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A Documentation on

# IIT KGP Network



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# The Documentation

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# Need for Documentation

- Unable to use Whatsapp, Telegram, Discord, Steam, etc.
- In few cases updating packages from AUR the package manager gives error related to network. (e.g Spotify).
- Some websites give PR\_CONNECT\_RESET\_ERROR or similar error.

This gives us the need to find a solution like VPN or tunnel, etc.

But, this raises a few doubts ...

- Hundreds of VPN out there, what to check and what to not?
- Which type of VPN protocols will work ?
- How to choose the best VPN among the working ones ?

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I will write about the problems students face on campus network and attempt to provide solution (feasible or non feasible). The solutions end at Section 3.

In Section 4, I will write in depth discussion on why does few protocols, which are really good, like Wireguard, UDP based VPNs, etc. do not work on campus network.











Section 5 deals with Contributing rules

Section 6 ends with a vote of thanks to people who helped me in anyway.

1—

VPNs

- Not working or untested:

VPN	Platform	Status	Reason
Wireguard hosted on any server	  	✗	Uses UDP, which is blocked. More about this under <a href="#">Wireguard</a> section
Warp (1.1.1.1)	  	✗	Uses Wireguard internally
VPNHub		✗	Could have worked by changing the settings, but that is for paid users only.
Tor	  	✗	Tor commonly uses ports 9001 and 9030 for network traffic and directory information - <a href="#">source</a> , which are blocked on network. See more about blocked ports under <a href="#">Packet Filtering</a> .

This section lists the working, recommended and not working VPN services. This also includes my observation on why they work or not work.



- Recommended Solutions

VPN	Platform	Status	Reason
ExpressVPN (Not free)	  	✓	Even though paid, its the fastest, most stable and the most secure option out there.
OpenVPN hosted on DigitalOcean or AWS ec2	  	✓	This is slower than ExpressVPN but its very much feasible for using on PC/Laptop. It uses more CPU than ExpressVPN and Wireguard

## The Working Solutions

ExpressVPN and OpenVPN worked in TCP mode only.  
For Expressvpn it used port 443 by default  
For OpenVPN it has to be configured to use tcp:443



## Step 1: Get an AWS account

⚠ Make sure to setup the server properly at your own risk. I am not liable to any charges you receive for your mistakes. First watch video about Billing here - [Billing and Terminating Instances](#).

Watch this video on how to create a free AWS account - [Create new AWS account](#). Remember this step requires you to have a debit card (Mastercard, American Express or Visa).

## Step 2: Create a free ec2 instance

Watch this video on how to create an ec2 instance- [Creating an AWS EC2 instance](#).

The further 2 steps are derived from a blog, [IIT KGP: Bypassing network restrictions without compromising on internet speed by Anjay Goel](#)

This subsection gives steps to setup OpenVPN Server on an AWS instance.

## 1.2 Observation : ExpressVPN works best

Express VPN works and it works damn fast - it uses `Lightway Protocol` whose core is open sourced now [here](#) - and a combination of `iptables` rules and `DNS Resolution`.

My speculation is that it runs in TCP Mode and its fast. But I need to verify this by looking at logs and iptable entries. I speculate that `Lightway UDP` doesn't work because I tried it specifically on the Android version of the app, it didn't connect at all where the TCP counterpart connected quickly.

ExpressVPN (the open Sourced wrapper) uses the following :

- `wolfSSL` : a lightweight crossplatform SSL library for security
- `libhelium` : ExpressVPN's internal API to call wolfSSL and manage robustness of the network
- `libuv` : To manage crossplatform asynchronous IO as backend server.

I will try to implement soon my own lightway based VPN. So do checkout this page in future too!

## ExpressVPN

Amazingly fast, robust and stable.

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LAN and WIFI

# LAN

This section includes information on:

- The LAN Cable to use
- Checking Gigabit hardware support
- Disabling auto-negotiation

## 2.3 Disbale auto-negotiation

✓ This is really important section.

Sometimes even though everything is correct the speed gets capped around 75Mbps . This is due to the LAN server auto negotiates to a speed which can be used by both the parties (server and client). You can force the speed and duplex to full speed.

⚠ This may not work for everybody so your connection **will go out** for a moment but it will come back soon. If it doesn't connect at all (at present or in future cases) then revert the changes to auto.

This method worked for me (tested on linux) and after a system restart my speed shot up from 75mbps to directly 700-800Mbps . I used ethtool again for this.

```
$ sudo ethtool -s [device_name] speed [10/100/1000] duplex [half/full] autoneg [on/off]
```

Here device\_name is obtained from ip link list (the same from previous step). Speed is in Mbps - 1000 means 1Gbps, and duplex is the communication multiplexing - full means both ways. autoneg will be off.

In my case (since the institute network supports 1Gbps we can use full duplex, it's less probable that it will cause issues like more collisions - [see here](#). The insti server auto negotiates and we won't so maybe a mismatch. ) I used this command :



## WIFI

This section include information regarding:

- The various available hardware in Laptops (Wifi 5 , Wifi 6). This could act as a helping guide in buying a laptop or buying a USB Wifi adapter
- Also includes other methods, such as setting up a router and bridging it via LAN.

### 3.2 Other Solutions

**Just buy a router/repeater or use raspberry Pi**

**Setting up router :**

Buy a good 300Mbps or (1 Gbps if u are rich) and then use ethernet interface to distribute internet via the wifi interface.

Before buying check if it will support OpenWRT, to be able to forward connections from ethernet to wifi ( to be used as Access point ) and vice versa. Setting up can be a bit tedious for beginner but it will give high speed internet.

Benefits : You can get 300Mbps internet, and even if u share with 3 room mates u still get around 100 Mbps in the worst case scenario which is much better than getting 12-13 Mbps on Wifi

**For Raspberry Pi :**

- The logic is same, route the connections on Wifi interface via the ethernet interface.
- Buy a 150/300 Mbps usb adapter which is **capable of AP mode** (verify before buying).

For detailed config : Check out my post [here](#).

Benefits : As in the previous solution you can get much better speed than the institute wifi and can enjoy online streaming. Cheers!

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# Discussion


# Technicalities

This section is the most important section for people who wish to work on something related to networks or they want to know why a particular protocol/application doesn't work

The information present in this section contains my views and understanding about networking and protocols, thus it may contain mistakes. This shall improve with time and knowledge.



# 4.1 Packet Filtering

Protocol	Status	Proof	Remarks
UDP		<ul style="list-style-type: none"><li>The network connected well to server hosted on Cloud on non standard port 55555 over UDP. But the connection is dropped after just a few requests (<a href="#">see issue</a>)</li></ul>	<ul style="list-style-type: none"><li>UDP works and connects to an external server on any unused port, other than the standard ports.</li><li>As common ports are most probably blocked, services like <code>dns</code> doesn't work. Hence programs depending on DNS-name resolution like <code>dig</code> and <code>nslookup</code> won't work. The server is able to use <b>only the DNS provided by campus network DHCP</b></li></ul>

## Packet Filtering

This subsection involves details of packet filtering on the network from inside to the external WAN.

It includes the status of most important protocols like TCP, UDP and ICMP.

It also includes the methods I used to verify my observations.

# 4.2 VPN Protocols

Rank		Speed	Stability	Security	Encryption
1	ExpressVPN	Very Fast	Very Stable	High	WolfSSL
2	WireGuard	Fast	Stable	High	ChaCha20
3	OpenVPN	Fast	Very stable	Very high	160-bit, 256-bit
4	IKEv2/IPSec	Fast	Very stable	High	256-bit
5	L2TP/IPsec	Medium, due to double encapsulation	Stable	Medium	256-bit
6	SSTP	Fast	Very stable	High	256-bit
7	PPTP	Speedy, due to low encryption	Very stable	Weak	128-bit

## Protocols

This subsection deals with the different types of VPN Protocols, available, ranked from best to least feasible base on various factors including authentication, speed, etc.



## 4.3 Wireguard

As we see in the section above, Wireguard is faster than OpenVPN. So it was a very good choice for a VPN.

- The issue faced in setting up was that Wireguard is `UDP only` VPN whereas the only option for us is to route traffic through `TCP:443`.
- Tunneling TCP over TCP can be a disaster : [Why TCP Over TCP Is A Bad Idea](#)
- There are alternative solutions which involve `tunneling UDP over TCP` using utilities like : [udp2raw](#) and [udptunnel](#). But sadly I was unable to set them up and couldn't make them work.
- Even routing UDP over TCP is not much of a good idea and did not produce interesting results. The above method results in a performance similar to OpenVPN so why not just use OpenVPN : [Using Wireguard when UDP is blocked](#)

### Wireguard

This subsection states my thoughts on the usage of wireguard and the issues that may arise.

# 4.4 OpenVPN vs ExpressVPN

The testing was done on a couple of devices from the campus ( LBS Hall ). Devices being - ROG Strix G15 2020, Aspitre 7 and MSI GL65 Leopard.

- For casual users 🖥️

Server	Download Speed Before	Download Speed After
ExpressVPN	600 Mbps	500-550 Mbps
OpenVPN - AWS ec2	600 Mbps	150 Mbps
openVPN - Digital Ocean	600 Mbps	200 Mbps

## Comparison

This subsection includes my personal testing on a small scale and the results of comparison between ExpressVPN and OpenVPN hosted on AWS/Digital Ocean.

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Next steps



# Lagnos VPN

This is an ongoing implementation of Lightway based VPN.

Lightway is used by ExpressVPN.

So combining the benefit of fast VPN and hosting it at choice on a server.

Plus, it's **Open Sourced** <3

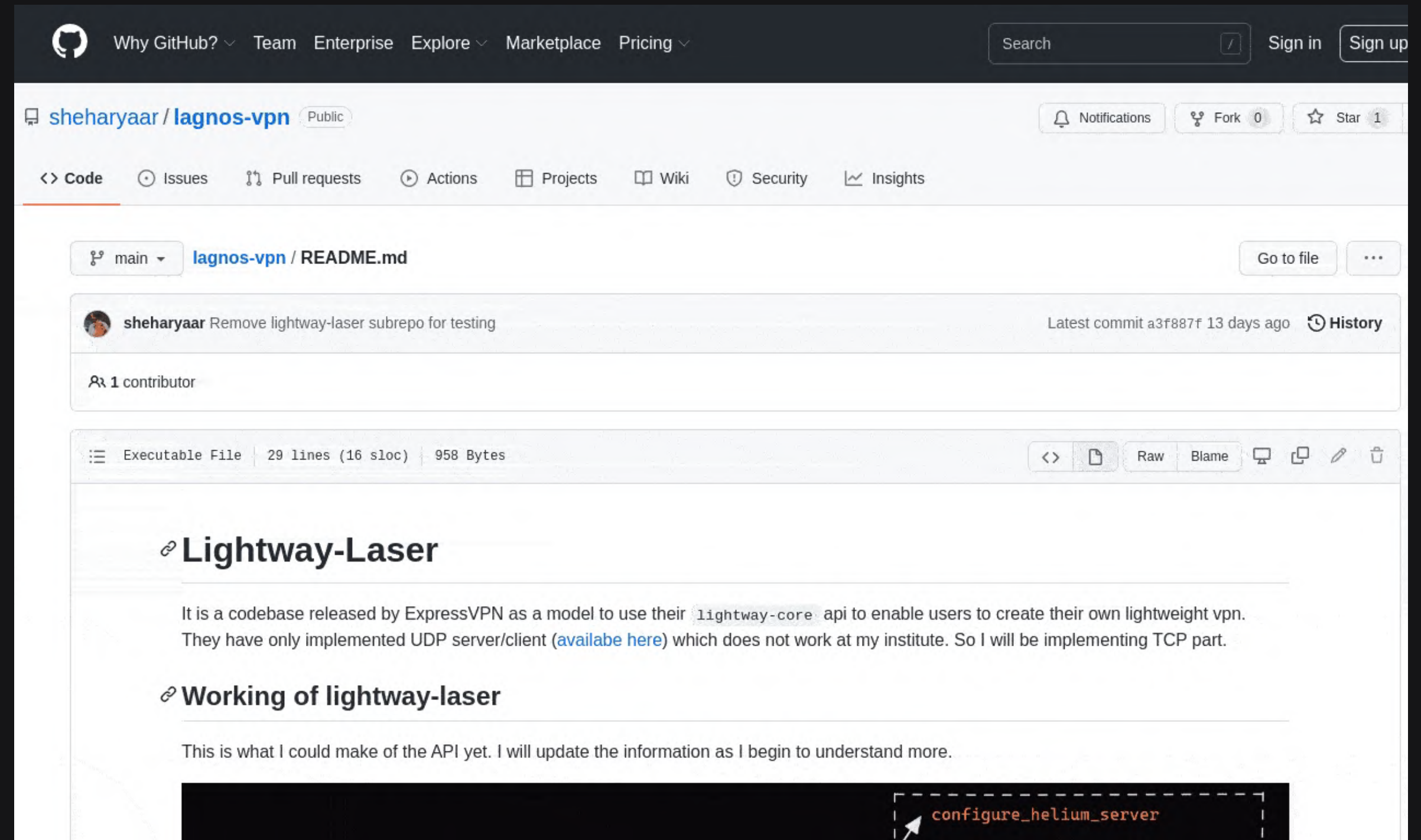
Pros :

- Very fast, similar to that of Express VPN (theoritically)
- Light and good security (we don't require much authentication)
- Free of cost (if hosted on free tier services).

Cons:

- Not much documentation available.
- New codebase, may have bugs.

Pitch



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# Suggestions



# Valuable Inputs

After interacting with a senior - Archit Rungta 4th Year, who worked on something similar, I received the following important suggestions and information regarding the Network -

- We do not need encryption - CIC clarified that it does not look into individual's usage of the internet - need to verify again for the current session
- Normal tunneling may also do - need to be tested.  
tcptun - <https://github.com/archit120/tcptun>
- Wireguard on TCP Tunnel can work good - need to be tested - personally I feel it's not worth it.  
udp2tcp - <https://github.com/dark/udp2tcp>

# Suggestions help a lot!

With just a single interaction, I was exposed to so many ways to try things.  
Plus, I got to learn :)

Suggestions are always welcome.

# Thank You.



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