Nginx notes

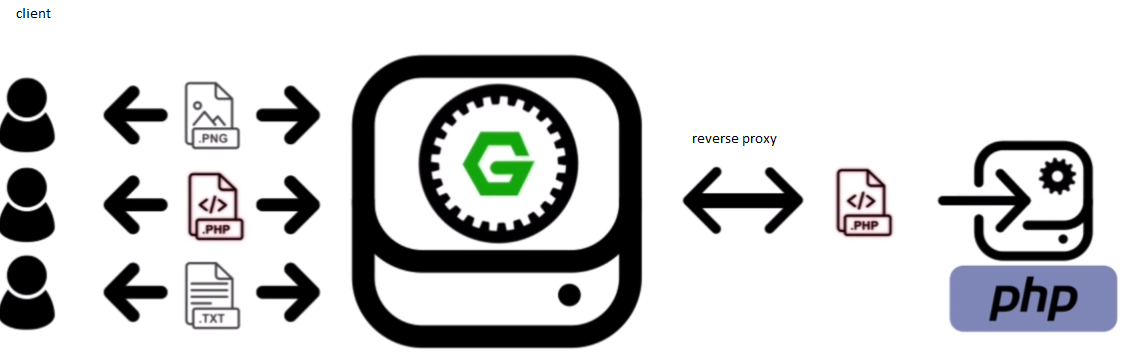
# Configuration

About Nginx(Igor Sysov 10k concurrent conections, high performance, high concurrency, low resource usage). It is web server but in its core it is a reverse proxy server.

Nginx vs apache:

Basic architecture of apache is prefork mode (had spawned a set number of processors, each of which can serve a single request at a time regardless wheathe that request is for php script of image)

Nginx is dealing with requests asynchronously (single process can serve multiple requests concurrently that number depends on system resource available to nginx process) –sidenote unlike apache can’t embed server side programming languages into its own processes meaning that all requests for Dynamic content has to be dealt with completely separate process like php fpm and then reverse proxy to the client via enginx (low resource usage because not hav9ing to deal directly with embedded programming languages). But unlike apache, server side language modules don’t need to be run for every single request that server receives, instead nginx will handle serving static resources without php ever knowing about it(apache will handle every request with that costly overhead)-that is saving on system resources



Nginx is faster than apache (internet collection will allow speed of getting data to the client, but can serve static resources much faster (no need for any server side languages), and handle a much larger number of concurrent requests (can receive 1k of requests on single processing thread. Apache will accept request up to preconfigured number and reject rest) ).

Nginx configuration (requests are interpreted as uri location \*location /images {}\* , this allows nginx to work not only as web server, but also as load balancer to mail server, whereas apache default to filesystem locations \*<Directory “/www/site/images”>\*). .htaccess file can override configuration, there is no such in nginx.

# Install Nginx

* Using package manager

Ssh [anel@163.172.171.154](mailto:anel@163.172.171.154) (to remove ip/remove it from .*ssh/known*\_hosts: *ssh-keygen –R 163.172.171.154* )

With package manager: quick and easy, limited install options, no support for additional modules. Suitable for most basic web servers or testing and development. Almost never best solution

**sudo apt-get install nginx**

With this particular package nginx is also running ( search for process command for all users listing detailed information and include boot processes*=> ps aux | grep nginx* => should have master and worker processes). Ifconfig = > ip in the browser to see does nginx works and listens oh http port 80.

Check for nginx configuration files : **ls –l /etc/nginx**

* Building from the source

<http://nginx.org/>

<https://www.nginx.com/> [nginx+ paid]

<https://www.nginx.com/resources/wiki/>

Main benefit why to build from the source is to have ability to add custom modules or to extend standard nginx functionality (which you cannot do with package manager). Nginx modules exists in 2 form: bundled modules(gzip,spdy,ssl,geoip – come with the source), third party modules.

Navigate to download link: <http://nginx.org/en/download.html>

We will use mainline version.

Copy link: => <http://nginx.org/download/nginx-1.15.5.tar.gz> and use wget. Navigate to workspace folder to get tarball format:

**$wget** [**http://nginx.org/download/nginx-1.15.5.tar.gz**](http://nginx.org/download/nginx-1.15.5.tar.gz)

**$ tar –xzvf nginx-1.15.5.tar.gz**

**$cd nginx-1.15.5**

Configure source code for the build.

To do this run the configure script in the source code directory. Before enable tool to compile nginx (gcc), and some dependencies : libpcre3, libpcre3-dev, zlib1g zlib1g-dev (for g zipping), libssl-dev (for ssl/https support)

**$ apt-get install libpcre3 libpcre3-dev zlib1g zlib1g-dev libssl-dev**

**$ apt-get install build-essential**

**$./configure**

We still haven’t added any custom configuration flags. To do so run **./configure –help** to see all of them. See documentation <http://nginx.org/en/docs/configure.html>

|  |  |
| --- | --- |
| **Flag** | **Description** |
| **--sbin-path** | = /usr/bin/nginx  location of nginx executable which will use to start and stop the nginx service (usr/bin common location for Ubuntu executables) |
| **--conf-path** | = /etc/nginx/nginx.conf  Path of nginx configuration files. |
| **--error-log-path** | = /var/log/nginx/error.log |
| **--http-log-path** | = /var/log/nginx/access.log |
| **--pid-path** | =/var/run/nginx.pid  We will need to know when configuring nginx |
| **--with-pcre** | Tell the nginx to use system specif library for regular expressions |
| **--with-http\_ssl\_module** | Bundled module |

**$ ./configure --sbin-path=/usr/bin/nginx --conf-path=/etc/nginx/nginx.conf --error-log-path=/var/log/nginx/error.log --http-log-path=/var/log/nginx/access.log --pid-path=/var/run/nginx.pid --with-pcre --with-http\_ssl\_module**

We can now go ahead and compile the configuration source by running make:

**$ make**

After this is done install the compiled source with make install:

**$ sudo make install**

See the configuration files: $ ls –l /etc/nginx ; See the binary : **$ls –l /usr/bin |grep nginx**.

Test the version: **$ nginx –V** (see the arguments which should be same as configured). Test **$ps aux|grep nginx** and run from source folder nginx: **$ sudo nginx**

Navigate to the browser to check again.

|  |
| --- |
| *Configuration summary*  *+ using system PCRE library*  *+ OpenSSL library is not used*  *+ using system zlib library*  *nginx path prefix: "/usr/local/nginx"*  *nginx binary file: "/usr/local/nginx/sbin/nginx"*  *nginx modules path: "/usr/local/nginx/modules"*  *nginx configuration prefix: "/usr/local/nginx/conf"*  *nginx configuration file: "/usr/local/nginx/conf/nginx.conf"*  *nginx pid file: "/usr/local/nginx/logs/nginx.pid"*  *nginx error log file: "/usr/local/nginx/logs/error.log"*  *nginx http access log file: "/usr/local/nginx/logs/access.log"*  *nginx http client request body temporary files: "client\_body\_temp"*  *nginx http proxy temporary files: "proxy\_temp"*  *nginx http fastcgi temporary files: "fastcgi\_temp"*  *nginx http uwsgi temporary files: "uwsgi\_temp"*  *nginx http scgi temporary files: "scgi\_temp"* |

## Configuring the system service for nginx (as systemd):

Adding nginx as systemd (newer standard for services, >Ubuntu 15.0.4) service (will enable us to start/stop/restart, reload(configuration) and start on boot.

To see options for nginx navigate to source folder and run : **$nginx –h**

To stop the service use signal flag (-s) and stop (terminated) : **$nginx –s stop**

* **Let’s add systemd service:**

To enable the service we are going to have to add a small script which being the same across all operating systems (init.d are old)

Nginx initscripts : <https://www.nginx.com/resources/wiki/start/topics/examples/initscripts/>

$ touch /lib/systemd/system/nginx.service

This file already exist in /lib/system/system folder but it is different (from Feb 11, 2017)

|  |
| --- |
| **[Unit]**  Description=The NGINX HTTP and reverse proxy server  After=syslog.target network.target remote-fs.target nss-lookup.target  **[Service]**  Type=forking  PIDFile=/var/run/nginx.pid  ExecStartPre=/usr/bin/nginx -t  ExecStart=/usr/bin/nginx  ExecReload=/usr/bin/nginx -s reload  ExecStop=/bin/kill -s QUIT $MAINPID  PrivateTmp=true  **[Install]**  WantedBy=multi-user.target |

Start with ngingx (needed to do daemon reload) :

*Warning: nginx.service changed on disk. Run 'systemctl daemon-reload' to reload units.*

**$ sudo systemctl daemon-reload**

**$sudo systemctl start nginx**

With systemd service enabled, we can also check nginx status using systemd instead of process command. **$sudo systemctl status nginx**

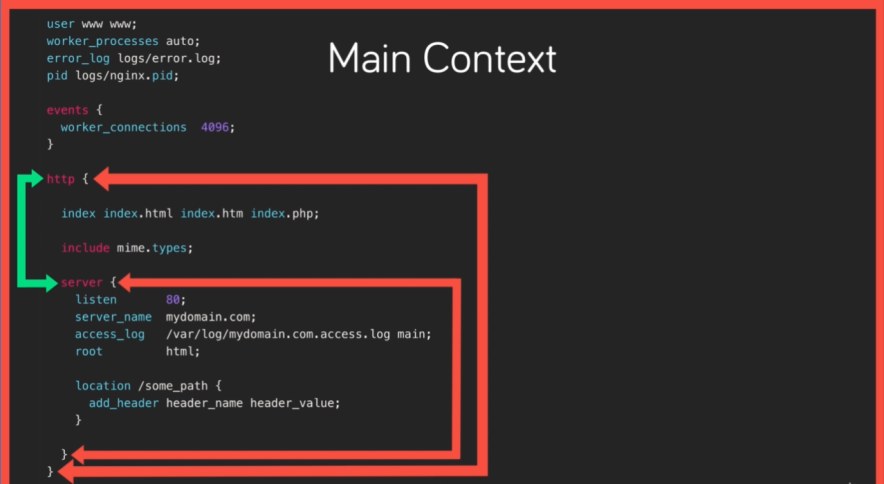
Enable startup on boot : **$sudo systemctl enable nginx**

|  |
| --- |
| *Synchronizing state of nginx.service with SysV init with /lib/systemd/systemd-sysv-install...*  *Executing /lib/systemd/systemd-sysv-install enable nginx* |

## Configuration terms:

*Context –* section within the configuration, where directives can be set for that given context. It is like scope (::) and like scope they can be nested and inherit from parents.Topmost context is configuration file itself - Main context (global directives that apply to master process). Http context , server context(apache V host), location context(matching uri locations on incoming requests to the parent server context)

*Directive* – specific configuration option that get set in configuration file (consists of name and value : *server\_name mydomain.com*)



## Creating a Virtual Host or server context:

To serve static files from directory on our server.

$ *mkdir my\_sites && cd my\_sites && mkdir demo && cd demo*

Server context is responsible for listening on some port (80 http, 443 https) for given ip address or domain.

Start with */etc/nginx/nginx.conf* file : add server context and *directive listen 80; server\_name IPadess; root /home/anel/..* and for variety of types in http context *include mimo.types*;

Using *nginx –t* you can verify does you configuration is successful.

|  |
| --- |
| *nginx: the configuration file /etc/nginx/nginx.conf syntax is ok*  *nginx: configuration file /etc/nginx/nginx.conf test is successful* |

Using *systemctl reload nginx* you can load a new configuration (with *systemctol restart nginx = >* it will stop and if it is not good old configuration will not be reloaded). Mime.types are used for providing the server content type for various of extensions.

To test the MIME type check the stylesheet header using curl (content-type: text/plain is not good) ; **curl –I http://163.172.171.154/style.css**

## Location context:

Added in server context.

According to the priority we have:

* Exact match :*location = /anel {return 200 “Status message!”;}* # when returning return status code and message
* Preferential prefix match : *location ^~ /Anel7 {return 200 “Status message!”;}*
* Regex match (case sensitive, for case insensitive put *~\**) : *location ~ /anel[0-9] {return 200 “Status message!”;}*
* Prefix match (can be treated as /anelh, /anelax/mariadb etc) *location /anel {return 200 “Status message!”;}*

## Variables:

Aside of concept of scope, includes there are variables and conditionals in nginx.

There are 2 types of variables:

* Configuration variables (user defined, we set ourselves used with **set** keyword (set $anel ‘Anel’))
* Nginx builtin global/modules variables (Alpabetical index of variables with modules that makes it available <http://nginx.org/en/docs/varindex.html> ).Modules like ngx\_http\_core\_module, ngx\_http\_log\_module are already part of nginx (not needed to add them manually).

***$host, $uri,***

***$args*** (test it with <http://163.172.171.154/demo?name=anel> ) will return *name=anel.*

To obtain only anel from query try with***$arg\_name****!(based on the query string nginx compiles named variable for each parameter prefixed with arg),*

***$date\_local*** *(*holds ISO date time string for the local time *:* Sunday, 07-Oct-2018 13:52:59 UTC*)*

*Basic conditionals*

Use of nginx conditionals inside nginx location context is highly discouraged (<https://www.nginx.com/resources/wiki/start/topics/depth/ifisevil/> ) (use only **return** and **rewrite** inside location context, everything else could give **SIGSEGV**).

When using “**if ($arg\_name != “anel”)**” make space between if and ( , as well as between arguments and operator hence it will be an error.

## Rewrites and redirects:

**rewrite pattern uri**

**return status\_code message**

In case where status\_code being 307 variant (which is for redirects) return behavior changes it accept URI as a second parameter.

But when using : return 307 /thumb.png url will be redirected, but the url wil be changed from route from location context to redirected link (/thumb.png), what is a main difference between rewrite and redirects ! Redirect tells the client preforming the request where to go instead, while rewrite mutates request internaly.

Rewrite: In server context before matching the request to any location context, we should write : **rewrite ^/user/\w+ /greet** (meaning first argument: regex **^** ==starting with, **\w+** more than 1 word character) (meaning second argument: new url to rewrite). The browser will be pointing to the same location of first argument!

Note: When uri is rewritten it is also re-evaluated by nginx, as a completely new request !!! Meaning that new /greet will start from the top of nginx.conf and will get re-evaluated again ! Reevaluation makes rewrites more powerful but requires more system resources then return.

Feature of rewrite is ability to capture certain parts of the original url using standard regex capture groups (wrap that part in braces, and the capture group can be accessed with $). For capturing user name:

**rewrite ^/user/(\w+) /greet/$1**

So now /user/anel will be rewritten to /greet/anel. After /greet/anel will be reevaluated , skipping past rewrite and exact match will take priority instead (if exist) prefix match.

Passing the **last** flag:

Add new rewrite bellow the previous ; **rewrite ^/greet/anel /thumb.png.** First rewrite will match to the same route, it will be rewritten to /greet/anel and will be re-evaluted and will match the second rewrite and again will be rewritten as /thumb.png and served as such.

With last flag will tell url not to be rewritten any more. So in this case with modification of the first rewrite as: **rewrite ^/user/(\w+) /greet/$1** l**ast**

/user/anel will be rewritten to /greet/anel and after re-evaluation it will skip the second rewrite.

**rewrite ^/user/(\w+) /greet/$1**

**Try files & named locations**:

Can be used in server context :

**try\_files path1 path2 final;** applying to all incoming request, or in location context .Have nginx check for resource to respond worth in any number of locations relative to the root directory with a final argument that result in a rewrite and re-evaluation as with rewrite directive.

**try\_files /thumb.png /greet; (**thumb relative to the root directory does exist and will be served (even if url doesn’t exist it will be served !) if doesn’t exist it will be skipped and tested with /greet).

Note: when try files reach last argument, that file is treated as internal rewrite, meaning that rewritten request will also be re-evaluated and caught by location !

Named locations: assign name to location context, and use directive such as try\_files use that location by its name, ensuring no re-evalution has to happen to the final argument, but instead definite call to that location. Use at sign @

## Logging:

* Error logs (for anything that failed and didn’t happen as expected)
* access logs( to log all request to the server)

<http://nginx.org/en/docs/ngx_core_module.html#error_log>

<http://nginx.org/en/docs/http/ngx_http_log_module.html>

<https://docs.nginx.com/nginx/admin-guide/monitoring/logging/>

Enabled by default !

During the installation we have set the path to the error and access logs (/var/log/nginx/error(access).log). Permission to view log files is granted to users being in **adm** group (created by nobody, owned by adm):

*$sudo usermod –aG adm anel*

Clear those files: $ sudo *echo ‘’>access.log && echo ‘’>error.log (Permission denied)*

*404 response can be viewed from access log and is valid response,but sometimes if url-ed to something that doesn’t exist will be shown in error.log. To simulate failing of nginx add second parameter to the root directive in .conf file reload nginx and see the log.*

*While having global access log, we can define location specific access logs, which are created by the running nginx : define in location context* ***access\_log /path/to/{custom\_name}.access.log*** *With such directive logs are redirected to this path instead to global access log. By adding another access log with the global path we will have both access logs!*

*Disabling for certain directives:* ***access\_log off*** *Doing so we are reducing server load and keeping log files smaller, userful for site receiving high traffic.*

*Check the last line of error log : $ tail –n 1 /var/log/nginx/error.log*

For more advanced logging configuration we can specify *format,* enable *gziping* of the log file*,* or set the log *level* for error logs.

## Ineritance and directive types:

Nginx context (for example loation context or scope) inherits configuration from its parent context.

Directive types:

* Standard directive – most common, and can be declared once in a given context. Root directive.Inheritance same as array = parent to child with child being able to override with its own declaration.
* Array directive – can be declared multiple time without overriding the previous. We can have access\_log directive declared in *main* context which will be inherited in *http*, *server* context,but if in server context we disabled **access\_log** it will be inherited for childs (locations) of server context except they changed their **access\_log** directive.
* Action directive – invoke some or break action in configuration (redirect via **return** directive or rewrite via **rewrite** or try\_**files** directive)

## Php processing:

Up to now we have dealt with configuring nginx to serve static files of various types leaving the rendering of that file be handled by client based on its content type or mime type.

Ability to serve dynamic content that is generated from server side language such as php, nginx isn’t able to embed its server side language processors. Instead we will configure standalone php service “php-fpm” to which nginx will pass the request for processing and then upon receiving the response from php-fpm typically as html return that to client. This is essentially nginx functioning as reverse proxy server. Nginx will communicate with php-fpm through FastCGI protocol (protocol like http for transferring binary data: <https://www.digitalocean.com/community/tutorials/understanding-and-implementing-fastcgi-proxying-in-nginx>).

Install php-fpm service using package manager: apt-get update && apt-get install php-fpm

It will install 8 new packages to apt (php-common php-fpm php7.0-cli php7.0-common php7.0-fpm php7.0-json php7.0-opcache php7.0-readline) (should be 7.1 ??).

Already configured as systemd service. To be sure list all systemd services:

***$ sudo systemctl list-units | grep php***

*php7.0-fpm.service loaded active running The PHP 7.0 FastCGI Process Manager*

Check the status of new service, which is already running (single master process and 2 workers):

**$ sudo systemctl status php7.0-fpm.service**

|  |
| --- |
| php7.0-fpm.service - The PHP 7.0 FastCGI Process Manager  Loaded: loaded (/lib/systemd/system/php7.0-fpm.service; enabled; vendor prese  Active: active (running) since Mon 2018-10-08 23:13:38 UTC; 4min 58s ago  Main PID: 25348 (php-fpm7.0)  Status: "Processes active: 0, idle: 2, Requests: 0, slow: 0, Traffic: 0req/se  CGroup: /system.slice/php7.0-fpm.service  ├─25348 php-fpm: master process (/etc/php/7.0/fpm/php-fpm.conf)  ├─25351 php-fpm: pool www  └─25352 php-fpm: pool www  Oct 08 23:13:38 scw-95fca6 systemd[1]: Starting The PHP 7.0 FastCGI Process Mana  Oct 08 23:13:38 scw-95fca6 systemd[1]: Started The PHP 7.0 FastCGI Process Manag |

Now we need to pass incoming requests to the service ! Lets do it in nginx.conf file.

First add in *server* context *index* directive (which file to load if request point to the directory, current value is *index.html; typically we want index.php and if not exist then index.html (like try\_files)=> index index.php index.html*).

**Location /** (try\_files $uri $uri/ =404) (prefix match for anything, request uri, requested uri for matching the directory with php or html, and finaly default nginx 404)=>any request with static content.

**Location ~\.php (**anything ending with php in order to pass it to php-fpm which will do by means of fastCGI protocol, have priority because of regex**).** Beforepassing request to php-fpm from location context, we have to include some paraemters: **include fastcgi.conf** (located in /etc/nginx/), need to pass unix socket created by php-fpm (socket->http port, a file on wich a service can listen for binary data; find that socket with: **find / -name \*fpm.sock** => (*/run/php/php7.0-fpm.sock*)) with **fastcgi\_pass** **unix:****/run/php/php7.0-fpm.sock**

**Create a php file: $ echo ‘?php phpinfo(); ?’ > ‘/home/anel/eacon/django/nginx\_workspace/nginx-1.15.5/mysites/demo/info.php’**

When trying to connect 502 (bad gateway). To check => With **ps aux | grep nginx** => default worker process is nobody

|  |
| --- |
| root 25758 0.0 0.0 6568 1844 ? Ss 23:43 0:00 nginx: master process /usr/bin/nginx  nobody 25759 0.0 0.0 6740 2476 ? S 23:43 0:00 nginx: worker process |

With **ps aux | grep php** => default worker process is www-data.

|  |
| --- |
| root 25348 0.0 0.2 118988 23772 ? Ss 23:13 0:00 php-fpm: master process (/etc/php/7.0/fpm/php-fpm.conf)  www-data 25351 0.0 0.0 118988 5968 ? S 23:13 0:00 php-fpm: pool www  www-data 25352 0.0 0.0 118988 5968 ? S 23:13 0:00 php-fpm: pool www |

**Conclusion:** nobody user doesn’t have permission to php-fpm socket (change permission of the socket, but secure is to configure nginx to run as the same user (www-data)!) In nginx.conf in main context add: **user www-data**

Processing index.html : $ echo ‘<h1> Date: <?php echo date(“l jS F”); ?> </h1>’ > **‘/home/anel/eacon/django/nginx\_workspace/nginx-1.15.5/mysites/demo/index.php**

## Worker processes:

* Master process – actual nginx service (/usr/bin/nginx)
* Worker process – master process spawns workers processeses which listen for and responds to client requests. Default number for worker processes is 1 (use **worker\_processes** directive in the main context). They are asyncrhonouse meaning they will handle requests as fast as hardware is capable of and creating the second worker process doesn’t increase hardware ability.Multicore processor cannot share processes ,meaning single nginx processes (worker) can be run on a single cpu core (*nproc, or lscpu*)=> number of cores=number of workers. Instead of setting it to 8 we can set worker\_processes to auto and have 1 worker per each cpu core!
* Inside *events* context we can set directive **worker\_connections** to number of connects each worker process can accept (how many files can be opened at once for each cpu core- to check *open file limit* run **ulimit -n**(1024)) =>worker\_processes x worker\_connections = max connections of concurrent requests our server should be able to accept.
* Pid directive - added during configuration file in /var/run/nginx.pid (reconfigure process id location via configuration file) **pid /var/run/new\_nginx.pid** in main context of nginx.conf file.

## Buffers and timeouts:

These parameters are dependent on the request to the server. Leave these values default.

Buffering in brief is when a process or nginx worker reads data into memory(ram) before writing it to its next destination. For example,nginx receives request which it reads from tcp port 80 , writes these request data to memory which is buffering , or if buffer is too small for the amount of data being read, write some of it to disk(buffer overflow).

In opposite, nginx response to a request with for example static file, which it reads from disk into memory (buffering the file) and send data to the client from memory.

Buffer – layer of protection between reading and writing of data.

Timeout – cut off time for a given event. If receiving a request from client stop after certain number of seconds, thus preventing the client of sending the endless stream of data and breaking the server.

For http context: **client\_body\_buffer\_size 10K;** # buffer size for POST submissions (most likely from form submission) k or K in bytes (<http://nginx.org/en/docs/syntax.html> ), **client\_max\_body\_size 8M;** meaning don’t accept post requests more than 8Mbytes (larger server will respond with 413 error => request entity too large). **Client\_header\_buffer\_size 1K;** (for reading request header it is enough).

Client timeouts :**client\_body\_timeout** and **client\_header\_timeout (**default **60s** body doesn’t refer to time to transmit the entire request body, but rather the time between consecutive read operations (that happen to the buffer))(number only (10) is 10 ms). **Keepalive\_timout** sets the amount of time nginx shoud keep a connection to a client open for in case more data is on the way (useful when client is requesting a number of files and keeping a connection open reduces the time it takes to open another new connection, this can influence on pool of max\_connections being used up –can be 15 or 1-2s).**send\_timeout** directive , if the client doesn’t receive any of response date in this amount of time, doesn’t have to be all of response data, but non of it at all,. **Sendfile on (**skip buffering for static files (when sending data to client from disk, don’t use a buffer…read that data from the disk and write it directly to the response), **)** and **tcp\_nopush on** (enable nginx to optimize the size of those data packets being sent to the client). The last two will help to optimize site with large number of stsatic resoureces.

## Adding Dynamic Modules:

Making more functionality available == adding new nginx modules

## Additional problems that occurred:

In order to start nginx use systemctl : **sudo systemctl start nginx && ps aux|grep nginx**

If there is an error in your nginx.conf file then: **sudo systemctl reload nginx will fail**

|  |
| --- |
| *root 10658 0.0 0.0 45408 2016 ? Ss 15:21 0:00 nginx: master process /usr/sbin/nginx -g daemon on; master\_process on;*  *www-data 10659 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10660 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10661 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10662 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10663 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10664 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10665 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process*  *www-data 10666 0.0 0.0 45776 3004 ? S 15:21 0:00 nginx: worker process* |

User that is worker is *www-data* , because that is specified in */etc/nginx/nginx.conf* file (user *www-data*)

For temporary enabling/disabling services : **sudo service apache2 stop**

With systemd we can do the following: **systemclt start apache2**

**401 – unauthorized status code**

Still the same version:

sudo nginx -v

nginx version: nginx/1.10.3 (Ubuntu)

Not 1.15.5 as expected !

/usr/bin/nginx -V

nginx version: nginx/1.15.5

$ whereis nginx

/usr/bin/nginx.old

/usr/bin/nginx

/usr/sbin/nginx (this is problematic)

/usr/local/nginx/

/usr/share/nginx/

/etc/nginx/

$ type nginx

nginx is hashed (/usr/sbin/nginx)

$ which nginx

/usr/sbin/nginx

PATH is used to find executables, shell needs to search the path. Shell keep list of programs that has already found – hash

$ hash –l # to list the hashes

$ hash –r # to reset the hashes

$ hash –l # list again

To list the year of files use $ ls --full-time

Echo $PATH

How to add to $PATH = > export $PATH ????