

# Опыт внедрения IPv6 на сети оператора

The logo for XCOM, featuring the letters 'XCOM' in a bold, orange, sans-serif font. The 'X' is stylized with a thick stroke and a slight shadow effect. The 'O' is a simple circle. The 'M' is also bold and has a slight shadow.

**XCOM**

ИНТЕРНЕТ В АКТАУ

# BRAS

- SKAT (VAS Experts)
- L2-BRAS
- PCRF/Radius
- DHCPv6
- Router Advertisement
- Изоляция абонентов сети
- \*PON-совместимость

# IPv6, с чего начинать и что делать

- Получение адресов в RIPE
- Планирование сети
- Аплинк/BGP
- DNS (A/AAAA-records)
- GGC
- MNA (FNA)
- Radius

# Получение адресов в RIPE и распределение сетей

- 2a06:678**0**::/**29** - LIR
- 2a06:678**0**::/**32** - ISP
- 2a06:678**1**::/**32** - ISP
- 2a06:678**2**::/**32** - ISP
- 2a06:678\*::**64** - ISP Host/Subscriber

# Планирование сети в ISP

- 2a06:6780::/32 - инфраструктура ISP
- 2a06:6781::/32 - сеть для выдачи хостам
- 2a06:6782::/32 - сеть для выдачи подсетей (PD)

Internet number resource	Status	Netname
<a href="#">2a06:6780::/32</a>	ASSIGNED	KZ-XCOM-ISP6-INFR
<a href="#">2a06:6781::/32</a>	ASSIGNED	KZ-XCOM-ISP6-SUBS
<a href="#">2a06:6782::/32</a>	ASSIGNED	KZ-XCOM-ISP6-PD

db.ripe

IPv4 mapping:

10 . 11 . 12 . 13



IPv6: 2a06:6781:10 11 : 12 13 :0000:0000:0000:0000/64

# Аплинк/BGP

```
# ipv6 bgp summary
```

```
Neighbor          V      AS MsgRcvd   MsgSent  TblVer  InQ  OutQ  Up/Down  State/PfxRcd
```

```
2001:db8::****
```

```
4 65535 164067232 593376      0      0      0 39w4d06h 190919
```

```
2001:db8::****
```

```
4 65535 163713136 593358      0      0      0 09w6d15h 190919
```

# DNS (A/AAAA-records)



```
# nslookup -type=ns xcom.kz 1.1.1.1
Server:      1.1.1.1
Address:     1.1.1.1#53
```

```
Non-authoritative answer:
xcom.kz nameserver = ns1.xcom.kz.
xcom.kz nameserver = ns2.xcom.kz.
```

```
# nslookup ns1.xcom.kz 1.1.1.1
Server:      1.1.1.1
Address:     1.1.1.1#53
```

```
Non-authoritative answer:
Name:       ns1.xcom.kz
Address:    91.235.179.66
Name:       ns1.xcom.kz
Address:    2a06:6780::1
```

# Google Global Cache (GGC)



## Child Assets

Click on a row to show details for that asset.

Name ↑	IPv4	IPv6
xcom-XXXXX	91.228.176.100	2001:4860:4000::4
xcom-XXXXX	91.228.176.101	2001:4860:4000::5

all 2 items

## BGP Configuration

This is the BGP configuration currently configured on the GGC. It's only available after...

### IPv4 BGP Configuration:

GGC ASN: 11344

GGC IP: 91.228.176.100

Peer AS: 11344

Peer IP: 192.168.1.1

BGP session: established

### IPv6 BGP Configuration:

GGC ASN: 11344

GGC IP: 2001:4860:4000::4

Peer AS: 11344

Peer IP: 2001:4860:4000::5

BGP session: established



# MNA Edge Network Appliance (ex FNA)



## Cluster Details

**Cluster:** [blurred]  
**Nickname:** [blurred]  
**Carrier:** [blurred]  
**Multipeer:** [blurred]

### Installation Address

[blurred]

### Shipping Address

[blurred]

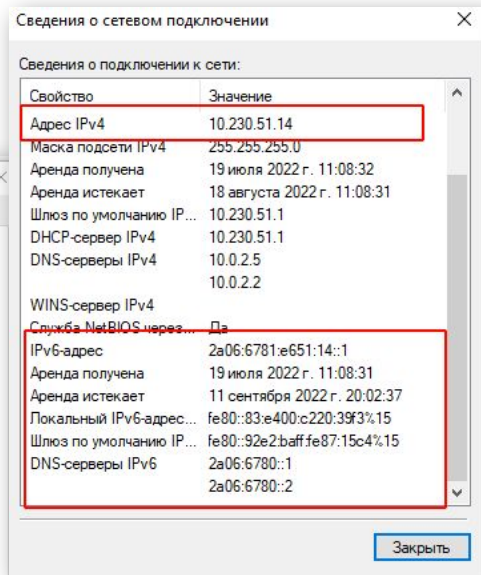
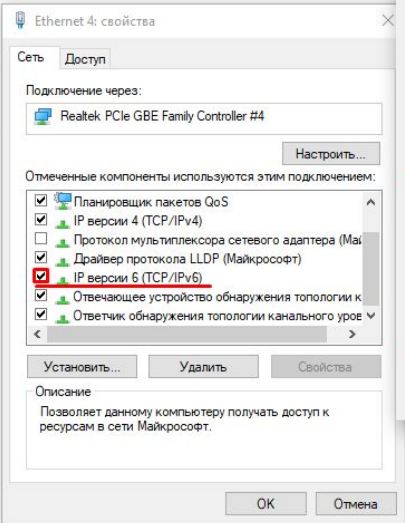
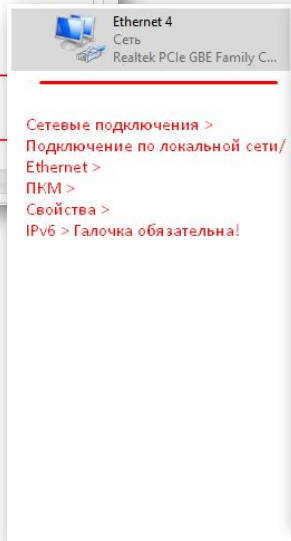
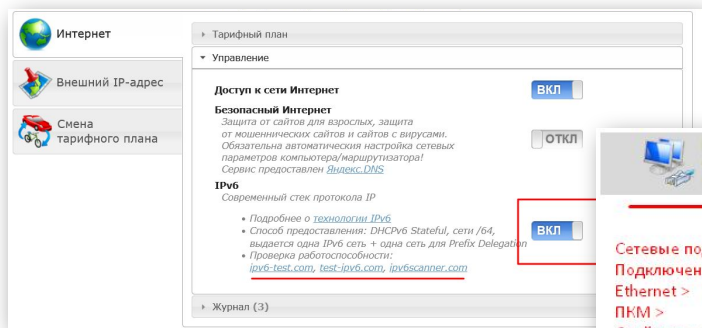
**Host Prefix:** 9 [blurred]  
2 [blurred] 64  
**FNA P2P:** 9 [blurred] 0  
2 [blurred] /64  
**ISP P2P:** 9 [blurred] 0  
2 [blurred] /64  
**FNA BGP:** 9 [blurred]  
2 [blurred] 0  
**ISP BGP:** 9 [blurred]  
2 [blurred]

# RADIUS

Auth	subscriber-29135-30158	2a06:6781:2905:223::	Framed-IPv6-Prefix	=	2a06:6781:2905:223::/64
Auth	subscriber-29135-30158	2a06:6781:2905:223::	User-Name	=	subscriber-29135
Auth	subscriber-29135-30158	2a06:6781:2905:223::	VasExperts-Policing-Profile	=	XCOM_TURBINE
Auth	subscriber-29135-30158	2a06:6782:2905:223::	Framed-IPv6-Prefix	=	2a06:6782:2905:223::/64
Auth	subscriber-29135-30158	2a06:6782:2905:223::	User-Name	=	subscriber-29135
Auth	subscriber-29135-30158	2a06:6782:2905:223::	VasExperts-Policing-Profile	=	XCOM_TURBINE

ips	DHCPv6	DNS-Server-IPv6-Address	=	2a06:6780::1
ips	DHCPv6	DNS-Server-IPv6-Address	=	2a06:6780::2
ips	DHCPv6	VasExperts-DHCP-Option-IPv6	=	31:2a06:6780::1
ips	DHCPv6	VasExperts-DHCP-Option-IPv6	=	31:2a06:6780::2

# Абонентские устройства, ПК



# Абонентские устройства, маршрутизатор

The image displays three screenshots of the TP-Link Archer C60 web interface, illustrating the configuration of IPv6 on a subscriber device. The screenshots are annotated with red numbers 1 through 9, indicating the sequence of steps.

- Step 1:** The main configuration menu is shown. The 'Дополнительные настройки' (Advanced Settings) tab is selected, and the 'IPv6' option is highlighted in the left sidebar.
- Step 2:** The 'IPv6' configuration page is shown. The 'Состояние IPv6' (IPv6 Status) is set to 'IPV6 WAN'.
- Step 3:** The 'Интернет' (Internet) configuration page is shown. The 'Тип подключения к Интернету' (Internet connection type) is set to 'Динамический IP-адрес (SLAAC/DHCPv6)'. The 'IPv6-адрес' (IPv6 address) is set to '2A06:6781:705:104::1/64'. The 'Предпочтительный DNS-сервер' (Preferred DNS server) is set to '2A06:6780:1' and the 'Альтернативный DNS-сервер' (Alternative DNS server) is set to '2A06:6780:2'.
- Step 4:** The 'IPv6 WAN' configuration page is shown. The 'Тип подключения' (Connection type) is set to 'Динамический IPv6-адрес'. The 'IP-адрес' (IP address) is set to '6A:0:0', the 'Маск подсети' (Subnet mask) is set to '6A:0:0', and the 'Шлюз' (Gateway) is set to '6A:0:0'. The 'MTU (байт)' (MTU (bytes)) is set to '1500'. The 'Включить NAT' (Enable NAT) checkbox is checked. The 'Включить максимальную скорость SPI' (Enable maximum SPI speed) checkbox is checked. The 'Включить DMZ-порт' (Enable DMZ port) checkbox is checked. The 'Получить IP-адрес с помощью UPnP' (Obtain IP address using UPnP) checkbox is checked. The 'Указать адрес DNS-сервера вручную' (Specify DNS server address manually) checkbox is unchecked. The 'Имя узла' (Hostname) field is empty.
- Step 5:** The 'IPv6 WAN' configuration page is shown. The 'Сохранить' (Save) button is highlighted.
- Step 6:** The 'IPv6' configuration page is shown. The 'Состояние IPv6' (IPv6 Status) is set to 'IPV6 LAN'. The 'Предпочтительный DNS-сервер' (Preferred DNS server) is set to '2A06:6780:1' and the 'Альтернативный DNS-сервер' (Alternative DNS server) is set to '2A06:6780:2'.
- Step 7:** The 'IPv6 LAN' configuration page is shown. The 'Тип автонастройки адреса' (Address autoconfiguration type) is set to 'RADVD' and the 'DHCPv6-сервер' (DHCPv6 server) is set to 'DHCPv6-сервер'. The 'Включить RDNSS' (Enable RDNSS) checkbox is checked. The 'Включить префикс ULA' (Enable ULA prefix) checkbox is checked. The 'Тип настроек глобального префикса сети' (Global prefix settings type) is set to 'Делегированный' (Delegated). The 'Делегированный префикс подключения WAN' (Delegated WAN connection prefix) is set to 'Нет доступных интервалов' (No available intervals).
- Step 8:** The 'IPv6 LAN' configuration page is shown. The 'Сохранить' (Save) button is highlighted.
- Step 9:** The 'IPv6 LAN' configuration page is shown. The 'Сохранить' (Save) button is highlighted.

# Тесты связности

## Проверьте ваше IPv6 подключение.

Результаты | **Пройденные тесты** | Поделиться результатами / Обратная связь | Другие IPv6 сайты

**Принципы работы теста:** В процессе теста ваш браузер посетит серию адресов. Процент успешности

Нажмите для просмотра [Техническая информация](#)

Тест IPv4 записи в DNS	ок (0.531s) используя ipv4
Тест IPv6 записи в DNS	ок (0.570s) используя ipv6
Тест обеих (IPv4 и IPv6) записей в DNS	ок (0.565s) используя ipv6
Тест двухстекового (IPv4 и IPv6) DNS большими пакетами	ок (0.494s) используя ipv6
Тест IPv6 большими пакетами	ок (1.880s) используя ipv6
Тест использования IPv6 DNS сервером вашего провайдера	ок (0.703s) используя ipv6
Поиск провайдера IPv4	ок (0.243s) используя ipv4 ASN 56568
Поиск провайдера IPv6	ок (0.208s) используя ipv6 ASN 56568

Нажмите для просмотра [Поделиться результатами / Обратная связь](#)

test-ipv6.com

ipv6 test | General | Speed | Ping | Website | Stats | API

IPv6-test.com is a free service that checks your IPv6 and IPv4 connectivity and speed. Diagnose connection problems, discover which address(es) you are currently using to browse the Internet, and what is your browser's protocol of choice when both v6 and v4 are available.

IPv4 connectivity

- IPv4: Supported
- Address: 91.235.
- Hostname: 91.235...x-com.kz
- ISP: X-communication LLP

IPv6 connectivity

- IPv6: Supported
- Address: 2a06:6781:
- Type: Native IPv6
- SLAAC: No
- ICMP: Reachable
- Hostname: None
- ISP: X-communication LLP

Score: 19 / 20

Browser: Default: IPv6, Fallback: to IPv4 in 1 second

DNS: DNS4 + IP6: Reachable, DNS6 + IP4: Reachable, DNS6 + IP6: Reachable

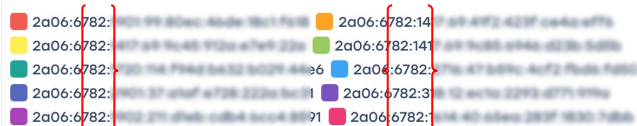
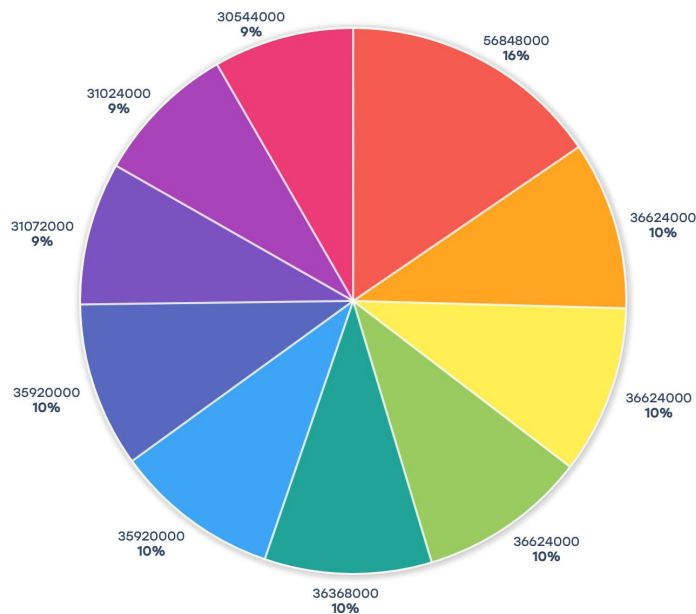
More: Speed test » | Ping test »

ipv6-test.com

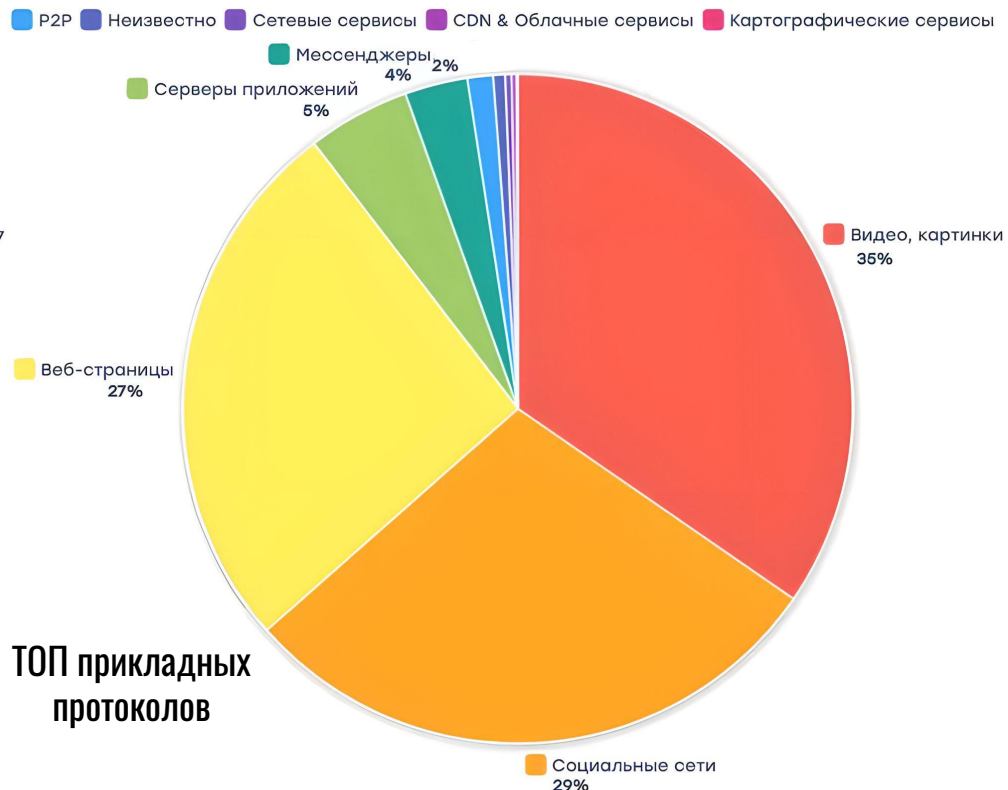
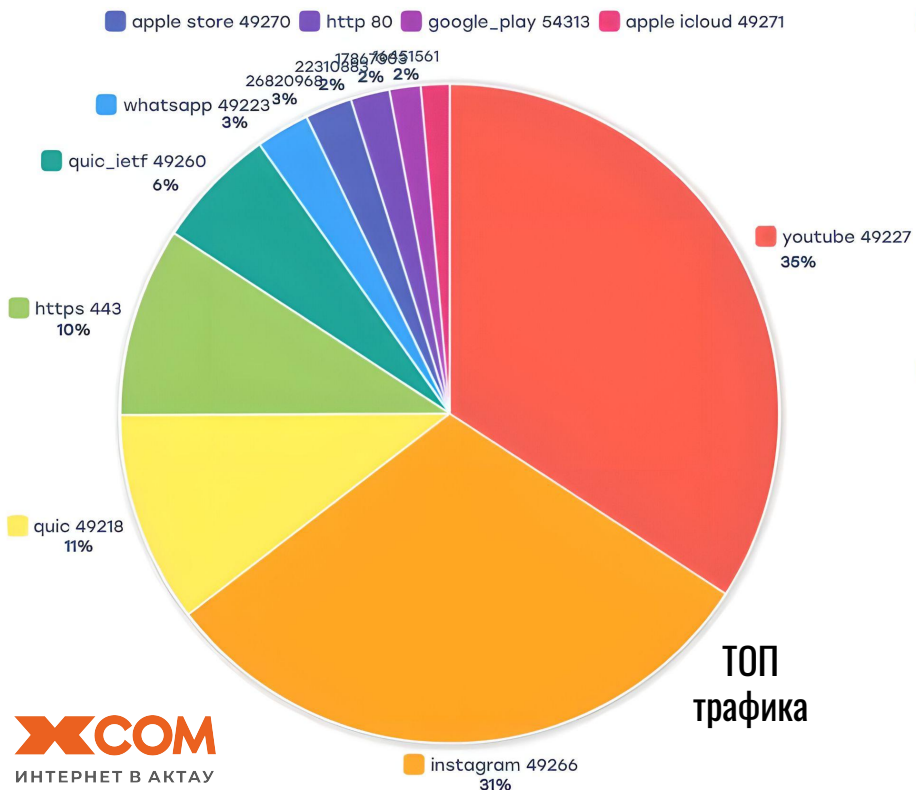
# Абоненты - IPv6 или Prefix Delegation?

2a06:6781:: - IPv6

2a06:6782:: - PD

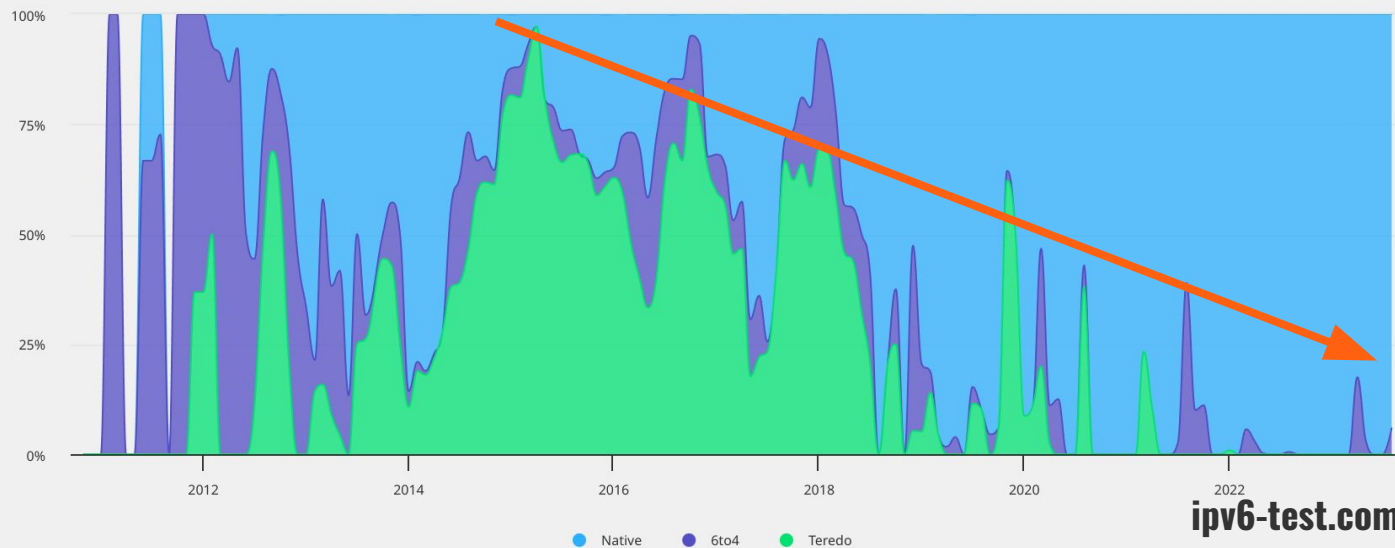


# Объём трафика по протоколам - Что там ходит по IPv6?



# Способы доступа к IPv6-сетям

IPv6 address types in Kazakhstan



ipv6-test.com



# Что за львы эти тигры?

Top 25 internet service providers for IPv6 speed in Kazakhstan (Aug 2023)

	ISP	Test count	IPv6 average
1.	X-communication Llp	11	26.9 Mbps
2.	Kar-Tel LLC	7	11.8 Mbps
3.	Stark Industries Solutions LTD	6	0.0 Mbps
4.	TNS-Plus LLP	5	0.0 Mbps

[ipv6-test.com](https://ipv6-test.com)

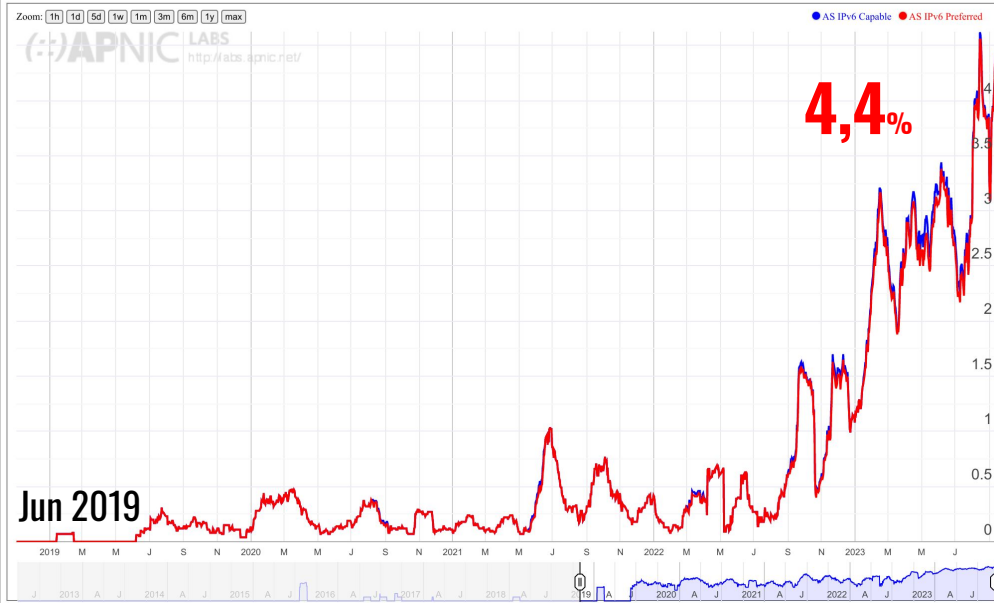
# Статистика по Казахстану (APNIC)

ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples ▼
AS206026	IPNET_KAR-TEL	35.46%	34.62%	607,099
AS48503	TELE2-KZ Tele2 Kazakhstan	26.69%	26.35%	488,379
AS29555	Tele2 Kazakhstan	28.10%	27.75%	105,322
AS197556	TNS	33.76%	32.82%	22,088
AS56568	XCOMMUNICATION-AS	4.43%	4.41%	13,950

[stats.labs.apnic.net/ipv6/KZ](https://stats.labs.apnic.net/ipv6/KZ)

# Динамика по Казахстану (APNIC)

## Deployment for AS56568: XCOMMUNICATION-AS, Kazakhstan (KZ)



## AS48503: TELE2-KZ Tele2 Kazakhstan, Kazakhstan (KZ)



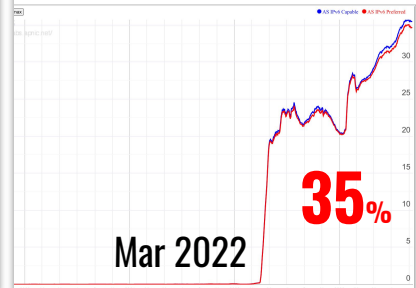
## AS29555: Tele2 Kazakhstan, Kazakhstan (KZ)



## AS197556: TNS, Kazakhstan (KZ)



## AS206026: IPNET\_KAR-TEL, Kazakhstan (KZ)



# А что в итоге?

Включили IPv6 **21,3%**

**4,1%** IPv6 трафика