CprE 489, Section 4
Lab Experiment #5: Introduction to GENI

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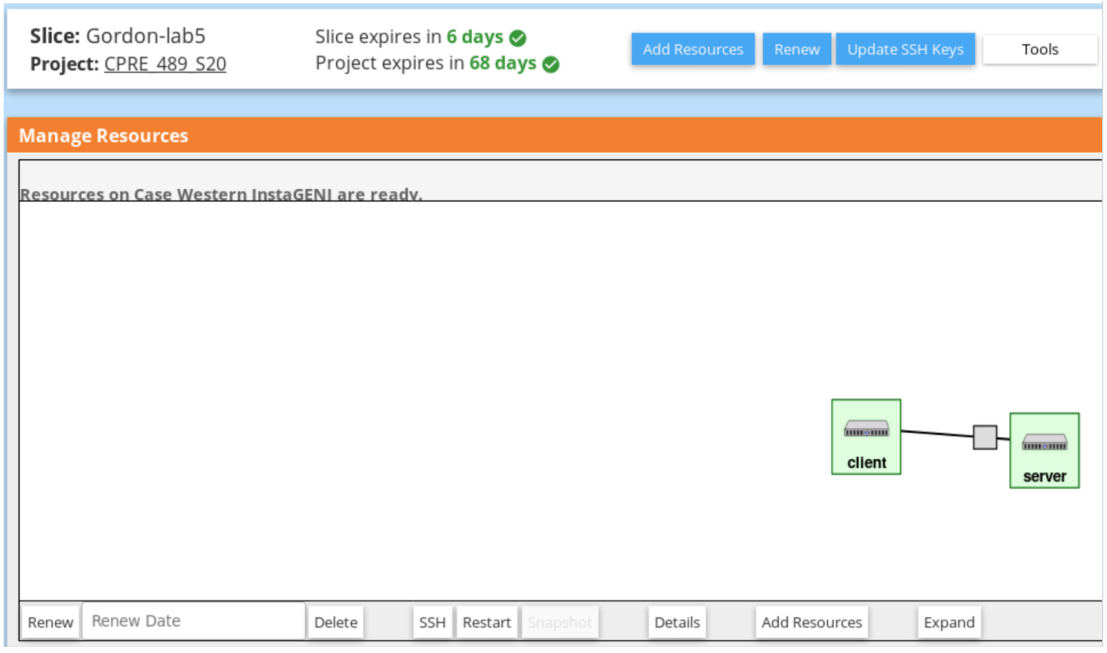
This lab involved using GENI portal, a suite of tools to experiment with and research networking. In this lab, we worked with slices in order to familiarize ourselves with the platform. Slices allow us to reserve a small amount of Geni's computational resources to allow for individual experiments within a project. We were able to remotely access the resources from several institutions in cooperation with GENI. Computing resources are provided by aggregates, machines that cooperate with the GENI platform to allow access to resources for experimenters. Using SSH, an SSH key was generated in order to access the slice from the terminal of our local machines.

The following screenshot shows an visual overview of one of our slices:



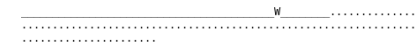
The following screenshot shows statistics for the computing resources within our slice:

Apache Server Status for 192.171.20.110 (via 192.171.20.110)

Server Version: Apache/2.4.29 (Ubuntu)
Server MPM: event
Server Built: 2019-12-03T15:55:03

Current Time: Friday, 06-Mar-2020 13:48:47 CST
Restart Time: Friday, 06-Mar-2020 13:40:40 CST
Parent Server Config. Generation: 1
Parent Server MPM Generation: 0
Server uptime: 8 minutes 6 seconds
Server load: 0.09 0.33 0.38
Total accesses: 1103 - Total Traffic: 103.0 MB
CPU Usage: u.49 s1.67 cu0 cs0 - .444% CPU load
2.27 requests/sec - 217.1 kB/second - 95.7 kB/request
1 requests currently being processed, 49 idle workers

Slot	PID	Stopping	Connections		Threads		Async connections		
			total	accepting	busy	idle	writing	keep-alive	closing
0	2878	no	0	yes	0	25	0	0	0
1	2879	no	0	yes	1	24	0	0	0
Sum	2	0	0		1	49	0	0	0



Scoreboard Key:
"_" Waiting for Connection, "S" Starting up, "R" Reading Request,
"W" Sending Reply, "K" Keepalive (read), "D" DNS Lookup,
"C" Closing connection, "L" Logging, "G" Gracefully finishing,
"I" Idle cleanup of worker, "." Open slot with no current process

Srv	PID	Acc	M	CPU	SS	Req	Conn	Child	Slot	Client	Protocol	VHost	Request
0-0	2878	0/21/21	_	1.07	24	1536	0.0	1.80	1.80	10.10.10.2	http/1.1		
0-0	2878	0/24/24	_	1.08	24	24	0.0	2.51	2.51	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80	GET /iperflogs/iperf-server.log HTTP/1.1
0-0	2878	0/20/20	_	1.06	24	0	0.0	1.67	1.67	10.10.10.2	http/1.1		
0-0	2878	0/24/24	_	1.07	25	23	0.0	2.49	2.49	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80	GET /iperflogs/iperf-server.log HTTP/1.1
0-0	2878	0/18/18	_	0.97	24	0	0.0	1.56	1.56	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80	GET /graphics/hellogeni-banner.png HTTP/1.1
0-0	2878	0/23/23	_	1.08	24	26	0.0	2.15	2.15	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80	GET /iperflogs/iperf-server.log HTTP/1.1
0-0	2878	0/26/26	_	1.07	24	62	0.0	2.82	2.82	10.10.10.2	http/1.1		
0-0	2878	0/20/20	_	1.08	24	0	0.0	1.21	1.21	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80	GET /graphics/hellogeni-banner.png HTTP/1.1
0-0	2878	0/21/21	_	1.03	24	0	0.0	1.96	1.96	10.10.10.2	http/1.1		
0-0	2878	0/20/20	_	1.00	24	0	0.0	2.08	2.08	10.10.10.2	http/1.1		

The following screenshot shows the result of running iperf (a test for throughput) on the slice with 2 parallel connections:

```
sgordon4@server:~$ iperf -c server -P 2
------------------------------------------------------------
Client connecting to server, TCP port 5001
TCP window size: 2.50 MByte (default)
------------------------------------------------------------
[  3] local 10.10.10.1 port 44310 connected with 10.10.10.1 port 5001
[  4] local 10.10.10.1 port 44312 connected with 10.10.10.1 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.0 sec  2.64 GBytes  2.27 Gbits/sec
[  4]  0.0-10.0 sec  2.66 GBytes  2.28 Gbits/sec
[SUM]  0.0-10.0 sec  5.30 GBytes  4.54 Gbits/sec
```

The following screenshot shows the result of running iperf with 3 parallel connections:

```
sgordon4@server:~$ iperf -c server -P 3
------------------------------------------------------------
Client connecting to server, TCP port 5001
TCP window size: 2.50 MByte (default)
------------------------------------------------------------
[  5] local 10.10.10.1 port 44318 connected with 10.10.10.1 port 5001
[  3] local 10.10.10.1 port 44314 connected with 10.10.10.1 port 5001
[  4] local 10.10.10.1 port 44316 connected with 10.10.10.1 port 5001
[ ID] Interval       Transfer     Bandwidth
[  5]  0.0-10.0 sec  1.75 GBytes  1.50 Gbits/sec
[  4]  0.0-10.0 sec  1.76 GBytes  1.52 Gbits/sec
[  3]  0.0-10.0 sec  1.67 GBytes  1.43 Gbits/sec
[SUM]  0.0-10.0 sec  5.18 GBytes  4.45 Gbits/sec
```

Fewer GB were transferred per connection when using more connections, but the overall sum stayed fairly constant.

The following screenshot shows the final logs for the web server. These logs have recorded the various servers interacted with throughout the course of the experiment:

0-0	2878	0/26/26	_	1.86	27	0	0.0	3.41	3.41	10.10.10.2	http/1.1	
0-0	2878	0/41/41	_	1.88	27	448	0.0	4.95	4.95	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80 GET /iperflo
0-0	2878	0/34/34	_	1.77	27	0	0.0	4.48	4.48	10.10.10.2	http/1.1	
0-0	2878	0/43/43	_	1.89	27	171	0.0	5.06	5.06	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80 GET /iperflo
1-0	2879	0/28/28	_	1.89	5	2	0.0	3.02	3.02	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/43/43	_	1.92	2	2	0.0	5.73	5.73	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/31/31	_	1.93	2	3	0.0	3.50	3.50	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/39/39	_	1.72	27	0	0.0	4.67	4.67	10.10.10.2	http/1.1	
1-0	2879	0/34/34	_	1.88	7	2	0.0	4.21	4.21	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/33/33	_	1.92	3	3	0.0	3.91	3.91	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/41/41	_	1.89	5	3	0.0	5.51	5.51	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/30/30	_	1.87	8	1	0.0	3.38	3.38	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/38/38	_	1.89	5	3	0.0	4.86	4.86	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/23/23	_	1.84	27	0	0.0	2.94	2.94	10.10.10.2	http/1.1	
1-0	2879	0/35/35	_	1.92	3	2	0.0	4.37	4.37	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/36/36	_	1.88	6	2	0.0	3.83	3.83	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/37/37	_	1.87	27	136	0.0	5.29	5.29	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80 GET /iperflo
1-0	2879	0/30/30	_	1.87	27	151	0.0	3.88	3.88	10.10.10.2	http/1.1	pcvm1-19.geni.case.edu:80 GET /graphi
1-0	2879	0/41/41	_	1.87	8	2	0.0	5.03	5.03	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/40/40	_	1.90	4	2	0.0	4.62	4.62	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/30/30	_	1.90	5	2	0.0	3.44	3.44	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/33/33	_	1.90	4	2	0.0	4.72	4.72	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/37/37	_	1.93	1	2	0.0	4.33	4.33	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/42/42	_	1.80	27	83	0.0	5.46	5.46	10.10.10.2	http/1.1	
1-0	2879	0/37/37	_	1.88	6	3	0.0	4.53	4.53	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/34/34	_	1.93	1	1	0.0	3.67	3.67	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/34/34	_	1.91	3	3	0.0	4.67	4.67	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/34/34	**W**	1.74	0	0	0.0	4.56	4.56	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-
1-0	2879	0/32/32	_	1.93	0	2	0.0	3.96	3.96	129.186.252.43	http/1.1	pcvm1-19.geni.case.edu:80 GET /server-

Srv	Child Server number - generation
PID	OS process ID
Acc	Number of accesses this connection / this child / this slot
M	Mode of operation
CPU	CPU usage, number of seconds
SS	Seconds since beginning of most recent request
Req	Milliseconds required to process most recent request
Conn	Kilobytes transferred this connection
Child	Megabytes transferred this child
Slot	Total megabytes transferred this slot

Apache/2.4.29 (Ubuntu) Server at 192.171.20.110 Port 80