

# Hardware Functional Verification

## COEN413/COEN6541

### QuestaSIM Demo

Concordia University  
Winter 2023

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Teaching Assistant: Ashkan Samadi

# Outline:

1. Prerequisite
2. QuestaSIM Access
  - Window User
  - MAC OS User
  - Linux User
3. Concordia Remote Desktop Connection Set-Up
4. QuestaSIM Simulation

# Prerequisite

- **ENCS User Account:** All students within Gina Cody School of Engineering and Computer Science are given an ENCS user account.
  - If you are a first-time user, please submit request to IT service Desk or email to [help@concordia.ca](mailto:help@concordia.ca) to get access.
  - If you don't remember your password, contact IT service Desk (link) or email to [help@concordia.ca](mailto:help@concordia.ca) to get new password.
- **ENCS Account Storage:** Make sure you have storage space in your ENCS account. You can check it using your ENCS account. <https://fis.encs.concordia.ca/helpdesk-cgi/quota.cgi>
- **QuestaSIM License:** All students enrolled in COEN413/COEN6541 are authorized to use the QuestaSIM, licensed by CMC Microsystems.

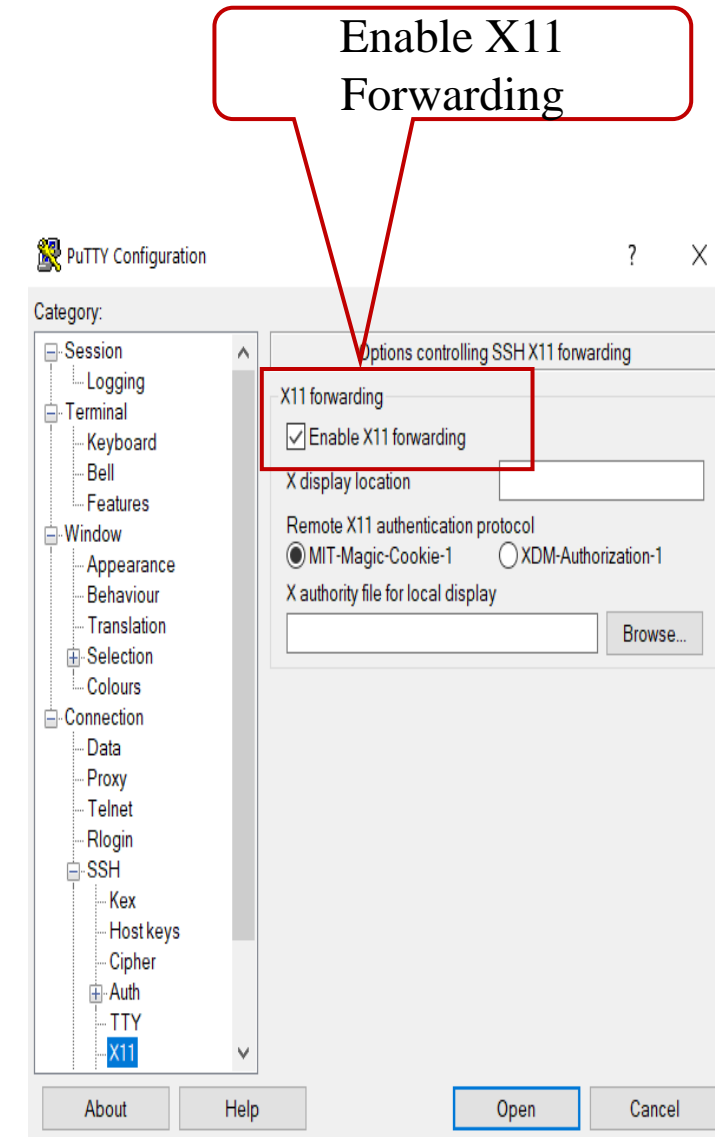
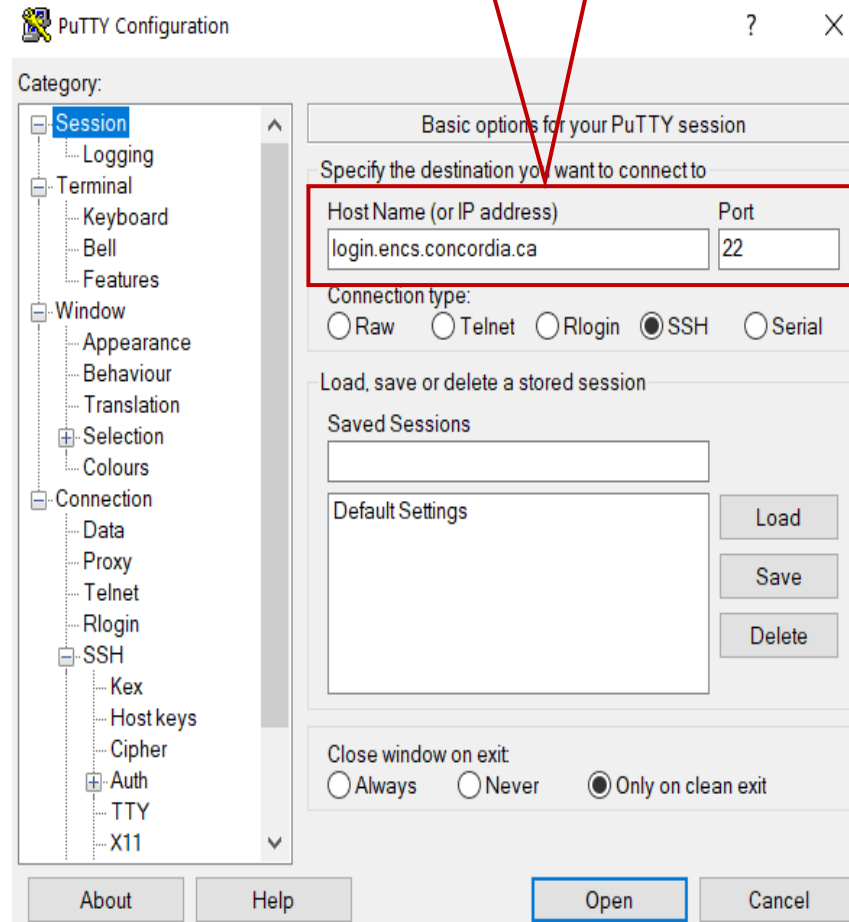
# QuestaSIM Access – Windows

Install:

- SSH Software : Putty
- X11 Forwarding software: Xming

## Steps to connect ENCS server:

- As of Dec. 19, 2022, the use of Forticlient VPN software is required for all remote connections (ie. Putty) to a University server.
- Run Xming software in the background.
- Launch Putty
- Enter Host name and port number:
  - Host: login.encs.concordia.ca
  - Port: 22
- Enable X11 Forwarding: You can find it in putty console.
  - Connection > SSH >> X11 >> Enable X11 Forwarding
- Click “Open”: It will launch window console.



# QuestaSIM Access – Windows (Continue)

## Steps to connect ENCS account:

- Enter your ENCS User name & press enter
- Enter your ENCS password & press enter



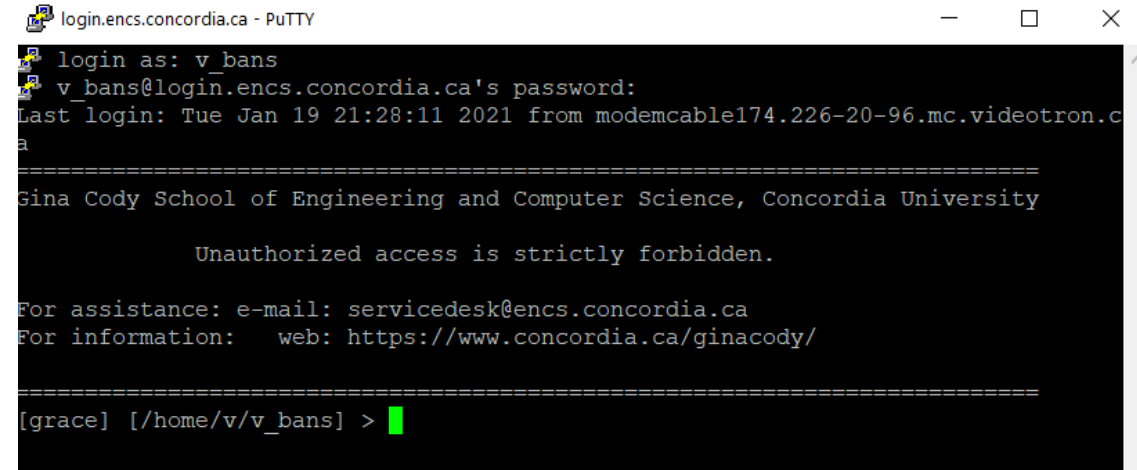
```
login.encs.concordia.ca - PuTTY
login as: █
```

## Steps to Launch QuestaSIM:

- **Step 1:** Create a directory called Questa: **mkdir Questa**
  - Go to that directory: **cd Questa**
- **Step 2:** Set up Questa Environment
  - **source /CMC/ENVIRONMENT/questasim.env**
  - **vsim**

QuestaSIM Tool will be launched using Graphical User Interface


**Note:** Make sure that **Xming** is running in background. Otherwise, we will get display error.



```
login.encs.concordia.ca - PuTTY
login as: v_bans
v_bans@login.encs.concordia.ca's password:
Last login: Tue Jan 19 21:28:11 2021 from modemcable174.226-20-96.mc.videotron.c
a
=====
Gina Cody School of Engineering and Computer Science, Concordia University

Unauthorized access is strictly forbidden.

For assistance: e-mail: servicedesk@encs.concordia.ca
For information: web: https://www.concordia.ca/ginacody/
=====
[grace] [/home/v/v_bans] > █
```



```
login.encs.concordia.ca - PuTTY
login as: v_bans
v_bans@login.encs.concordia.ca's password:
Last login: Tue Jan 19 21:28:11 2021 from modemcable174.226-20-96.mc.videotron.c
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=====
[grace] [/home/v/v_bans] > █
```

Command Line window

```
[grace] [/home/v/v_bans] > mkdir Questa
[grace] [/home/v/v_bans] > cd Questa/
[grace] [/home/v/v_bans/Questa] > source /CMC/ENVIRONMENT/questasim.env
[grace] [/home/v/v_bans/Questa] > vsim █
```

# QuestaSIM Access – MAC OS

## Download

- X11 Forwarding software: XQuartz

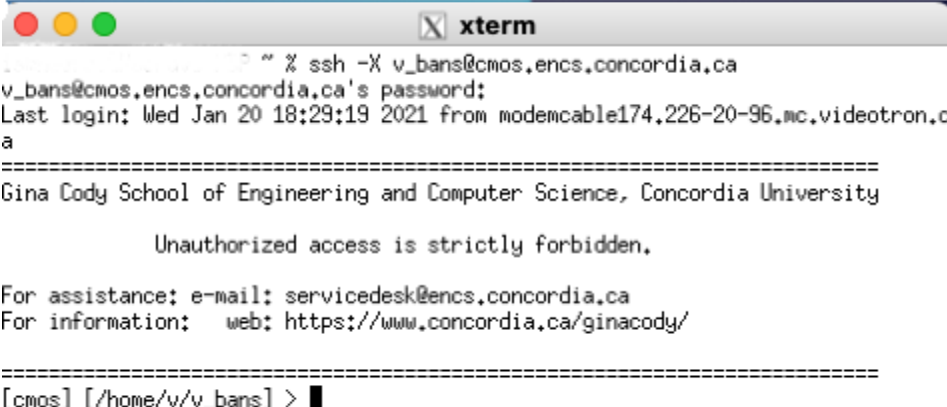
## Steps to connect ENCS server:

- Run XQuartz in the background.
- Open Xterm from XQuartz
- To connect SSH Server:
  - `ssh -X encs_user_name@encs.concordia.ca`
- Enter your ENCS user-name & password

## Steps to Launch QuestaSIM:

- **Step 1:** Create a directory called Questa: `mkdir Questa`
  - Go to that directory: `cd Questa`
- **Step 2:** Set up Questa Environment
  - `source /CMC/ENVIRONMENT/questasim.env`
  - `vsim`

QuestaSIM Tool will be launched using Graphical User Interface



```
xterm
~ % ssh -X v_bans@cmos.encs.concordia.ca
v_bans@cmos.encs.concordia.ca's password:
Last login: Wed Jan 20 18:29:19 2021 from modemcable174.226-20-96.mc.videotron.c
a
=====
Gina Cody School of Engineering and Computer Science, Concordia University

Unauthorized access is strictly forbidden.

For assistance: e-mail: servicedesk@encs.concordia.ca
For information: web: https://www.concordia.ca/ginacody/

=====
[cmos] [/home/v/v_bans] >
```



```
xterm
~ % ssh -X v_bans@cmos.encs.concordia.ca
v_bans@cmos.encs.concordia.ca's password:
Last login: Wed Jan 20 18:29:19 2021 from modemcable174.226-20-96.mc.videotron.c
a
=====
Gina Cody School of Engineering and Computer Science, Concordia University

Unauthorized access is strictly forbidden.

For assistance: e-mail: servicedesk@encs.concordia.ca
For information: web: https://www.concordia.ca/ginacody/

=====
[cmos] [/home/v/v_bans] > mkdir QuestaMACOS
[cmos] [/home/v/v_bans] > cd QuestaMACOS/
[cmos] [/home/v/v_bans/QuestaMACOS] > source /CMC/ENVIRONMENT/questasim.env
[cmos] [/home/v/v_bans/QuestaMACOS] > vsim
```



# QuestaSIM Access – LINUX

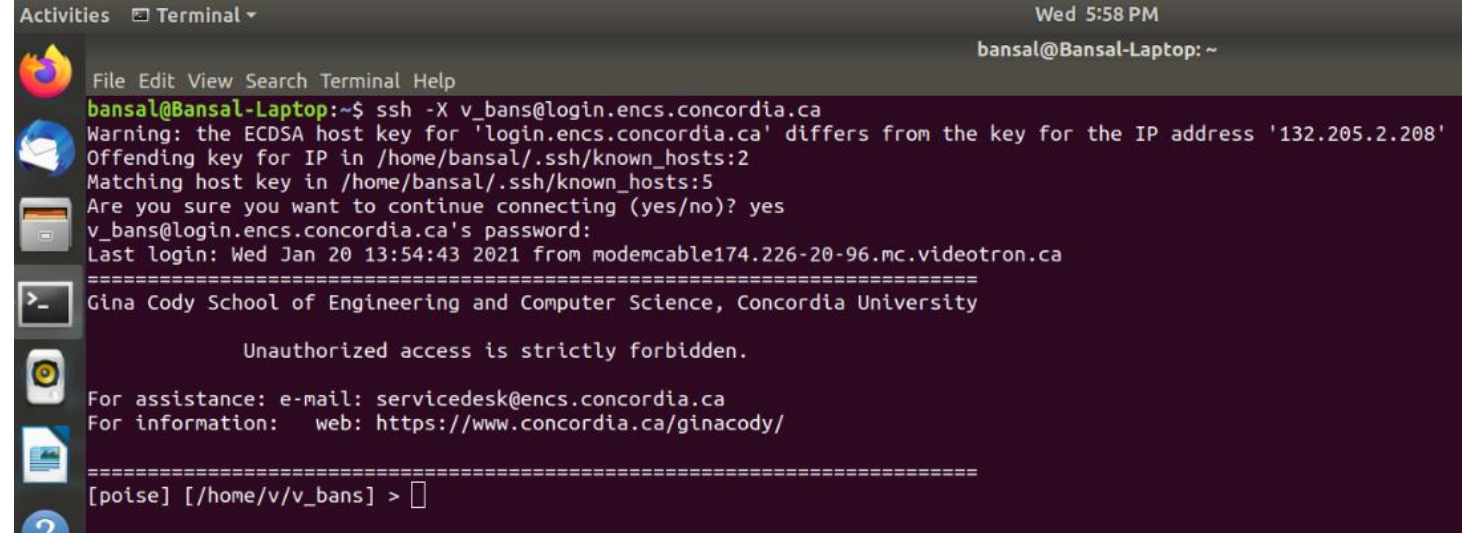
## Steps to connect ENCS server:

- Open Terminal.
- To connect SSH Server:
  - `ssh -X encs_user_name@encs.concordia.ca`
- Enter your ENCS user-name & password

## Steps to Launch QuestaSIM:

- **Step 1:** Create a directory called Questa: `mkdir Questa`
  - Go to that directory: `cd Questa`
- **Step 2:** Set up Questa Environment
  - `source /CMC/ENVIRONMENT/questasim.env`
  - `vsim`

QuestaSIM Tool will be launched using Graphical User Interface

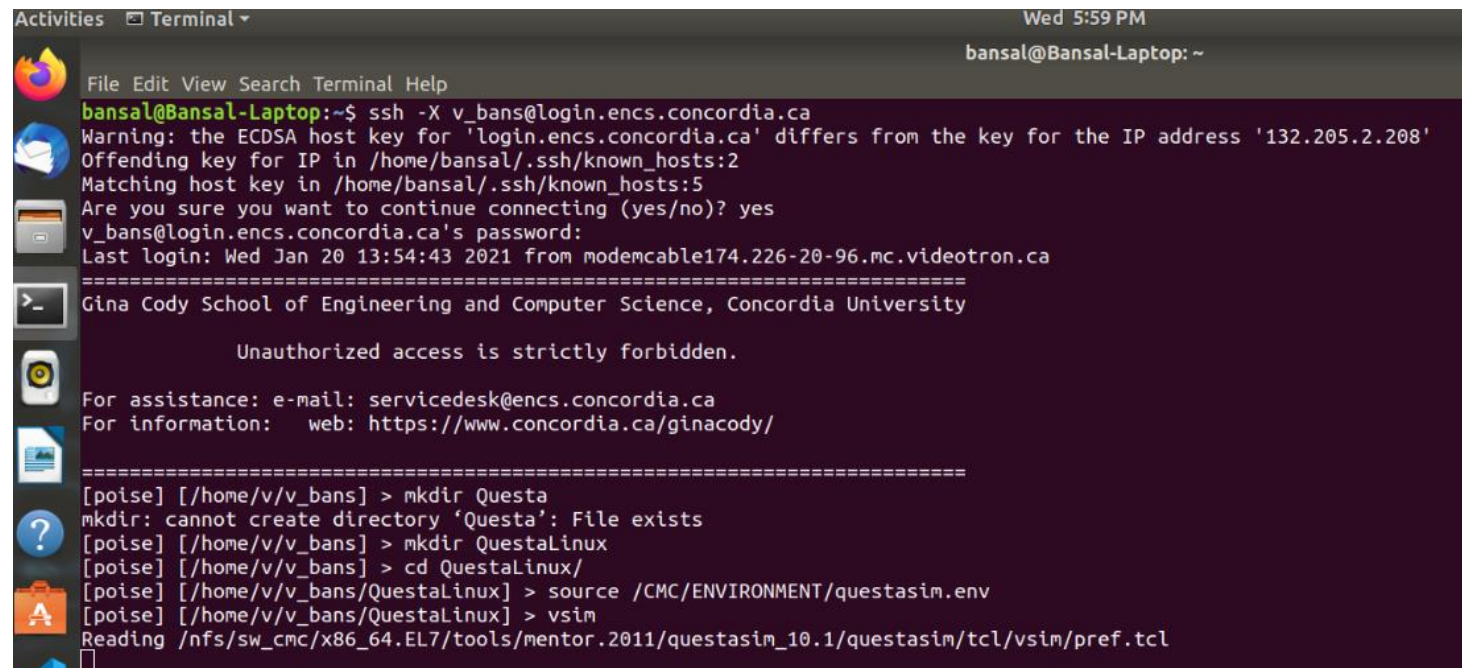
A terminal window titled 'Terminal' showing an SSH connection from 'bansal@Bansal-Laptop' to 'v\_bans@login.encs.concordia.ca'. It displays a warning about host keys, a confirmation to continue, and a login message from 'Gina Cody School of Engineering and Computer Science, Concordia University'. The prompt is '[poise] [/home/v/v\_bans] >'.

```
File Edit View Search Terminal Help
bansal@Bansal-Laptop:~$ ssh -X v_bans@login.encs.concordia.ca
Warning: the ECDSA host key for 'login.encs.concordia.ca' differs from the key for the IP address '132.205.2.208'
Offending key for IP in /home/bansal/.ssh/known_hosts:2
Matching host key in /home/bansal/.ssh/known_hosts:5
Are you sure you want to continue connecting (yes/no)? yes
v_bans@login.encs.concordia.ca's password:
Last login: Wed Jan 20 13:54:43 2021 from modemcable174.226-20-96.mc.videotron.ca
=====
Gina Cody School of Engineering and Computer Science, Concordia University

Unauthorized access is strictly forbidden.

For assistance: e-mail: servicedesk@encs.concordia.ca
For information: web: https://www.concordia.ca/ginacody/

=====
[poise] [/home/v/v_bans] >
```

A terminal window titled 'Terminal' showing the continuation of the SSH session. The user creates a directory 'Questa', attempts to create 'QuestaLinux' (which fails because it exists), changes to 'QuestaLinux', sources the environment file, and runs 'vsim'. The prompt is '[poise] [/home/v/v\_bans/QuestaLinux] >'.

```
File Edit View Search Terminal Help
bansal@Bansal-Laptop:~$ ssh -X v_bans@login.encs.concordia.ca
Warning: the ECDSA host key for 'login.encs.concordia.ca' differs from the key for the IP address '132.205.2.208'
Offending key for IP in /home/bansal/.ssh/known_hosts:2
Matching host key in /home/bansal/.ssh/known_hosts:5
Are you sure you want to continue connecting (yes/no)? yes
v_bans@login.encs.concordia.ca's password:
Last login: Wed Jan 20 13:54:43 2021 from modemcable174.226-20-96.mc.videotron.ca
=====
Gina Cody School of Engineering and Computer Science, Concordia University

Unauthorized access is strictly forbidden.

For assistance: e-mail: servicedesk@encs.concordia.ca
For information: web: https://www.concordia.ca/ginacody/

=====
[poise] [/home/v/v_bans] > mkdir Questa
mkdir: cannot create directory 'Questa': File exists
[poise] [/home/v/v_bans] > mkdir QuestaLinux
[poise] [/home/v/v_bans] > cd QuestaLinux/
[poise] [/home/v/v_bans/QuestaLinux] > source /CMC/ENVIRONMENT/questasim.env
[poise] [/home/v/v_bans/QuestaLinux] > vsim
Reading /nfs/sw_cmc/x86_64.EL7/tools/mentor.2011/questasim_10.1/questasim/tcl/vsim/pref.tcl
[poise] [/home/v/v_bans/QuestaLinux] >
```

# QuestaSIM Access – Concordia Remote Desktop Connection

**Step 1: Get the GCS Lab Available computer's name:** Log in to the Available GCS Lab Hosts service with your ENCS user account credentials ((<https://fis.encs.concordia.ca/helpdesk-cgi/available-hosts.cgi>))

Available ENCS Lab Hosts

Authentication Form

After you authenticate, you will get the list of available ENCS Lab Hosts that you can log into.

Please enter your ENCS login name :

Please enter your ENCS password :

Authenticate

Clear Form

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**Step 2:** Connecting to the Concordia Network: To download the VPN FortiClient software, visit the Software and Applications section of the MyConcordia portal. Once the software has been installed, enter your Concordia Netname and password to establish a connection.

VPN

SSL-VPNIPsec VPN

Connection NameConcordia\_VPN

DescriptionConcordia VPN

Remote Gatewayvpn.concordia.ca

+Add Remote Gateway

☒ Customize port443

Client CertificateNone

Authentication

☒ Prompt on login☐ Save login

☒ Do not Warn Invalid Server Certificate

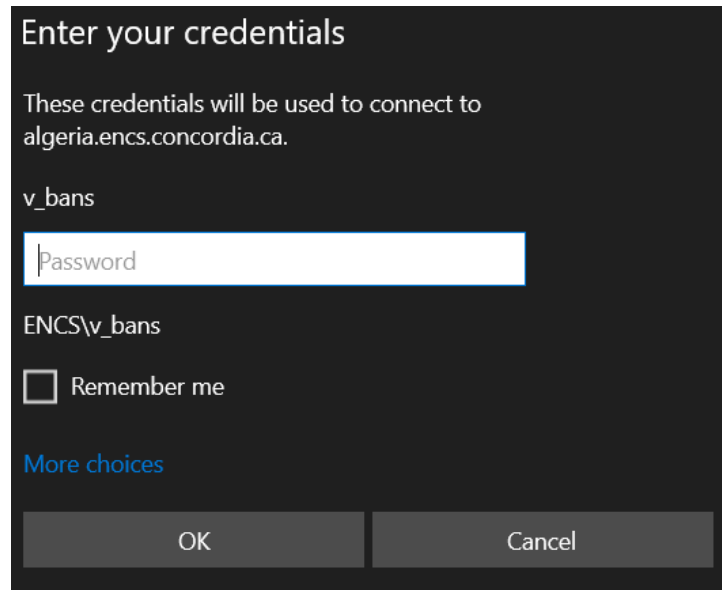
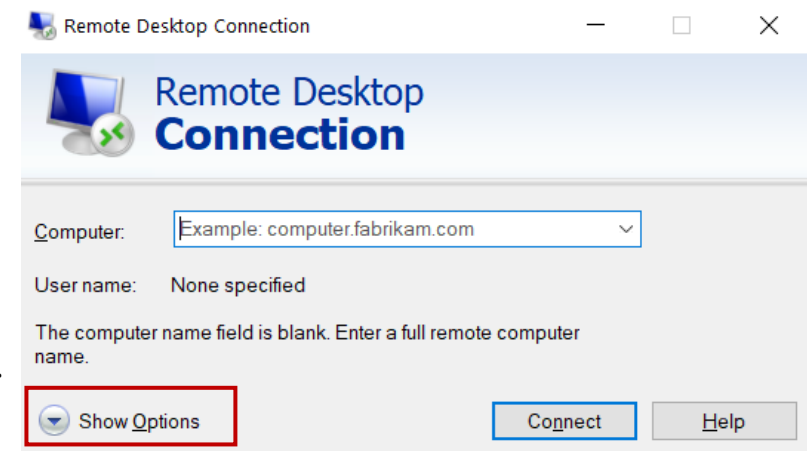
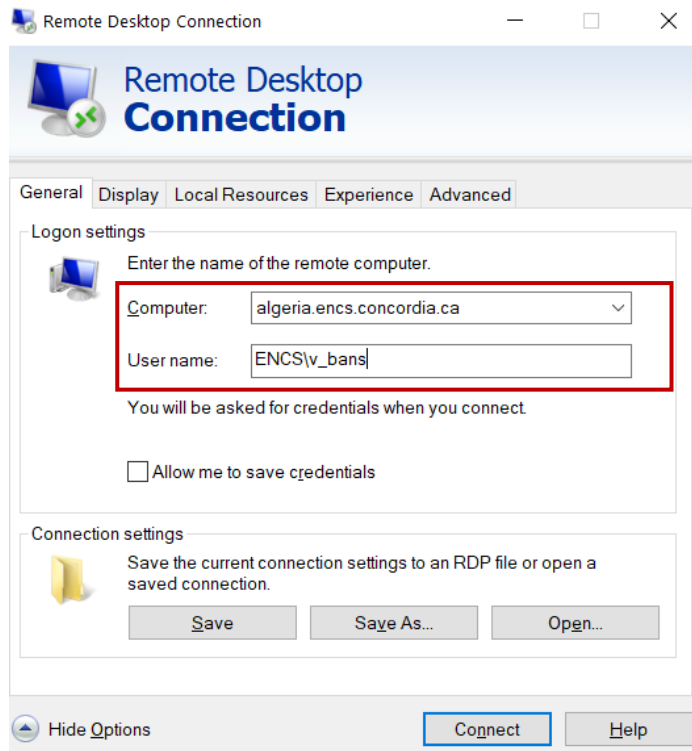
CancelSave



# QuestaSIM Access – Concordia Remote Desktop Connection (Continue)

## Step 3: Connecting to a GCS Lab computer (Window User)

- Open Remote Desktop Connection by navigating to the following location:  
Start > All Programs > Accessories > Remote Desktop Connection
- Enter the full computer name of the GCS lab computer (from step 1) and your encs account user-name.



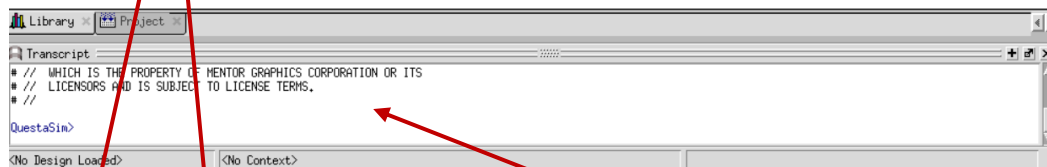
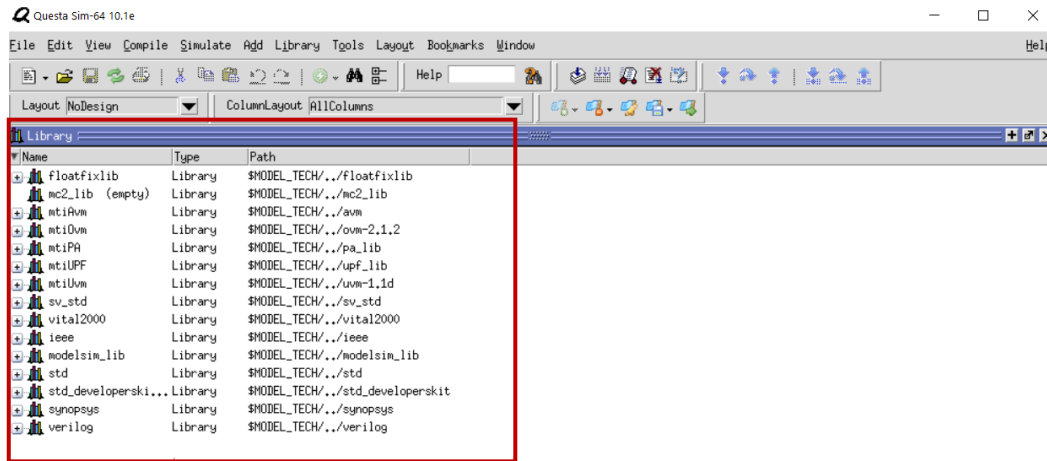
After a minute or so, you will be setup with a Remote Desktop to the chosen computer. It is as if you are sitting in front of the computer in the lab. You can now run any of the available Window's software (e.g. Putty, Xming) which is installed on the remote lab PC. Any results will be displayed on your home monitor.

***MAC OS user: Install Microsoft Remote Desktop and follow same steps***

# Simulation using QuestaSIM

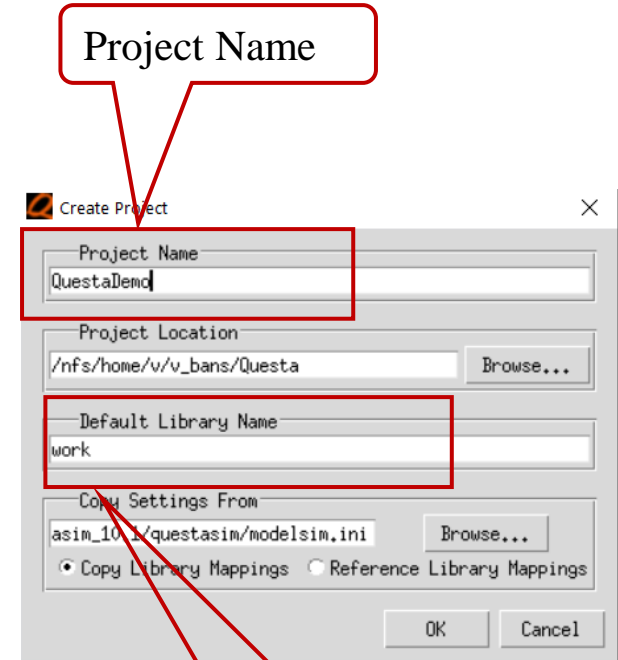
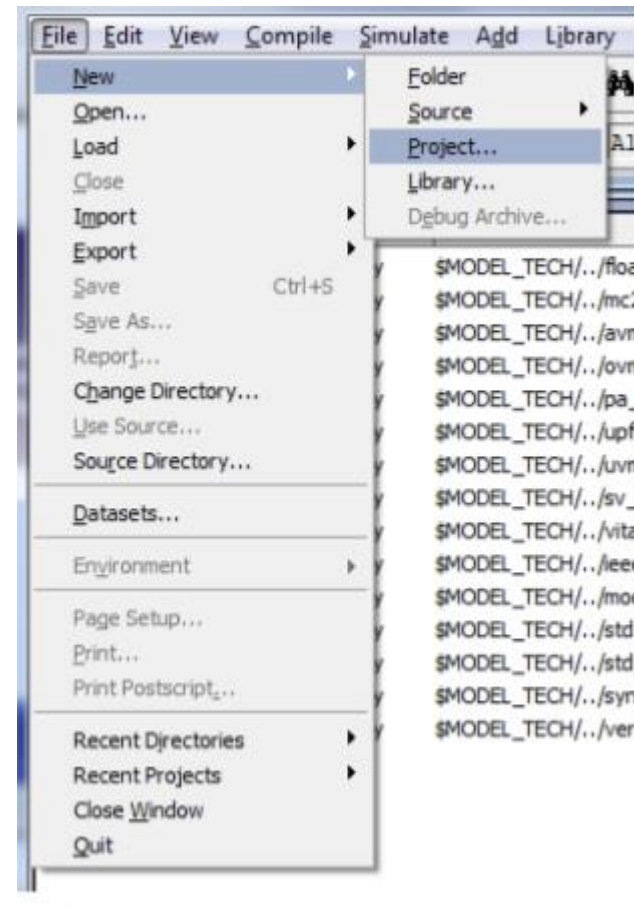
Graphical User Interface will be invoked after command **vsim** in terminal.

## Step 1: Create a new project



Libraries that contain  
Compile components

Shell (tcl) to write and  
execute commands from the  
prompt

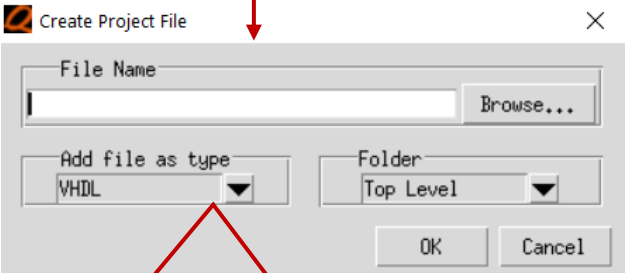
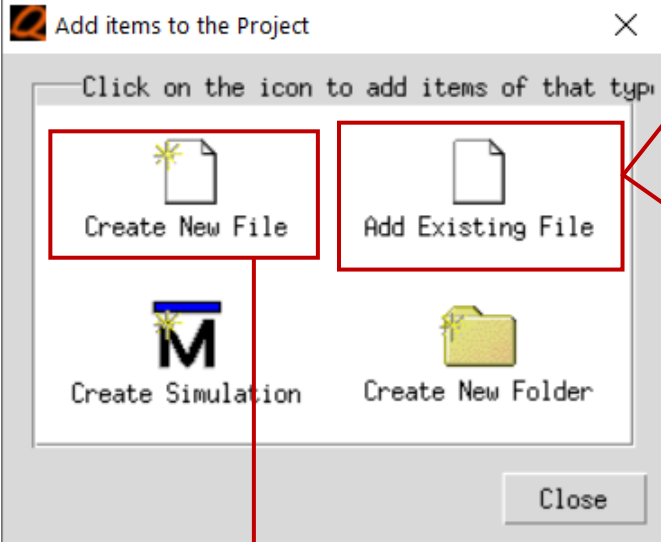


Library used for  
simulation

If it is the first time and  
the work directory is not  
yet made it will ask to  
permission to make one.  
Click yes.

# Simulation using QuestaSIM (Continue)

## Step 2: Add/Create VHDL/Verilog Files

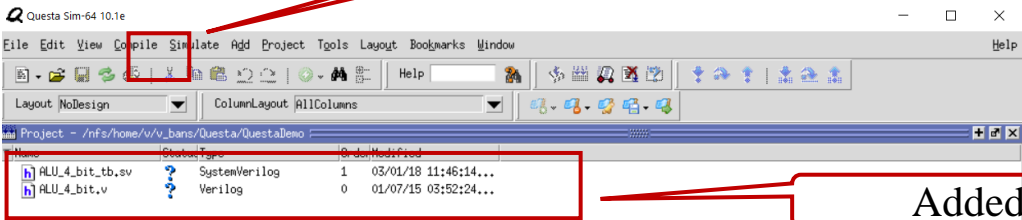


We can directly create a file in QuestaSIM. Select the file type as per requirement.

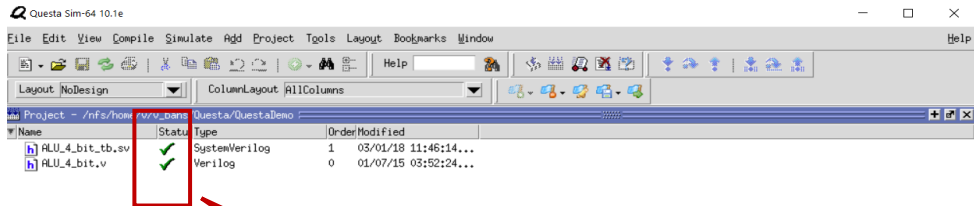
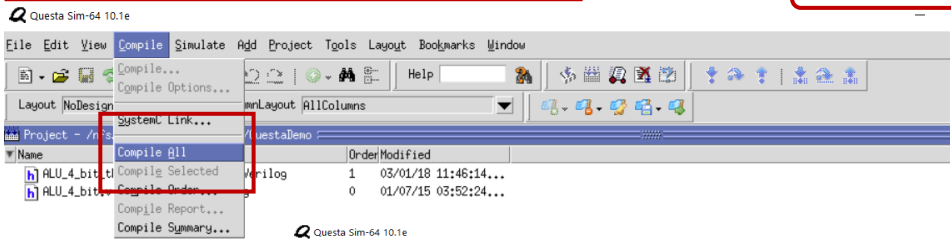
Add all the files already stored in directory (ENCS Server Directory)

To transfer files from personal system to ENCS server, we can use File Transfer Protocol Software (e.g. WINscp).

## Step 3: Compilation

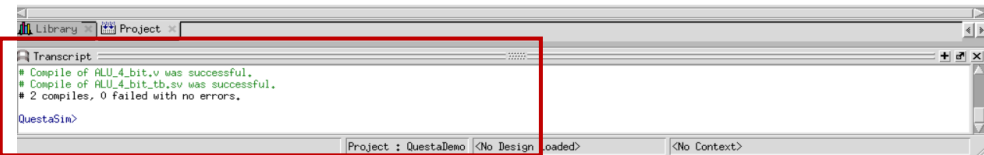


Added files



A green check shows for each file if the compilation was successful

Command Window to check compilation error if any



# Simulation using QuestaSIM (Continue)

## Step 4(a): Run simulation for top level design

**Library**

Name	Type	Path
work	Library	/nfs/home/v/v_bans/questa/work
ALU_4_bit	Module	/nfs/home/v/v_bans/questa/ALU_4....
ALU_4_bit_tb	Module	/nfs/home/v/v_bans/questa/ALU_4....
FloatFixLib	Library	\$MODEL_TECH/./FloatFixLib
nc2_lib (empty)	Library	\$MODEL_TECH/./nc2_lib
ntiAvm	Library	\$MODEL_TECH/./avm
ntiDvm	Library	\$MODEL_TECH/./ovm-2.1.2
ntiPA	Library	\$MODEL_TECH/./pa_lib
ntiUFF	Library	\$MODEL_TECH/./upf_lib
ntiUvm	Library	\$MODEL_TECH/./uvm-1.1d
sv_std	Library	\$MODEL_TECH/./sv_std
vital2000	Library	\$MODEL_TECH/./vital2000
ieee	Library	\$MODEL_TECH/./ieee
modelsim_lib	Library	\$MODEL_TECH/./modelsim_lib
std	Library	\$MODEL_TECH/./std
std_developerski...	Library	\$MODEL_TECH/./std_developerskit
synopsys	Library	\$MODEL_TECH/./synopsys
verilog	Library	\$MODEL_TECH/./verilog

**Hierarchical Design Tree**

Instance	Design unit	Design unit
ALU_4_bit_tb	ALU_4_bit_tb	Module
check_result	ALU_4_bit_tb	Task
checkC	ALU_4_bit_tb	Task
assert_reset	ALU_4_bit_tb	Task
ALU_4_bit	ALU_4_bit	Module
#INITIAL#54	ALU_4_bit_tb	Process
#INITIAL#62	ALU_4_bit_tb	Process
std	std	VIPackage
semaphore	std	SVCClass
mailbox	std	SVCParamCla
process	std	SVCClass
#vsim_capacity#		Capacity

**Objects**

Name	Value	Kind	Mode
Add	00	Par...	Int...
Sub	01	Par...	Int...
Not_A	10	Par...	Int...
ReductionOR_B	11	Par...	Int...
NAVPOS	7	Par...	Int...
ZERO	0	Par...	Int...
NAVNEG	-8	Par...	Int...
clk	x	Reg...	Int...
reset	x	Reg...	Int...
A	x	Pac...	Int...
B	x	Pac...	Int...
C	x	Net	Int...
error_count	x	Int...	Int...
correct_count	x	Int...	Int...
Opcode	xx	Pac...	Int...

**Wave - Default**

Now 0 ns  
Cursor 1 0 ns

0 ns 200 ns 400 ns 600 ns 800 ns

**Transcript**

```
QuestaSim> |
Loading work/ALU_4_bit_tb
Refreshing /nfs/home/v/v_bans/questa/work/ALU_4_bit
Loading work/ALU_4_bit
```

**Callouts:**

- Under work library, right click on the top-level design file (testbench) and start simulation
- Hierarchical Design Tree
- Signal on top level
- Mark signals to be shown in waveform and right click on it to Add to Wave block

# Simulation using QuestaSIM (Continue)

## Step 4 (b): Add waves & Run simulation

Set run time, start simulation run or restart simulation after recompilation

The screenshot shows the QuestaSIM 10.1e interface. The top menu bar includes File, Edit, View, Compile, Simulate, Add, Wave, Tools, Layout, Bookmarks, and Window. The toolbar contains various icons for simulation control. A red box highlights the '1000 ns' time scale setting. Another red box highlights the 'Run' button (a green play icon). The 'Objects' window on the left lists design units and their components. The 'Wave' window on the right displays a waveform for the selected signals. A red box highlights the 'Selected Wave signals' list, which includes /ALU\_4\_bit\_tb/cik, /ALU\_4\_bit\_tb/reset, /ALU\_4\_bit\_tb/A, /ALU\_4\_bit\_tb/B, /ALU\_4\_bit\_tb/C, /ALU\_4\_bit\_tb/error\_count, /ALU\_4\_bit\_tb/correct\_count, and /ALU\_4\_bit\_tb/Opcode. The 'Waveform' window shows a digital signal trace for the selected signals. A red box highlights the 'Waveform' label. The 'Transcript' window at the bottom shows the simulation output, including a message about a break in the module ALU\_4\_bit\_tb.

Name	Value	Kind	Mode
Add	00	Par...	Int...
Sub	01	Par...	Int...
Not_A	10	Par...	Int...
ReductionOR_B	11	Par...	Int...
MAXPOS	7	Par...	Int...
ZERO	0	Par...	Int...
MAXNEG	-8	Par...	Int...
clk	0	Reg...	Int...
reset	0	Reg...	Int...
A	0	Pac...	Int...
B	5	Pac...	Int...
C	-1	Net	Int...
error_count	0	Int...	Int...
correct_count	32	Int...	Int...
Opcode	10	Pac...	Int...

Waveform

Selected Wave signals

Transcript

```
# 1
# Break in Module ALU_4_bit_tb at /nfs/home/v/v_bans/Questa/ALU_4_bit_tb.sv line 170
VSIM 5> run
VSIM 5>
```

Different options to jump with the cursor to falling or rising Edges of the clock

Waveform

Selected Wave signals

Transcript window stating the errors/warnings pops-up if any. Double-click on the message in the window to get the error/warning messages

Thank You!