS over Tcpip Enab...	Yes
IPv6 Address	2001:470:36:59c:d447:639a:5551:3fe9
Temporary IPv6 Address	2001:470:36:59c:b8d6:9269:8e21:2f95
Link-local IPv6 Address	fe80::d447:639a:5551:3fe9%10
IPv6 Default Gateway	fe80::4e5e:cff:fe7e:6700%10
IPv6 DNS Server	
- Command Prompt:** A terminal window showing the results of a ping test to `web.whatsapp.com`. The output indicates successful connectivity with 0% packet loss and an average round trip time of 31ms.
- The Pirate Bay:** A web browser window showing the homepage of The Pirate Bay, featuring a pirate ship logo and navigation links.

8. Kesimpulan & Saran

1. 6to4 tunnel dapat digunakan sebagai mekanisme transisi IPv4 ke IPv6, dengan memakai jaringan IPv4 untuk tunnel (berjalan pada layer-3)
2. Dual Stack pada client memungkinkan akses ke IPv4 dan IPv6
3. Router Tunnel dan Client mendapatkan IPv6 Public
4. Firewall perlu di setting untuk melindungi jaringan di belakang Router Tunnel

9. Q & A

The Problem

雞同鴨講
Chicken Talks Duck

Or maybe

IPv4同IPv6講
IPv4 talk IPv6?

