GPG Quickstart Guide 🔒 - Anton Paras - Medium

Anton Paras

```
GPG(1)                    GNU Privacy Guard 2.1                    GPG(1)

NAME
       gpg - OpenPGP encryption and signing tool

SYNOPSIS
       gpg [--homedir dir] [--options file] [options] command [args]

DESCRIPTION
       gpg  is  the  OpenPGP part of the GNU Privacy Guard (GnuPG). It is a
       tool to provide digital encryption and signing  services  using  the
       OpenPGP  standard.  gpg features complete key management and all the
       bells and whistles you would expect from a full OpenPGP  implementa-
```

14 min read

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I recently discovered GPG and how awesome it is.
Shortly after that, I discovered CLI-GPG's documentation, and how not-awesome it is.

The man page is comprehensive but unwieldy — more like a glossary than a tutorial.

There's *The GNU Privacy Handbook*. It's more instructive than the man page, but it's outdated. It demonstrates `gpg 0.9.4 (1999)`. As of today, `gpg 2.2.3 (2017)` is the current version. Between the 2 versions, there is good interoperability. But there are enough differences to frustrate/deter beginners.

It took me the greater part of a day to begin basic tasks with GPG. Here, I'll list common tasks and how to perform them with modern `gpg 2.2.3`.

This post was originally intended for future Anton, but maybe others will make use of it too!

This article assumes you understand the basics of public key cryptography, the heart of the OpenPGP protocol.

This article also assumes you're using **MacOS** and that you have the **Homebrew Package Manager** installed.

Unless otherwise specified, a **"key"** (primary *key*, sub*key*, etc.) refers to a key**PAIR** of public and private keys. I think this is confusing. We should always say keyPAIR if we mean a pair of 1 public key and 1 private key.

Unfortunately, referring to a keypair as a “key” is standard. So in this article, I will abide.

I know you’re *dying* to get started sending cryptographically secure messages to all your buddies. So, let’s begin!

Installing GPG

```
brew install gpg
```

As of this day, the latest version is 2.2.3

Generating Keys

```
gpg --full-generate-key
```

The `--full-generate-key` option will guide you through each step with helpful dialogs.

The steps:

Choosing your key types.
By default, GPG uses 1 primary key for authentication/signing, and 1 subkey for encryption/decryption.
These two keys can utilize different cryptosystems. (E.g. a **DSA** key for signing and an **ElGamal** key for encryption/decryption.)
However, GPG uses RSA for both keys by default.
Unless you know what you're doing, I would just stick with the RSA+RSA default.

Choosing keysizes.
Your keys can be between 1024 and 4096 bits long.
The default keysize is 2048 bits long.
Shorter keysizes are less secure, but more performant.
Longer keysizes are more secure, but less performant.
I usually opt for the max keysize: 4096 bits.

Setting an expiration date.
You can set your key to expire in N days, weeks, months, or years. Or, you can set it to **never** expire.
The default setting is — no expiration date.
If you are some high-profile person who's constantly at risk of having keys stolen, then perhaps you'd like to set an expiration date. Otherwise, I see no reason to do this, so long as you guard your private keys properly.

Fill out your user ID information.
Give your name, email address, and any comments you'd like to add.
This information will be attached to your keys.

Set a passphrase.
For added security, `gpg` will prompt you for a passphrase every time you perform some operation that requires access to your private keys.

Move your mouse and spam your keyboard.
All of the above cryptosystems rely on random numbers to generate keys.
Computers aren't capable of generating truly random numbers. They rely on a plethora of inputs with wide value-ranges to generate numbers that **seem random**.
Mouse position and keystrokes are part of those inputs, among other things. To increase the randomness of your keys, manipulate these inputs during this section.

You've created your keys! In the output, you'll see rows for your **primary keypair's public key, user ID, and sub-keypair's public key**.

Listing public keys

```
gpg --list-public keys
```

This provides information about the public keys in your *"contacts list"*.

This **won't** list the **contents** of the public keys, only **metadata** such as cryptosystem, keysize, and date-of-creation.

It will also show the associated **user ID** for a given set of public keys.

The ***fingerprints*** of **primary-public keys** will also be shown.

According to [Wikipedia](),

> A **public key fingerprint** is a short sequence of bytes used to identify a longer [public key](). Fingerprints are created by applying a [cryptographic hash function]() to a public key. Since fingerprints are shorter than the keys they refer to, they can be used to simplify certain key management tasks.

Listing ALL public keys fingerprints (Primary Keys + Subkeys)

```
gpg --fingerprint --fingerprint
```

You must give the `--fingerprint` command **twice**.

```
--fingerprint
       List  all keys (or the specified ones) along with their fin-
       gerprints. This is the same output as --list-keys  but  with
       the  additional  output  of a line with the fingerprint. May
       also be combined with --check-signatures.  If  this  command
       is  given  twice, the fingerprints of all secondary keys are
       listed too.  This command also  forces  pretty  printing  of
       fingerprints if the keyid format has been set to "none".
```

Relevant snippet from gpg manpage.

Listing private keys

`gpg --list-secret-keys`

This provides information about the private keys you have.

For me, this output is identical to `gpg --list-public-keys` because I have all the private keys for each keypair I have.

It's possible to only have the private key/public key of a given keypair. If you have that asymmetry, then your `gpg --list-secret-keys` would give different output from your `gpg --list-public-keys`.

Why is it called* `secret` *keys?

According to dave_thompson_085 on [this serverfault post](),

> gpg **calls private keys 'secret'** because PGP dates from before people settled on the names 'private' key for the half of an asymmetric pair held by (ideally) only one party versus 'secret' key for a symmetric value usually held by two or more mutually trusting parties but nobody else.

Listing key IDs

gpg --list-public-keys --keyid-format **none|short|0xshort|long|0xlong**

Various `gpg` operations target keys. E.g. **deleting keys, signing files with a *specific* private key, etc.** To specify a key, you must provide some sort of key-identification.

Key IDs fulfill this purpose.

Key IDs are essentially abbreviations of fingerprints. Here’s a guide to key ID formats, given by Jens Erat on this superuser post.

Fingerprint: 0D69 E11F 12BD BA07 7B37 26AB 4E1F 799A A4FF 2279
Long key ID: 4E1F 799A A4FF 2279
Short key ID: A4FF 2279

A `short` key ID is the last 8 characters of the fingerprint.
A `long` key ID is the last 16 characters of the fingerprint.

`0xshort` and `0xlong` simply prefix `0x` to the `short` and `long` key IDs respectively.

E.g. a `short` key ID would be `A4FF2279`. The corresponding `0xshort` key ID would be `0xA4FF2279`.

The `0x` is sometimes used to explicitly note that the key ID is a **hex value**.

Encrypting a message (binary encoding)

gpg --encrypt --recipient 'some user ID value' <file>

The default encryption format is in **binary**. If you're exchanging messages via entire files, this is fine.

However, if you wish to copy/paste your encrypted message on a website (go check out /r/GPGpractice!), binary won't work.

You can't copy/paste/type binary like normal text. If you want to interact with the encrypted message like normal text, you'll need to encode the message in ASCII armor using the `--armor` option. (See below)

By default, the encrypted file's name is `<filename>.gpg`. But you can specify a different filename using the `--output` option. (See below.)

Encrypting a message (ASCII Armor)

gpg --encrypt **--armor** --recipient 'some user ID value' <file>

The `--armor` option encodes the encrypted message in ASCII armor. This allows you to interact with your encrypted message like normal text.

With the binary encryption, you couldn't copy/paste/type it onto a forum or in an email. You can't do that with binary.

But with ASCII text, you can.

Specifying an encrypted file's filename

gpg **--output <file>** --encrypt --recipient 'some userID value' <file>

The `--output` option can also be used with other operations, such as **decrypting** a file and **signing** a file.

Decrypting a message

gpg --decrypt <encrypted-file>

By default, `gpg` will print the decrypted message to `STDOUT`.

You can write the decrypted message to a file using the `--output` option, like how it was used with encryption above.

Writing the decrypted message to a file

gpg **--output <file>** --decrypt <encrypted-file>

Signing a file (binary encoding)

gpg --sign <file>

Signing a file produces a new, signed file that's **binary encoded**.

IMPORTANT NOTE:
Signing and *encrypting* a single document is a common task.

People encrypt their documents to ensure that only a specific recipient can read them (**encryption**).

People sign their documents to assure others that the document was sent by the themselves — that the document-sender's identify wasn't spoofed (**authentication**)…

…AND to assure others that the document was not modified from the original (**integrity check**).

It's common to perform both operations on a given document.

When you `gpg --sign` a document, the output is in **binary**.
So you **might** *think* **that you've** *encrypted* **the document, in addition to signing it**.

You *technically* have, but you **practically** haven't.

I say *technically*, because the document was indeed encrypted with your private key. To read the signed document, it must be ***decrypted*** **with your** ***public key*****.**

But from an encryption standpoint, how useless is that? Your public key is widely available. Basically anyone can decrypt it. That's not secure at all.

Bad things might happen if you post sensitive documents, thinking that they're properly encrypted…

TL;DR: Documents signed with `gpg --sign` are binary-encoded. The binary encoding might persuade you that a document is also *encrypted*. It's not. **But you might think it is. So, you might publicly post documents, thinking they're encrypted. You might post sensitive information — that everyone can decrypt with your public key. That's not secure at all.**

Signing a file (readable message)

gpg --clearsign <file>

With normal `gpg --sign`, the outputted document is binary-encoded.

Often, you don't want this. You want the message to immediately readable, without having to decrypt it with the corresponding public key.

In other words, you just want the message to be verifiable. You don't care that everyone can see the message.

`gpg --clearsign` allows this. Like with `gpg --sign`, this embeds your signature into the outputted document.

But as the name implies, the contents of the document are clear. I.e. they're still readable without any decryption.

Signing a file (detached signature — in binary)

gpg --detach-sign <file>

Sometimes, you want a **signature** to be ***separate*** from its corresponding file.

You’d likely do this with any file that ***isn’t*** **a plaintext message**. E.g. programs, videos, images, audio, etc.

Why? Because signing a file **alters** its **contents**.
Altering the contents of a program-file, video, etc. could **break** it.

Example: Signing a simple node.js program, rendering the signed file unexecutable.

Signing a file (detached signature — ASCII armor)

gpg --armor --detach-sign <file>

With a typical `gpg --detach-sign <file>`, the detached signature **binary-encoded.**

As mentioned above, binary is cumbersome for copy/pasting onto web forums, email, etc.

If you'd like to copy/paste/type your detached signature as such, encode it with **ASCII armor** using the `--armor` option.

Signing a file (specifying output file's filename)

gpg **--output <file>** --sign <file>

You can use the `--output` option to specify the outputted file's filename.

You can also do this with **ASCII-armored/clearsign** signatures and **detached** signatures.

Verifying a signed file (binary encoded)

gpg --verify <signed-file>

A signed-file that's binary-encoded is unreadable (unless you can read binary!).

When using `gpg --verify` on a binary-encoded signed-file, it will only inform you of the file's authenticity. **It won't decode the file for you.**

If you want to decode the file/**make it readable**, you need to `gpg --decrypt` it.

```
❯ ls
message
❯ gpg --sign message
❯ ls
message         message.gpg
❯ gpg --verify message.gpg
gpg: Signature made Sun Nov 26 20:50:30 2017 PST
gpg:                using RSA key 7A722563ACD3C24C761D16E1B972CF670B0E
11AD
gpg: Good signature from "Bobby the Builder (I build things) <bobby@th
ebuilder.com>" [ultimate]
❯ █
```

Note: Running `gpg --decrypt` on a binary-encoded signed-file will **also inform you of the file's *authenticity*** — as shown above.

I.e. Running `gpg --decrypt` on a binary-encoded signed-file does `gpg --decrypt` and `gpg --verify`.

Verifying a signed file (clearsigned)

gpg --verify <clearsigned-file>

```
❯ █
```

Verifying a signed-file with ASCII-armor is identical to verifying the binary-encoded counterpart.

Though, what's nice is that you **don't have to `gpg --decrypt` the ASCII-armor signed-file to read it, since it was readable *to begin with*.** (That is the nature of clearsigned files.)

Verifying a file with a detached signature

gpg --verify <detached-signature-file> <corresponding-**content**-file>

The process is **identical** for both **binary-encoded** detached signatures and **ASCII-armored** detached signatures.

For fun, you can try **tampering** with the corresponding **content-**file for a detached signature. You'll see it **fail.**

Exporting a PUBLIC key (binary encoded)

gpg --export <key ID>

This **prints the key to STDOUT** in **binary**.

This isn’t really useful, but this is the base-functionality of the command.

Exporting a PUBLIC key (ASCII armor)

gpg --armor --export <key ID>

This **prints the key to STDOUT** in **ASCII-armor**.

Exporting a PUBLIC key (write to a file)

gpg --output <file> --export <key ID>

This exports the given public key **(in binary encoding)** to the given file.

If you wish to export the key in **ASCII-armor,** simply use the `--armor` option.

Exporting PRIVATE keys

gpg --export-secret-keys

< I'm not gonna show a video of this lol. >

I don't believe you can export a single private key by passing a `<key ID>`. Based on the `man gpg`, I think you can only export ALL private keys.

Importing a Public Key

gpg --import <public-key-file>

If you run `gpg --list-public-keys`, you'll see the newly added key in the listing.

Importing a Private Key

gpg --import <private-key-file>

The procedure for importing private keys is identical to the procedure for importing public keys.

If you run `gpg --list-secret-keys`, you'll see the newly added private key to the listing.

Deleting a Key

gpg --delete-key <key ID>

Searching for a Public Key on a Keyserver

gpg --keyserver <URL without scheme> --search-key**s** <string of info>

DO NOT INCLUDE THE URL SCHEME WHEN SPECIFYING A KEYSERVER.
E.g. DON'T INCLUDE `http://` OR `https://` . THIS HAS CAUSED ME A LOT OF HEADACHE.

There are various PGP Public Key Registries online. These registries are meant to facilitate the exchange of people's public keys.

Here are a few major ones:

[pgp.mit.edu](pgp.mit.edu)

keyserver.ubuntu.com

keyserver.pgp.com

The good thing about these registries — they are all part of the **SKS Pool**.

The SKS Pool is a **large, decentralized network of servers hosting PGP key registries**.

Changes among individuals servers *propagate* ***across the entire pool, keeping the whole pool***

*synchronized***.**

So, if you submit your key/update your key on one server's registry, your key will eventually be updated across all servers' registries. Very cool!

For example, I originally submitted my key to [`pgp.mit.edu`], but it has already propagated to [`keyserver.ubuntu.com`]. Check it out!

```
❯ gpg --keyserver 'pgp.mit.edu' --search-keys 'Anton Paras'
gpg: data source: http://pgp.mit.edu:11371
(1)     Anton Paras <anton@paras.nu>
          4096 bit RSA key 2CBE5B5C3B4FA4E8, created: 2017-11-24
Keys 1-1 of 1 for "Anton Paras".  Enter number(s), N)ext, or Q)uit > N
❯
```

Importing a Public Key from a Keyserver

gpg --keyserver --receive-key**s** <key ID>

```
❯ gpg --keyserver 'keyserver.ubuntu.com' --search-keys 'Anton Paras'
gpg: data source: http://91.189.89.49:11371
(1)     Anton Paras <anton@paras.nu>
          4096 bit RSA key 2CBE5B5C3B4FA4E8, created: 2017-11-24
Keys 1-1 of 1 for "Anton Paras".  Enter number(s), N)ext, or Q)uit > N
❯
```

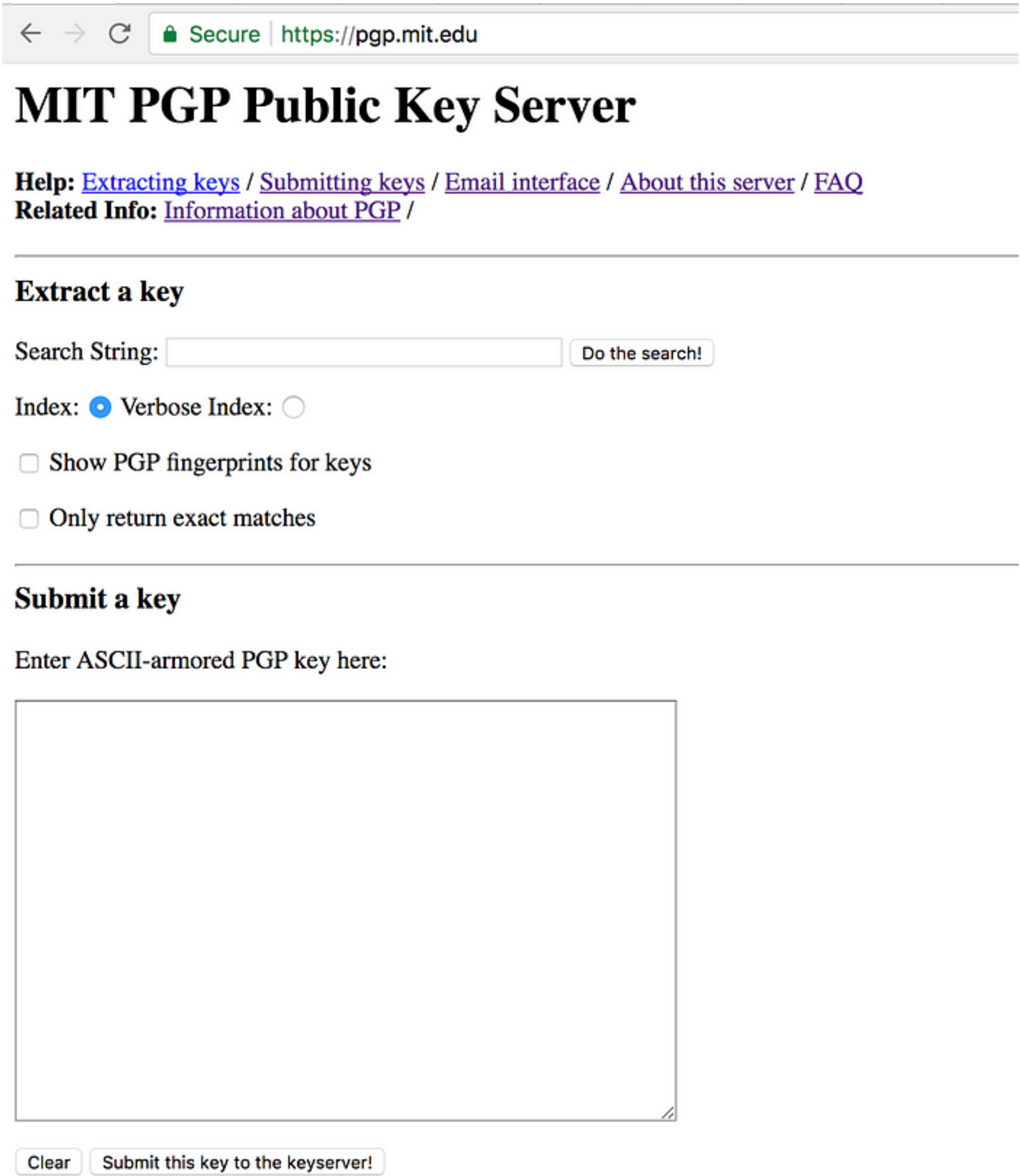
Sending a Public Key to a Keyserver

gpg --keyserver <URI> --send-key**s** <key ID>

< I didn't record a video because I didn't want to send this dummy PGP key to all the servers in the SKS pool. >

For many keyservers, there are also **websites** with GUIs for searching for keys/submitting keys.

Example: https://pgp.mit.edu's website



Minimal UI for searching for keys/submitting keys.

Refreshing Keys

```
gpg --keyserver <URI> --refresh-keys
```

Sometimes, you’d like to **update** all the public keys you have on your **public keyring**.

Over time, some public keys on your ring may get **new signatures**, **modified user IDs**, etc.

That’s why it’s useful to refresh the public keys on your public keyring every once-in-a-while.

Setting a Default Keyserver

Add the following line to your `~/.gnupg/gpg.conf`

keyserver <URL without scheme>

E.g.

Now, you **don’t need to specify a `--keyserver`** for the operations above.

Signing Others’ Public Keys

gpg --sign-key <key ID>

I did not actually upload that signature to the SKS pool. That would be unethical of me.

Signing others’ public keys is an important part of the PGP system. The PGP system is very community-oriented. It relies on a so-called “Web of Trust”.

Consider this: There is nothing stopping someone from publishing public keys **under YOUR name**.

How would people know that that public key is a spoof — that an impostor made it — that it’s not really yours?

By building your true public key’s reputation.

PGP requires community involvement. You should always sign public keys you **KNOW** are real.

E.g. you know the public key that Bob gave to you is legitimate, so you should sign it.

Then, you can send it back to him (`gpg --export`).

Or, you can submit the newly-signed key to a public key registry in the SKS pool (`gpg --send-keys`). Your signature on Bob’s key will propagate throughout the SKS pool.

With this, public keys circulate with **signatures attached to them**.

Then, we can have the following situation:

I trust Alice.

I import a public key under the name of “Bob”.

I see that Alice has signed this public key.

Thus, Alice is claiming that this “Bob” is legit.

I trust Alice, so by extension, I trust “Bob” to **really be** Bob.

I trust Bob.

As more people sign public keys **AFTER VERIFYING THAT THEY’RE LEGIT**, you can start to see the “Web of Trust” grow.

This is how we ensure authenticity of identity in the PGP community.

Listing signatures on a Public Key

gpg --check-signatures <key ID>

If you omit `<key ID>`, it will print **all** signatures on **all** public keys on your public keyring.

Conclusion

Whew, that was a lot to cover! The `gpg` tool is very featureful and quite fun to use, but the documentation can be quite frustrating.

Hopefully this article helped you out in that respect. I know it will help future me!

Opinions expressed in these articles do not represent those of my employer.