PostgreSQL Setup Guide

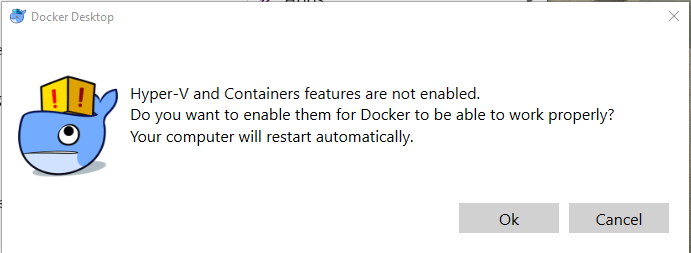
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This document describes the standard Swirlds configuration for the PostgreSQL local development environment.

## PostgreSQL Setup for Local Development

1. Download and Install Docker CE: [Windows](https://hub.docker.com/editions/community/docker-ce-desktop-windows) or [MacOS X](https://hub.docker.com/editions/community/docker-ce-desktop-mac)
   1. If prompted, choose to use Linux Containers during installation
   2. On Windows, you may be forced to log off after the install completes.
   3. On Windows, if Hyper-V and Containers features are disabled you will see the prompt below. Save your work, press Ok, and wait for your computer to restart.



1. Create a local folder to use with PostgreSQL: [MacOS/Linux Only]

# MacOS / Linux

mkdir -p ~/Docker/Volumes/PostgreSQL/swirlds-fcfs

1. Execute the following docker commands from the CLI:

# MacOS / Linux

docker run --name postgres -d -p 5432:5432 \

-v ~/Docker/Volumes/PostgreSQL/swirlds-fcfs:/var/lib/postgresql/data \

--env POSTGRES\_PASSWORD=password --env POSTGRES\_USER=swirlds \

--env POSTGRES\_DB=fcfs \

--env PGDATA=/var/lib/postgresql/data/pgdata \

postgres:10.6-alpine

# Windows

cd “%USERPROFILE%”

docker run --name postgres -d -p 5432:5432 ^

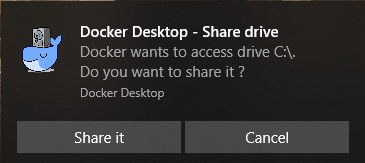
--env POSTGRES\_PASSWORD=password --env POSTGRES\_USER=swirlds ^

--env POSTGRES\_DB=fcfs ^

--env PGDATA=/var/lib/postgresql/data/pgdata ^

postgres:10.6-alpine

* 1. On Windows, you may be asked to authorize the drive sharing as shown below. Press the “Share It” button to allow access.



1. Copy the PostgreSQL Configuration file ([postgresql.conf](#_PostgreSQL_Configuration_File)) below into the appropriate folder (also available in the folder beside this document): [MacOS/Linux Only]

# MacOS / Linux

~/Docker/Volumes/PostgreSQL/swirlds-fcfs/pgdata

1. Control your PostgresSQL container with the following commands:

# Start Postgres

docker start postgres

# Stop Postgres

docker stop postgres

# List Running Containers

docker ps

# List all Containers

docker ps -a

## PostgreSQL Configuration File

# -----------------------------

# PostgreSQL configuration file

# -----------------------------

#

# This file consists of lines of the form:

#

# name = value

#

# (The "=" is optional.) Whitespace may be used. Comments are introduced with

# "#" anywhere on a line. The complete list of parameter names and allowed

# values can be found in the PostgreSQL documentation.

#

# The commented-out settings shown in this file represent the default values.

# Re-commenting a setting is NOT sufficient to revert it to the default value;

# you need to reload the server.

#

# This file is read on server startup and when the server receives a SIGHUP

# signal. If you edit the file on a running system, you have to SIGHUP the

# server for the changes to take effect, run "pg\_ctl reload", or execute

# "SELECT pg\_reload\_conf()". Some parameters, which are marked below,

# require a server shutdown and restart to take effect.

#

# Any parameter can also be given as a command-line option to the server, e.g.,

# "postgres -c log\_connections=on". Some parameters can be changed at run time

# with the "SET" SQL command.

#

# Memory units: kB = kilobytes Time units: ms = milliseconds

# MB = megabytes s = seconds

# GB = gigabytes min = minutes

# TB = terabytes h = hours

# d = days

#------------------------------------------------------------------------------

# FILE LOCATIONS

#------------------------------------------------------------------------------

# The default values of these variables are driven from the -D command-line

# option or PGDATA environment variable, represented here as ConfigDir.

#data\_directory = 'ConfigDir' # use data in another directory

# (change requires restart)

#hba\_file = 'ConfigDir/pg\_hba.conf' # host-based authentication file

# (change requires restart)

#ident\_file = 'ConfigDir/pg\_ident.conf' # ident configuration file

# (change requires restart)

# If external\_pid\_file is not explicitly set, no extra PID file is written.

#external\_pid\_file = '' # write an extra PID file

# (change requires restart)

#------------------------------------------------------------------------------

# CONNECTIONS AND AUTHENTICATION

#------------------------------------------------------------------------------

# - Connection Settings -

listen\_addresses = '\*'

# comma-separated list of addresses;

# defaults to 'localhost'; use '\*' for all

# (change requires restart)

#port = 5432 # (change requires restart)

max\_connections = 100 # (change requires restart)

#superuser\_reserved\_connections = 3 # (change requires restart)

#unix\_socket\_directories = '/var/run/postgresql' # comma-separated list of directories

# (change requires restart)

#unix\_socket\_group = '' # (change requires restart)

#unix\_socket\_permissions = 0777 # begin with 0 to use octal notation

# (change requires restart)

#bonjour = off # advertise server via Bonjour

# (change requires restart)

#bonjour\_name = '' # defaults to the computer name

# (change requires restart)

# - Security and Authentication -

#authentication\_timeout = 1min # 1s-600s

#ssl = off

#ssl\_ciphers = 'HIGH:MEDIUM:+3DES:!aNULL' # allowed SSL ciphers

#ssl\_prefer\_server\_ciphers = on

#ssl\_ecdh\_curve = 'prime256v1'

#ssl\_dh\_params\_file = ''

#ssl\_cert\_file = 'server.crt'

#ssl\_key\_file = 'server.key'

#ssl\_ca\_file = ''

#ssl\_crl\_file = ''

#password\_encryption = md5 # md5 or scram-sha-256

#db\_user\_namespace = off

#row\_security = on

# GSSAPI using Kerberos

#krb\_server\_keyfile = ''

#krb\_caseins\_users = off

# - TCP Keepalives -

# see "man 7 tcp" for details

#tcp\_keepalives\_idle = 0 # TCP\_KEEPIDLE, in seconds;

# 0 selects the system default

#tcp\_keepalives\_interval = 0 # TCP\_KEEPINTVL, in seconds;

# 0 selects the system default

#tcp\_keepalives\_count = 0 # TCP\_KEEPCNT;

# 0 selects the system default

#------------------------------------------------------------------------------

# RESOURCE USAGE (except WAL)

#------------------------------------------------------------------------------

# - Memory -

shared\_buffers = 1GB # min 128kB

# (change requires restart)

huge\_pages = try # on, off, or try

# (change requires restart)

temp\_buffers = 8MB # min 800kB

max\_prepared\_transactions = 50 # zero disables the feature

# (change requires restart)

# Caution: it is not advisable to set max\_prepared\_transactions nonzero unless

# you actively intend to use prepared transactions.

work\_mem = 512MB # min 64kB

maintenance\_work\_mem = 64MB # min 1MB

#replacement\_sort\_tuples = 150000 # limits use of replacement selection sort

#autovacuum\_work\_mem = -1 # min 1MB, or -1 to use maintenance\_work\_mem

#max\_stack\_depth = 2MB # min 100kB

dynamic\_shared\_memory\_type = posix # the default is the first option

# supported by the operating system:

# posix

# sysv

# windows

# mmap

# use none to disable dynamic shared memory

# (change requires restart)

# - Disk -

#temp\_file\_limit = -1 # limits per-process temp file space

# in kB, or -1 for no limit

# - Kernel Resource Usage -

#max\_files\_per\_process = 1000 # min 25

# (change requires restart)

#shared\_preload\_libraries = '' # (change requires restart)

# - Cost-Based Vacuum Delay -

#vacuum\_cost\_delay = 0 # 0-100 milliseconds

#vacuum\_cost\_page\_hit = 1 # 0-10000 credits

#vacuum\_cost\_page\_miss = 10 # 0-10000 credits

#vacuum\_cost\_page\_dirty = 20 # 0-10000 credits

#vacuum\_cost\_limit = 200 # 1-10000 credits

# - Background Writer -

bgwriter\_delay = 200ms # 10-10000ms between rounds

#bgwriter\_lru\_maxpages = 100 # 0-1000 max buffers written/round

#bgwriter\_lru\_multiplier = 2.0 # 0-10.0 multiplier on buffers scanned/round

#bgwriter\_flush\_after = 512kB # measured in pages, 0 disables

# - Asynchronous Behavior -

effective\_io\_concurrency = 5 # 1-1000; 0 disables prefetching

max\_worker\_processes = 8 # (change requires restart)

max\_parallel\_workers\_per\_gather = 2 # taken from max\_parallel\_workers

max\_parallel\_workers = 8 # maximum number of max\_worker\_processes that

# can be used in parallel queries

#old\_snapshot\_threshold = -1 # 1min-60d; -1 disables; 0 is immediate

# (change requires restart)

#backend\_flush\_after = 0 # measured in pages, 0 disables

#------------------------------------------------------------------------------

# WRITE AHEAD LOG

#------------------------------------------------------------------------------

# - Settings -

#wal\_level = replica # minimal, replica, or logical

# (change requires restart)

fsync = on # flush data to disk for crash safety

# (turning this off can cause

# unrecoverable data corruption)

#synchronous\_commit = on # synchronization level;

# off, local, remote\_write, remote\_apply, or on

wal\_sync\_method = fsync # the default is the first option

# supported by the operating system:

# open\_datasync

# fdatasync (default on Linux)

# fsync

# fsync\_writethrough

# open\_sync

#full\_page\_writes = on # recover from partial page writes

#wal\_compression = off # enable compression of full-page writes

#wal\_log\_hints = off # also do full page writes of non-critical updates

# (change requires restart)

#wal\_buffers = -1 # min 32kB, -1 sets based on shared\_buffers

# (change requires restart)

#wal\_writer\_delay = 200ms # 1-10000 milliseconds

#wal\_writer\_flush\_after = 1MB # measured in pages, 0 disables

#commit\_delay = 0 # range 0-100000, in microseconds

#commit\_siblings = 5 # range 1-1000

# - Checkpoints -

#checkpoint\_timeout = 5min # range 30s-1d

#max\_wal\_size = 1GB

#min\_wal\_size = 80MB

#checkpoint\_completion\_target = 0.5 # checkpoint target duration, 0.0 - 1.0

#checkpoint\_flush\_after = 256kB # measured in pages, 0 disables

#checkpoint\_warning = 30s # 0 disables

# - Archiving -

#archive\_mode = off # enables archiving; off, on, or always

# (change requires restart)

#archive\_command = '' # command to use to archive a logfile segment

# placeholders: %p = path of file to archive

# %f = file name only

# e.g. 'test ! -f /mnt/server/archivedir/%f && cp %p /mnt/server/archivedir/%f'

#archive\_timeout = 0 # force a logfile segment switch after this

# number of seconds; 0 disables

#------------------------------------------------------------------------------

# REPLICATION

#------------------------------------------------------------------------------

# - Sending Server(s) -

# Set these on the master and on any standby that will send replication data.

#max\_wal\_senders = 10 # max number of walsender processes

# (change requires restart)

#wal\_keep\_segments = 0 # in logfile segments, 16MB each; 0 disables

#wal\_sender\_timeout = 60s # in milliseconds; 0 disables

#max\_replication\_slots = 10 # max number of replication slots

# (change requires restart)

#track\_commit\_timestamp = off # collect timestamp of transaction commit

# (change requires restart)

# - Master Server -

# These settings are ignored on a standby server.

#synchronous\_standby\_names = '' # standby servers that provide sync rep

# method to choose sync standbys, number of sync standbys,

# and comma-separated list of application\_name

# from standby(s); '\*' = all

#vacuum\_defer\_cleanup\_age = 0 # number of xacts by which cleanup is delayed

# - Standby Servers -

# These settings are ignored on a master server.

#hot\_standby = on # "off" disallows queries during recovery

# (change requires restart)

#max\_standby\_archive\_delay = 30s # max delay before canceling queries

# when reading WAL from archive;

# -1 allows indefinite delay

#max\_standby\_streaming\_delay = 30s # max delay before canceling queries

# when reading streaming WAL;

# -1 allows indefinite delay

#wal\_receiver\_status\_interval = 10s # send replies at least this often

# 0 disables

#hot\_standby\_feedback = off # send info from standby to prevent

# query conflicts

#wal\_receiver\_timeout = 60s # time that receiver waits for

# communication from master

# in milliseconds; 0 disables

#wal\_retrieve\_retry\_interval = 5s # time to wait before retrying to

# retrieve WAL after a failed attempt

# - Subscribers -

# These settings are ignored on a publisher.

#max\_logical\_replication\_workers = 4 # taken from max\_worker\_processes

# (change requires restart)

#max\_sync\_workers\_per\_subscription = 2 # taken from max\_logical\_replication\_workers

#------------------------------------------------------------------------------

# QUERY TUNING

#------------------------------------------------------------------------------

# - Planner Method Configuration -

enable\_bitmapscan = on

enable\_hashagg = on

enable\_hashjoin = on

enable\_indexscan = on

enable\_indexonlyscan = on

enable\_material = on

enable\_mergejoin = on

enable\_nestloop = on

enable\_seqscan = on

enable\_sort = on

enable\_tidscan = on

# - Planner Cost Constants -

#seq\_page\_cost = 1.0 # measured on an arbitrary scale

random\_page\_cost = 1.0 # same scale as above

#cpu\_tuple\_cost = 0.01 # same scale as above

#cpu\_index\_tuple\_cost = 0.005 # same scale as above

#cpu\_operator\_cost = 0.0025 # same scale as above

#parallel\_tuple\_cost = 0.1 # same scale as above

#parallel\_setup\_cost = 1000.0 # same scale as above

#min\_parallel\_table\_scan\_size = 8MB

#min\_parallel\_index\_scan\_size = 512kB

#effective\_cache\_size = 4GB

# - Genetic Query Optimizer -

#geqo = on

#geqo\_threshold = 12

#geqo\_effort = 5 # range 1-10

#geqo\_pool\_size = 0 # selects default based on effort

#geqo\_generations = 0 # selects default based on effort

#geqo\_selection\_bias = 2.0 # range 1.5-2.0

#geqo\_seed = 0.0 # range 0.0-1.0

# - Other Planner Options -

#default\_statistics\_target = 100 # range 1-10000

#constraint\_exclusion = partition # on, off, or partition

#cursor\_tuple\_fraction = 0.1 # range 0.0-1.0

#from\_collapse\_limit = 8

#join\_collapse\_limit = 8 # 1 disables collapsing of explicit

# JOIN clauses

#force\_parallel\_mode = off

#------------------------------------------------------------------------------

# ERROR REPORTING AND LOGGING

#------------------------------------------------------------------------------

# - Where to Log -

#log\_destination = 'stderr' # Valid values are combinations of

# stderr, csvlog, syslog, and eventlog,

# depending on platform. csvlog

# requires logging\_collector to be on.

# This is used when logging to stderr:

logging\_collector = on # Enable capturing of stderr and csvlog

# into log files. Required to be on for

# csvlogs.

# (change requires restart)

# These are only used if logging\_collector is on:

log\_directory = 'log' # directory where log files are written,

# can be absolute or relative to PGDATA

log\_filename = 'postgresql-%Y-%m-%d\_%H%M%S.log' # log file name pattern,

# can include strftime() escapes

#log\_file\_mode = 0600 # creation mode for log files,

# begin with 0 to use octal notation

#log\_truncate\_on\_rotation = off # If on, an existing log file with the

# same name as the new log file will be

# truncated rather than appended to.

# But such truncation only occurs on

# time-driven rotation, not on restarts

# or size-driven rotation. Default is

# off, meaning append to existing files

# in all cases.

#log\_rotation\_age = 1d # Automatic rotation of logfiles will

# happen after that time. 0 disables.

log\_rotation\_size = 250MB # Automatic rotation of logfiles will

# happen after that much log output.

# 0 disables.

# These are relevant when logging to syslog:

#syslog\_facility = 'LOCAL0'

#syslog\_ident = 'postgres'

#syslog\_sequence\_numbers = on

#syslog\_split\_messages = on

# This is only relevant when logging to eventlog (win32):

# (change requires restart)

#event\_source = 'PostgreSQL'

# - When to Log -

#client\_min\_messages = notice # values in order of decreasing detail:

# debug5

# debug4

# debug3

# debug2

# debug1

# log

# notice

# warning

# error

log\_min\_messages = warning # values in order of decreasing detail:

# debug5

# debug4

# debug3

# debug2

# debug1

# info

# notice

# warning

# error

# log

# fatal

# panic

log\_min\_error\_statement = error # values in order of decreasing detail:

# debug5

# debug4

# debug3

# debug2

# debug1

# info

# notice

# warning

# error

# log

# fatal

# panic (effectively off)

log\_min\_duration\_statement = 0 # -1 is disabled, 0 logs all statements

# and their durations, > 0 logs only

# statements running at least this number

# of milliseconds

# - What to Log -

#debug\_print\_parse = off

#debug\_print\_rewritten = off

#debug\_print\_plan = off

#debug\_pretty\_print = on

log\_checkpoints = on

log\_connections = on

log\_disconnections = on

log\_duration = on

log\_error\_verbosity = default # terse, default, or verbose messages

#log\_hostname = off

log\_line\_prefix = '%m [%p]: user=%u,db=%d,app=%a,client=%h ' # special values:

# %a = application name

# %u = user name

# %d = database name

# %r = remote host and port

# %h = remote host

# %p = process ID

# %t = timestamp without milliseconds

# %m = timestamp with milliseconds

# %n = timestamp with milliseconds (as a Unix epoch)

# %i = command tag

# %e = SQL state

# %c = session ID

# %l = session line number

# %s = session start timestamp

# %v = virtual transaction ID

# %x = transaction ID (0 if none)

# %q = stop here in non-session

# processes

# %% = '%'

# e.g. '<%u%%%d> '

log\_lock\_waits = on # log lock waits >= deadlock\_timeout

#log\_statement = 'none' # none, ddl, mod, all

#log\_replication\_commands = off

log\_temp\_files = 0 # log temporary files equal or larger

# than the specified size in kilobytes;

# -1 disables, 0 logs all temp files

log\_timezone = 'UTC'

# - Process Title -

#cluster\_name = '' # added to process titles if nonempty

# (change requires restart)

#update\_process\_title = on

#------------------------------------------------------------------------------

# RUNTIME STATISTICS

#------------------------------------------------------------------------------

# - Query/Index Statistics Collector -

track\_activities = on

track\_counts = on

track\_io\_timing = off

track\_functions = all # none, pl, all

track\_activity\_query\_size = 1024 # (change requires restart)

#stats\_temp\_directory = 'pg\_stat\_tmp'

# - Statistics Monitoring -

#log\_parser\_stats = on

#log\_planner\_stats = on

#log\_executor\_stats = on

log\_statement\_stats = on

#------------------------------------------------------------------------------

# AUTOVACUUM PARAMETERS

#------------------------------------------------------------------------------

autovacuum = on # Enable autovacuum subprocess? 'on'

# requires track\_counts to also be on.

log\_autovacuum\_min\_duration = 0 # -1 disables, 0 logs all actions and

# their durations, > 0 logs only

# actions running at least this number

# of milliseconds.

#autovacuum\_max\_workers = 3 # max number of autovacuum subprocesses

# (change requires restart)

#autovacuum\_naptime = 1min # time between autovacuum runs

#autovacuum\_vacuum\_threshold = 50 # min number of row updates before

# vacuum

#autovacuum\_analyze\_threshold = 50 # min number of row updates before

# analyze

#autovacuum\_vacuum\_scale\_factor = 0.2 # fraction of table size before vacuum

#autovacuum\_analyze\_scale\_factor = 0.1 # fraction of table size before analyze

#autovacuum\_freeze\_max\_age = 200000000 # maximum XID age before forced vacuum

# (change requires restart)

#autovacuum\_multixact\_freeze\_max\_age = 400000000 # maximum multixact age

# before forced vacuum

# (change requires restart)

#autovacuum\_vacuum\_cost\_delay = 20ms # default vacuum cost delay for

# autovacuum, in milliseconds;

# -1 means use vacuum\_cost\_delay

#autovacuum\_vacuum\_cost\_limit = -1 # default vacuum cost limit for

# autovacuum, -1 means use

# vacuum\_cost\_limit

#------------------------------------------------------------------------------

# CLIENT CONNECTION DEFAULTS

#------------------------------------------------------------------------------

# - Statement Behavior -

#search\_path = '"$user", public' # schema names

#default\_tablespace = '' # a tablespace name, '' uses the default

#temp\_tablespaces = '' # a list of tablespace names, '' uses

# only default tablespace

#check\_function\_bodies = on

#default\_transaction\_isolation = 'read committed'

#default\_transaction\_read\_only = off

#default\_transaction\_deferrable = off

#session\_replication\_role = 'origin'

#statement\_timeout = 0 # in milliseconds, 0 is disabled

#lock\_timeout = 0 # in milliseconds, 0 is disabled

#idle\_in\_transaction\_session\_timeout = 0 # in milliseconds, 0 is disabled

#vacuum\_freeze\_min\_age = 50000000

#vacuum\_freeze\_table\_age = 150000000

#vacuum\_multixact\_freeze\_min\_age = 5000000

#vacuum\_multixact\_freeze\_table\_age = 150000000

#bytea\_output = 'hex' # hex, escape

#xmlbinary = 'base64'

#xmloption = 'content'

#gin\_fuzzy\_search\_limit = 0

#gin\_pending\_list\_limit = 4MB

# - Locale and Formatting -

datestyle = 'iso, mdy'

#intervalstyle = 'postgres'

timezone = 'UTC'

#timezone\_abbreviations = 'Default' # Select the set of available time zone

# abbreviations. Currently, there are

# Default

# Australia (historical usage)

# India

# You can create your own file in

# share/timezonesets/.

#extra\_float\_digits = 0 # min -15, max 3

#client\_encoding = sql\_ascii # actually, defaults to database

# encoding

# These settings are initialized by initdb, but they can be changed.

lc\_messages = 'en\_US.utf8' # locale for system error message

# strings

lc\_monetary = 'en\_US.utf8' # locale for monetary formatting

lc\_numeric = 'en\_US.utf8' # locale for number formatting

lc\_time = 'en\_US.utf8' # locale for time formatting

# default configuration for text search

default\_text\_search\_config = 'pg\_catalog.english'

# - Other Defaults -

#dynamic\_library\_path = '$libdir'

#local\_preload\_libraries = ''

#session\_preload\_libraries = ''

#------------------------------------------------------------------------------

# LOCK MANAGEMENT

#------------------------------------------------------------------------------

deadlock\_timeout = 1s

#max\_locks\_per\_transaction = 64 # min 10

# (change requires restart)

#max\_pred\_locks\_per\_transaction = 64 # min 10

# (change requires restart)

#max\_pred\_locks\_per\_relation = -2 # negative values mean

# (max\_pred\_locks\_per\_transaction

# / -max\_pred\_locks\_per\_relation) - 1

#max\_pred\_locks\_per\_page = 2 # min 0

#------------------------------------------------------------------------------

# VERSION/PLATFORM COMPATIBILITY

#------------------------------------------------------------------------------

# - Previous PostgreSQL Versions -

#array\_nulls = on

#backslash\_quote = safe\_encoding # on, off, or safe\_encoding

#default\_with\_oids = off

#escape\_string\_warning = on

#lo\_compat\_privileges = off

#operator\_precedence\_warning = off

#quote\_all\_identifiers = off

#standard\_conforming\_strings = on

#synchronize\_seqscans = on

# - Other Platforms and Clients -

#transform\_null\_equals = off

#------------------------------------------------------------------------------

# ERROR HANDLING

#------------------------------------------------------------------------------

#exit\_on\_error = off # terminate session on any error?

#restart\_after\_crash = on # reinitialize after backend crash?

#------------------------------------------------------------------------------

# CONFIG FILE INCLUDES

#------------------------------------------------------------------------------

# These options allow settings to be loaded from files other than the

# default postgresql.conf.

#include\_dir = 'conf.d' # include files ending in '.conf' from

# directory 'conf.d'

#include\_if\_exists = 'exists.conf' # include file only if it exists

#include = 'special.conf' # include file

#------------------------------------------------------------------------------

# CUSTOMIZED OPTIONS

#------------------------------------------------------------------------------

# Add settings for extensions here