Latency of Remote Access

Introdunction

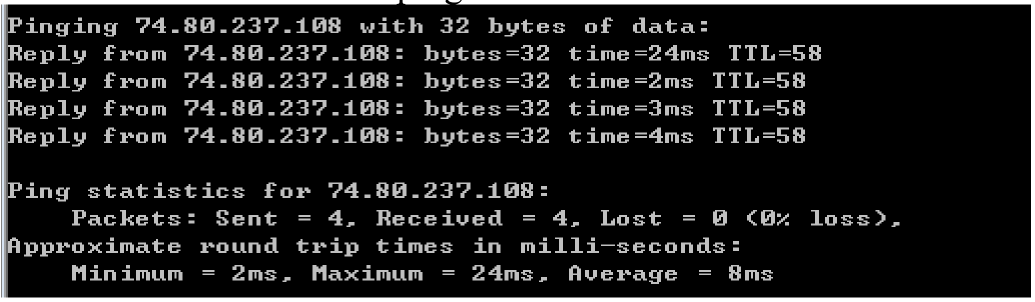
Remote access refers to that we log in the server system which is far away from where we are at the present. One typical example of "Remote Access" is Windows RDP. With RDP, we can log in the remote server locally if we provide correct host name, port number, user name and password.

Unlike local desktop operating system, remote access is much slower cause the signal and response will be transmitted through the network and thus we must take round trip time into consideration. What's the bottleneck of remote access? Next I will talk something about remote access latency.

What's latency

Latency here mainly refers to network propagation delay in cloud system. Because in cloud system, we may have a server across continent so that the propagation delay can really make significant difference to the overall performance. Also we should note that cloud system often runs in WAN instead of LAN, while in LAN, transmission delay is the key role and propagation delay is trivial. Here are the examples. Our company has servers in US, UK and Singapore. By pinging to servers in different locations, you can tell the difference of how propagation delay impacts latency and response time.

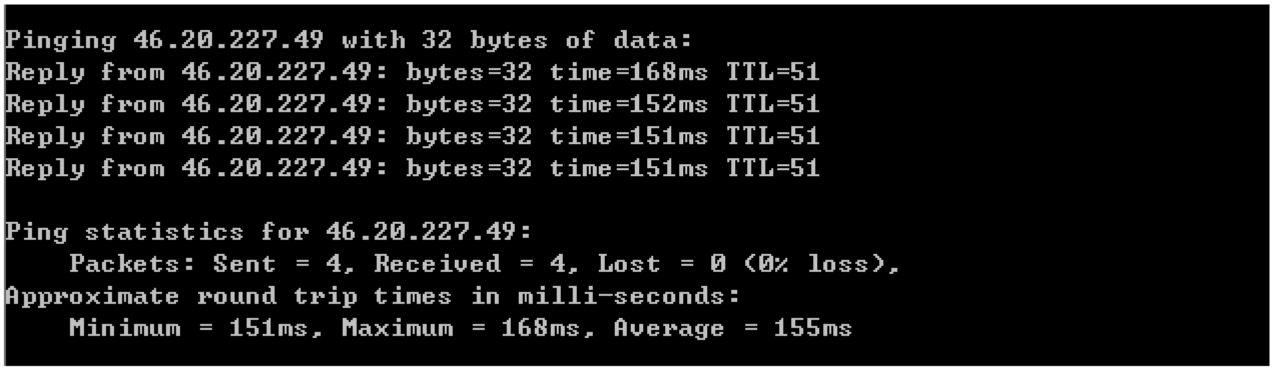
Firstly, we ping a server in US, which is in Tustin, pretty near from our current office. Now we ping the IP address of the server:



```
Pinging 74.80.237.108 with 32 bytes of data:
Reply from 74.80.237.108: bytes=32 time=24ms TTL=58
Reply from 74.80.237.108: bytes=32 time=2ms TTL=58
Reply from 74.80.237.108: bytes=32 time=3ms TTL=58
Reply from 74.80.237.108: bytes=32 time=4ms TTL=58

Ping statistics for 74.80.237.108:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 24ms, Average = 8ms
```

Secondly, we will ping a server in UK, which is very far from Tustin, CA, and to ping a server in UK, the signal must be transmitted from west coast of US to east coast of US, and then from east coast of US across Atlantic Ocean to UK. Since it is such a long distance, so it will cost almost as long 40 times as the ping time used in the first case.



```
Pinging 46.20.227.49 with 32 bytes of data:
Reply from 46.20.227.49: bytes=32 time=168ms TTL=51
Reply from 46.20.227.49: bytes=32 time=152ms TTL=51
Reply from 46.20.227.49: bytes=32 time=151ms TTL=51
Reply from 46.20.227.49: bytes=32 time=151ms TTL=51

Ping statistics for 46.20.227.49:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 151ms, Maximum = 168ms, Average = 155ms
```

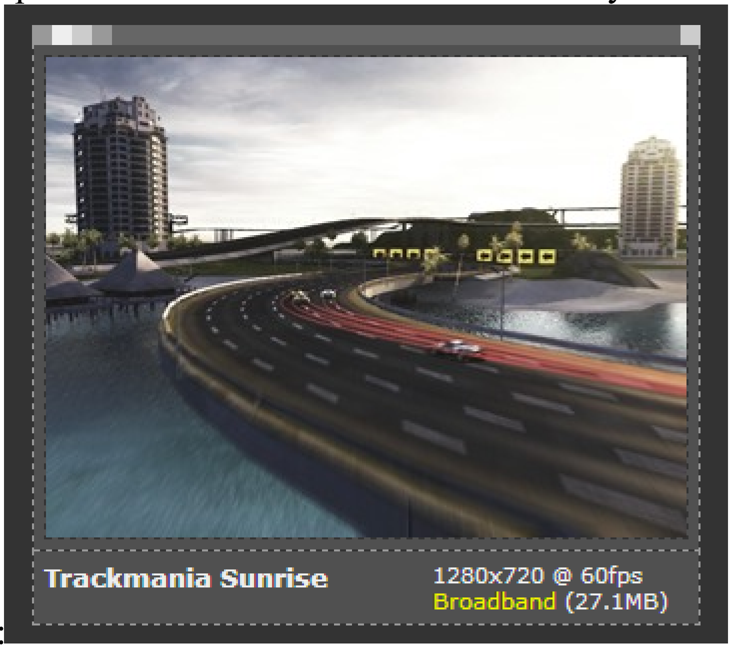
From all of the above, you can see the strong influence of long distance, which will result in the long response time. However, to improve the speed is not a small matter, it must contain many research in many areas, many facilities. But, in order to shorten the remote access latency, we should first measure the performance of remote access.

Measurement

In industrial world, everything must have a series of measurements, which we can rely on to test the quality of our product and whether our optimization is applicable. For instance, to measure the CPU, we refer to how much time it will cost to do integer calculation and floating point calculation. To test multi-media, we can take decoding rate, encoding rate, whether it is HD or not into account. As a result, it is necessary for us to come up with out own benchmarks. Until now, we only have two measurement ways.

Intuitively, the simplest thing is just to use the stopwatch to record starting time and ending time of each operation. Here, the stop watch doesn’t mean the real stop watch we use, but it means a smart software tools. It not only records how much time it uses to completely load the login page of remote server, but also records the time of every operation the user does., in other words, it is smart enough to keep track of user’s movements and judge what the user is doing now, even more, we can store the time used for every operation such as opening a file, opening a web page and so on into the database so that we can compare for each kind of operation in cloud system whether our optimization method is effective.

The second thing is that we can show the frame rate per second in a real time way. This inspiration comes from a software tools called “Fraps”. When we play a video game, we can open it at the same time to calculate how many frames per second. If the number of frame per second is over 30, the video games is fluent, otherwise, it gets stuck. So, I think we can develop our own tools like "Fraps" to measure the frame rate real-timely. The example of "Fraps" is as follows:



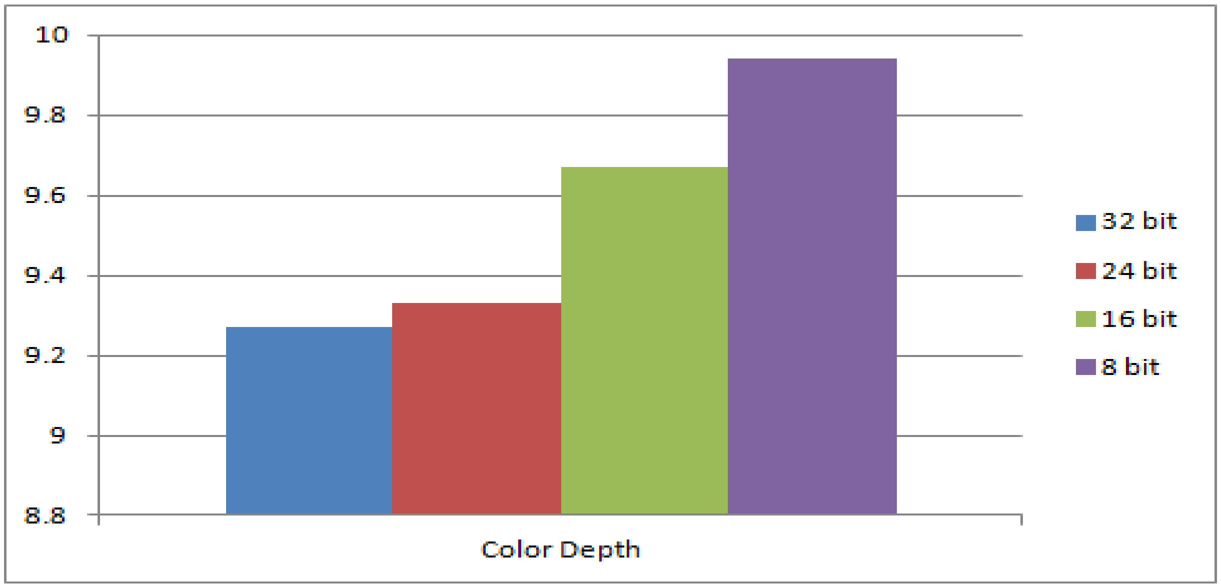
Here we can treat RDP as a simple kind of online video game so that we can use Fraps to measure its performance.In the above picture, the frame rate is 60fps. So we can also develop similar software to show the frame rate per second below RDP window.

Analyze performance of RDP

The main bottleneck of RDP locates in long propagation delay such that in order to improve performance, we'd better employ QoS in the network. In addition, to some extent, the quality of server can also affect RDP latency. However, all of these are not included in my research. What I do is mainly concerned with client side setting, which means through changing some properties of RDP client in Windows operating system, we can achieve improvement.

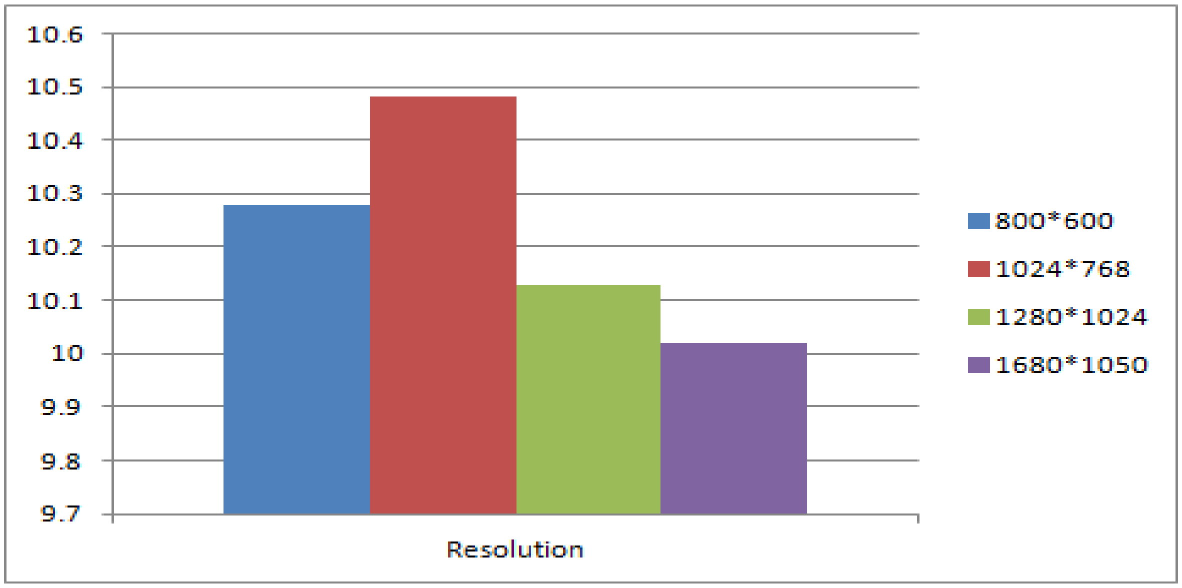
As is often the case, if the number of frames per second is more than 30, then we will feel that it is fluent. Once it is lower than 30, then we will feel the latency. If it is lower than 10, we will see that everything is intermittent. In order to give a convincing result, we must select highly interaction program as a test case. Therefore, I select a piece of video which shows a segment of soccer game. Because in soccer game, there are many motions, so I think it is a good test case. Thanks to the "Fraps" software, it can automatically benchmark for a given time period. (Insert a picture here) In this case, I let it automatically benchmark for 60 seconds. Then I use a series of such records to verify my assumption.

Color depth can contribute to the final performance although its function is not very outstanding. All the test cases here are given the same environment except color depth settings. There are four kinds of color depth scheme in my test case, 32-bit, 24-bit, 16-bit, 8-bit respectively. Intuitively by using a 8-bit setting, we can have a bit shorter response time. For each color depth scheme, I test at least 30 times, then I calculate the average frames per second. Now I will list the result as follows:



The above graph verifies my assumption. Lower color depth scheme can bring better performance.

Now we will turn to another factor which is resolution. Intuitively, it will follow the same pattern as color depth which is lower resolution will bring higher frames per seconds. However, the result tells me that my assumption turns out to be wrong. There are four kinds of resolution here, 800*600, 1024*768,1280*1024 , 1680*1050. Given the same environment except different resolution, for each resolution, I have tested more than 30 times, and I am too surprised to see that for the resolution 1024*768, it has the highest frames per second, not 800*600. The graph is as follows:

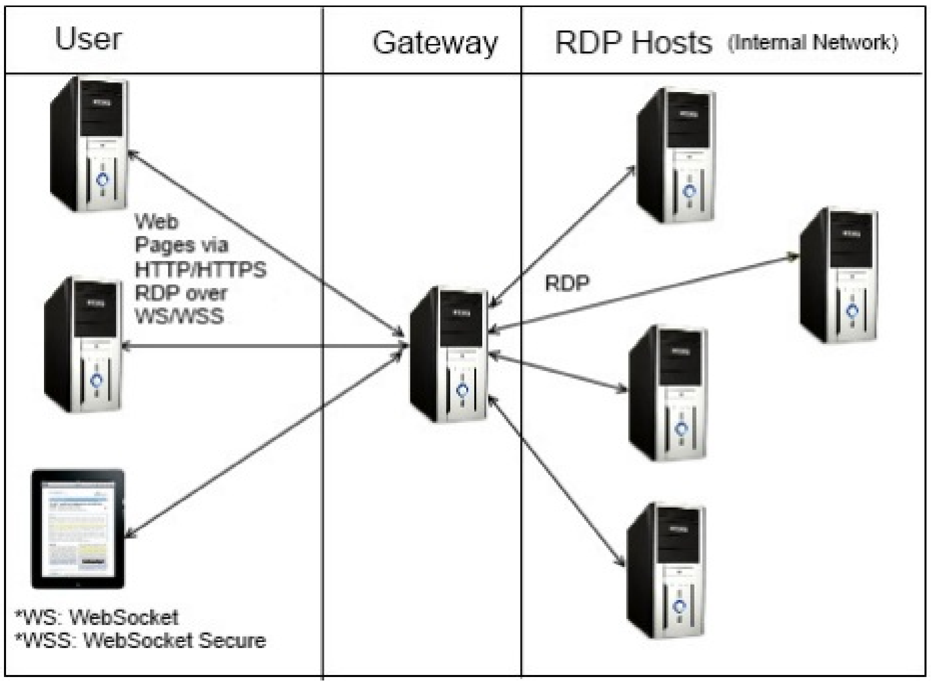


Why 1024*768 resolution has the highest number of frames per second? Maybe the reason is that for the resolution of 800*600, the total number of data which needs to be transmitted in the network is far less than that of resolution 1024*768. So the total number of frames is far less than that of resolution 1024*768, which can greatly affect the final "frames per second". Although we feel that 800*600 resolution gives us a faster response, its "frames per second" is not highest. All in all, it is just my guess. In addition, measuring "frames per second" is only one benchmark so it can't give us an overall judgement and we are required to get another several different benchmarks to make a complete analysis.

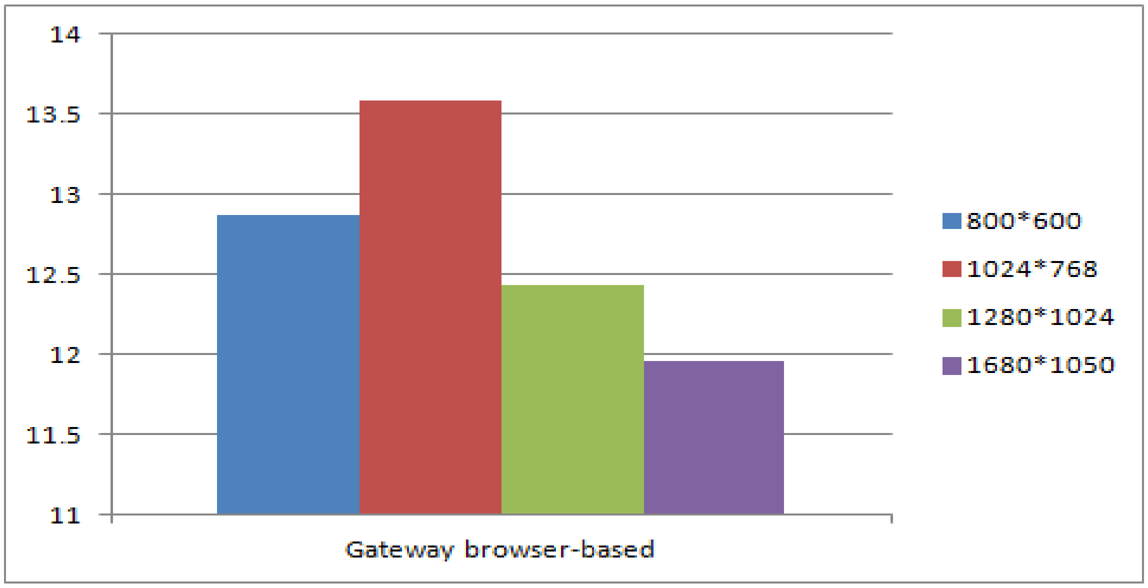
Another method other than RDP

Although RDP appears good for remote access requirement, its usage is restricted by platform. RDP is Microsoft's product. But in Linux, we'd better use ISA instead. They are all thin clients, which follows client-server mode. We must transfer it from C/S mode to B/S mode. What if we accomplish remote access just using a simple browser? Suppose we can install Google Chrome on every operating system, and thus there is no compatibility issue.

How to accomplish this goal? We can refer to "Spark Gateway". What's "Spark Gateway"? It is kind of agent. The working scheme is as follows:


User
Gateway
RDP Hosts (Internal Network)
Web Pages via HTTP/HTTPS RDP over WS/WSS
RDP
*WS: WebSocket
*WSS: WebSocket Secure

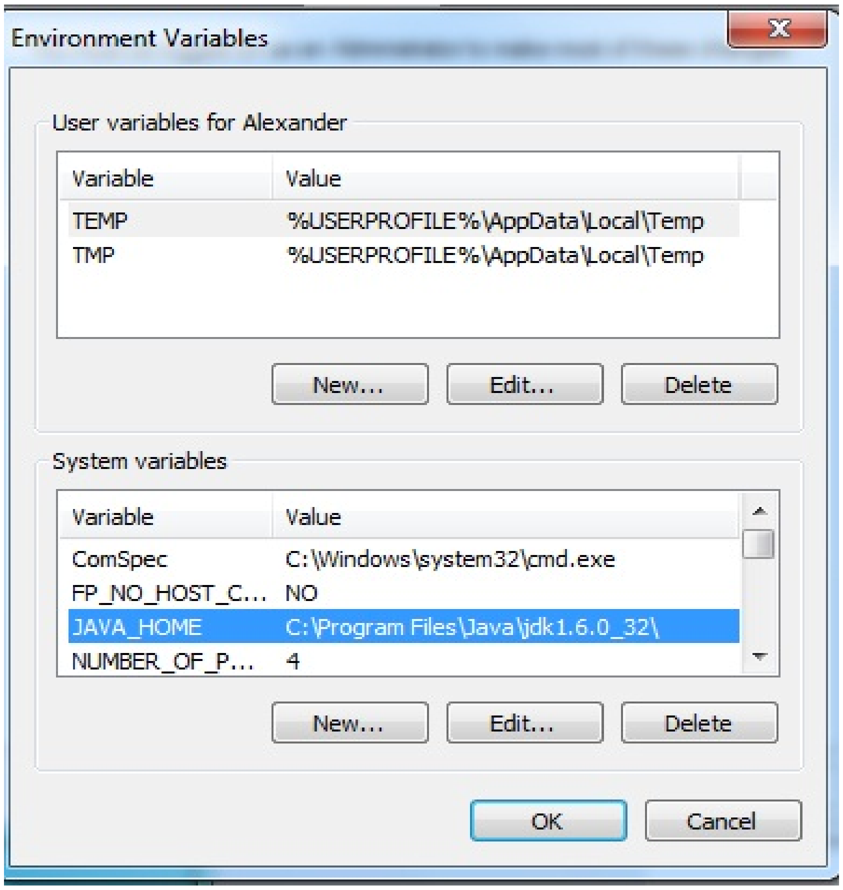
User passes request to Gateway server using http protocol, and then Gateway server communicate with hosts using RDP protocol, and in the end Gateway server passes response back to user by http protocol. As you see, Gateway server is just an agent in this scenery. It is not user directly using RDP protocol to communicate with hosts anymore, instead Gateway server does this thing. How about its performance? It seems like its performance will be even worse than that of RDP because we add the third party in it. However, under the same setting of session including color depth, resolution and so on, the only difference is that at this time we use browser-based method. The performance of browser-based remote access has improved 30%-40% compared with RDP. The result is as follows:



Why can this happen? According to the instruction, Spark Gateway company makes several optimization in QoS and local cache so that we can enjoy better performance. But the detailed modification still remains secret for us.

Now let's turn to how to use this software tool. Here I must make a statement, for the real users what they need is just a Google Chrome browser. But as the administrator of the server, we need to install Spark Gateway server as agent.

1, First we should download Spark Gateway application online, and install newest JDK. Then we set the environmental varible "JAVA_HOME" in our system.

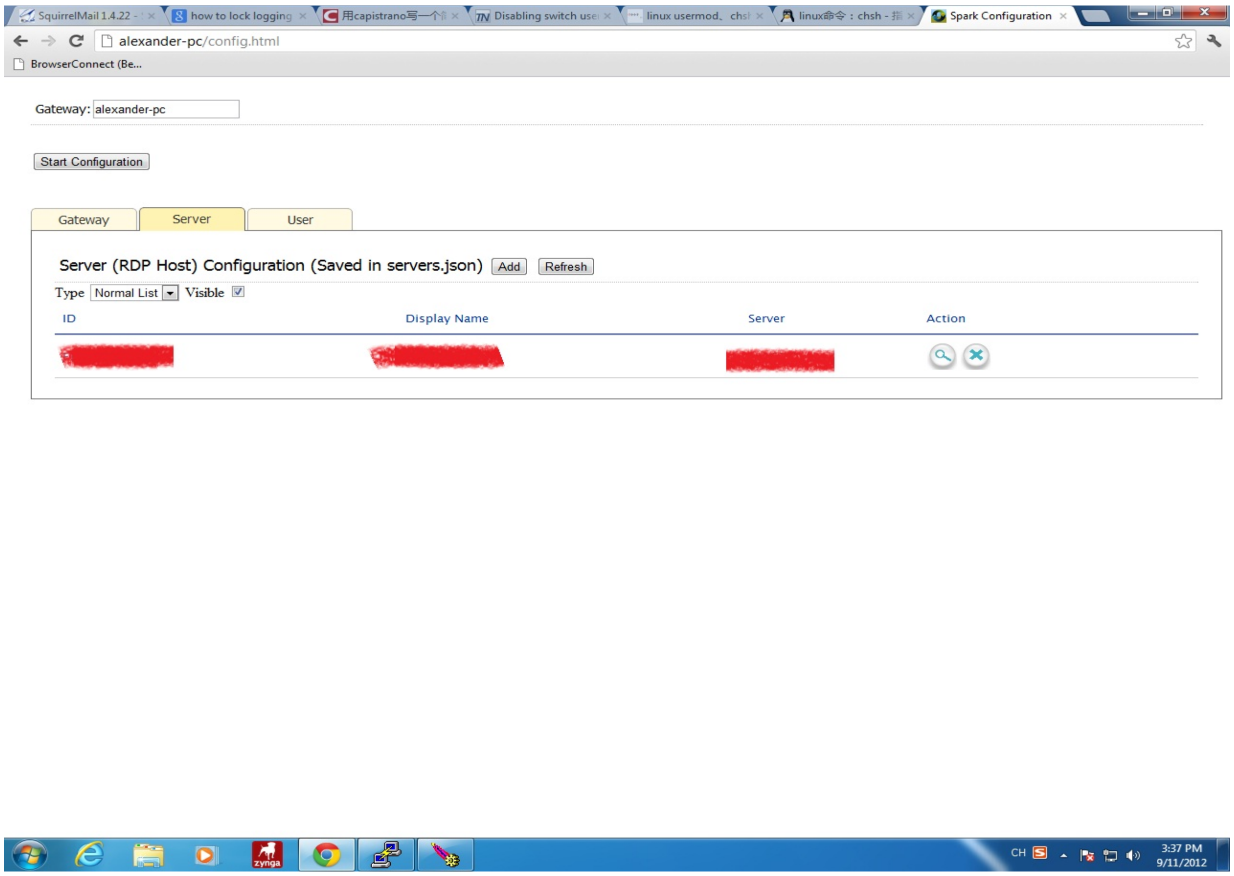


Variable	Value
TEMP	%USERPROFILE%\AppData\Local\Temp
TMP	%USERPROFILE%\AppData\Local\Temp

Variable	Value
ComSpec	C:\Windows\system32\cmd.exe
FP_NO_HOST_C...	NO
JAVA_HOME	C:\Program Files\Java\jdk1.6.0_32\
NUMBER_OF_P...	4

2, Click "Spark Gateway" Manager and start the service.

3, Since we already open the server service, and now we can configure gateway server now. The gateway name is your PC's name. Suppose here my PC's name is "alexander-shen", then this gateway's name is also "alexander-shen". Now, I input the URL "alexander-shen/config.html" in the browser and then open the "Server" tab and input server's name, port number and so on. After finishing input, the server information will be stored in a "JSON" file.


alexander-pc/config.html

Gateway: alexander-pc

Start Configuration

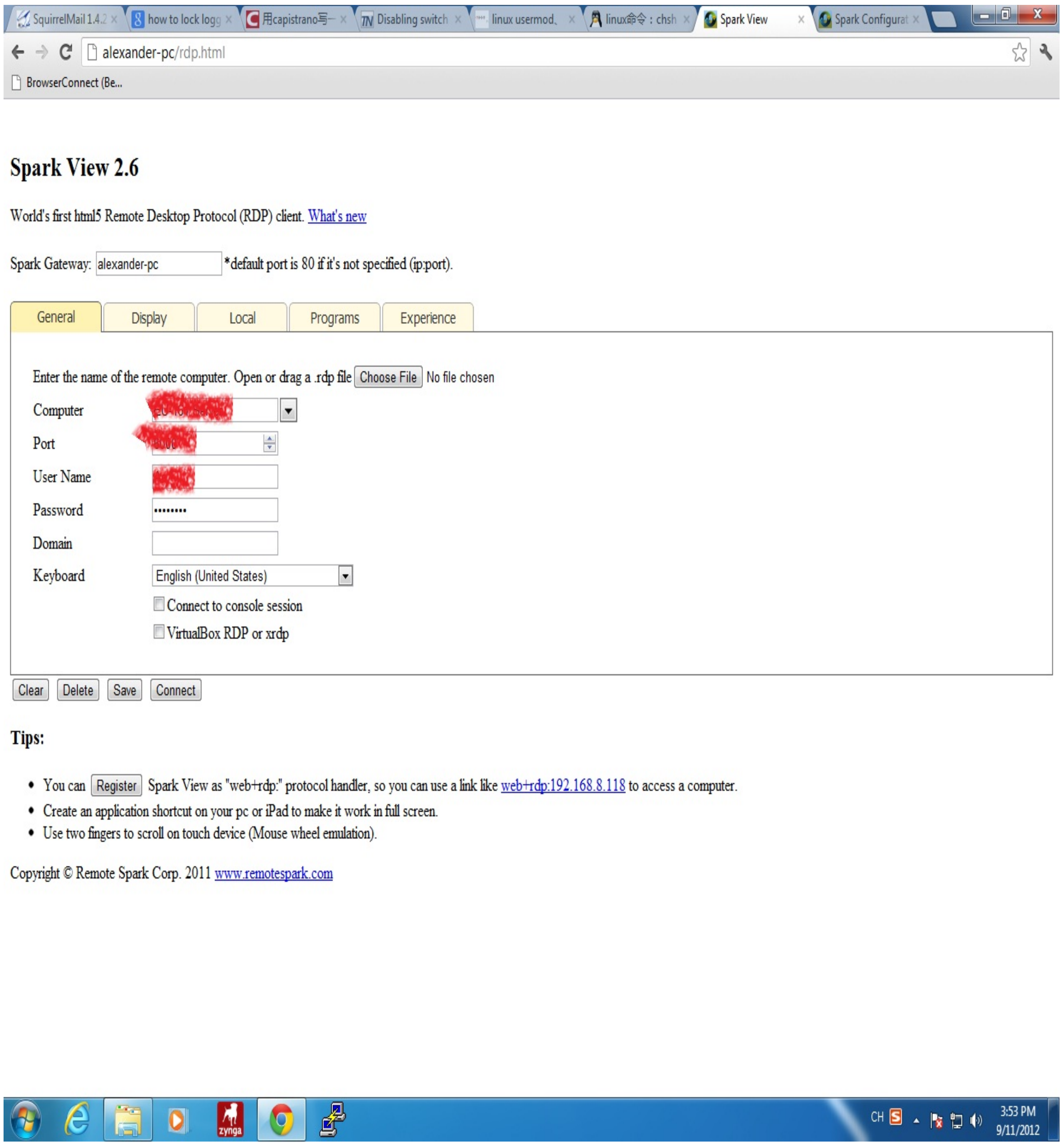
Gateway | Server | User

Server (RDP Host) Configuration (Saved in servers.json) Add Refresh

Type Normal List Visible ✓

ID	Display Name	Server	Action
[redacted]	[redacted]	[redacted]	

4, In this step, we can input “alexander-pc/rdp.html” in the browser, and then all the server information will be automatically read from JSON file to “rdp.html” webpage. In other wise, when loading it, it must be synchronized with “servers” JSON file.



Spark View 2.6

World's first html5 Remote Desktop Protocol (RDP) client. What's new

Spark Gateway: alexander-pc *default port is 80 if it's not specified (ip:port).

General | Display | Local | Programs | Experience

Enter the name of the remote computer. Open or drag a .rdp file Choose File No file chosen

Computer	[redacted]
Port	[redacted]
User Name	[redacted]
Password	••••••••
Domain	
Keyboard	English (United States)
	☐ Connect to console session
	☐ VirtualBox RDP or xrdp

Clear Delete Save Connect

Tips:

- You can Register Spark View as "web+rdp:" protocol handler, so you can use a link like web+rdp:192.168.8.118 to access a computer.
- Create an application shortcut on your pc or iPad to make it work in full screen.
- Use two fingers to scroll on touch device (Mouse wheel emulation).

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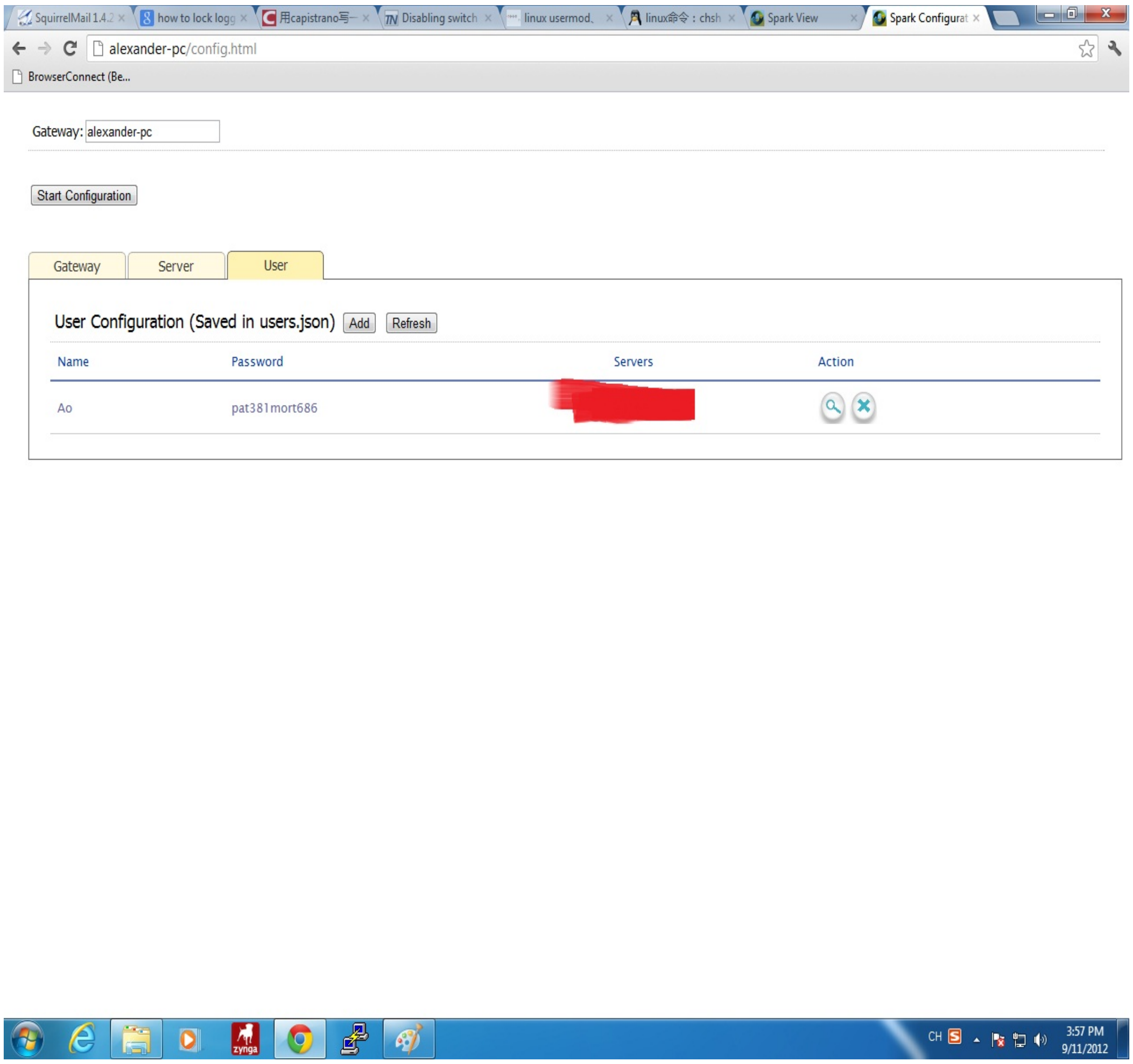
At the present, we finish all the basic configuration job. The above "rdp.html" will be shown to all the users but "config.html" is only open to server administrator.

5, What's more, we can also classify the servers and applications by the user name. What we to do is to add a new user and add the server name(can be one, or can be several) to this new user. The graph is as follows:


Gateway: alexander-pc

Start Configuration

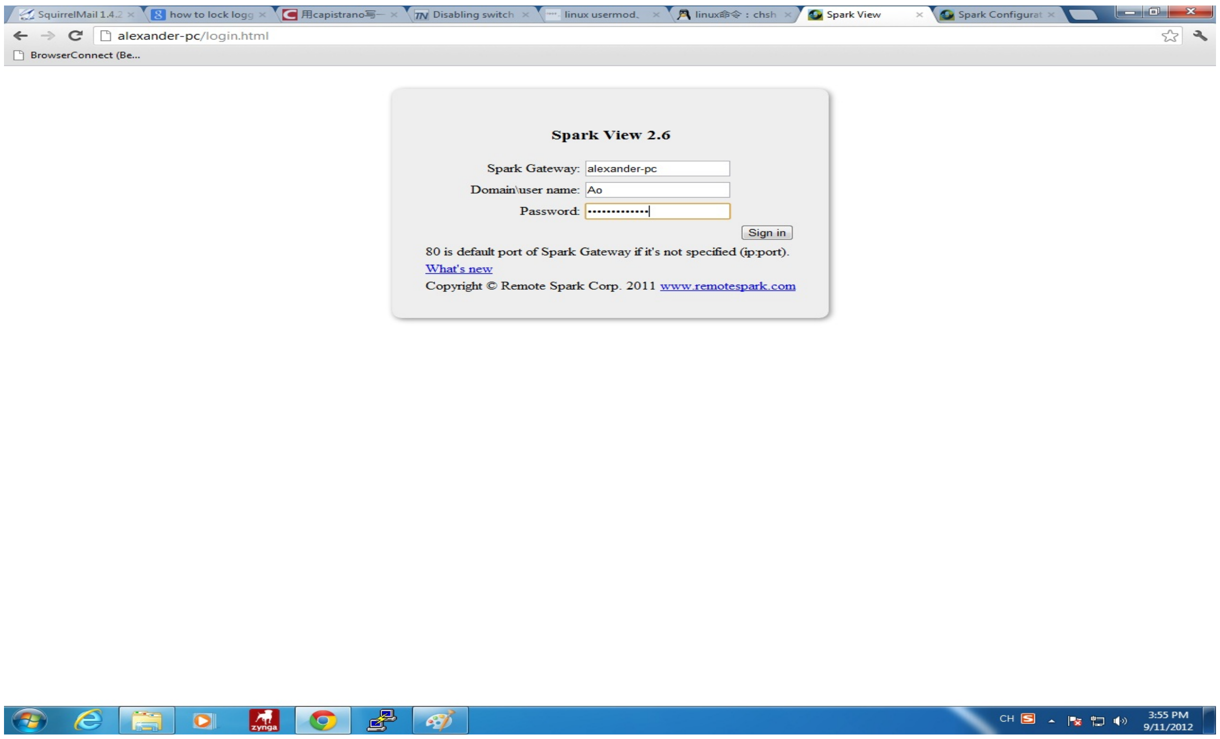
Gateway | Server | User

User Configuration (Saved in users.json) Add Refresh

Name	Password	Servers	Action
Ao	pat381mort686	[redacted]	

6, As we create a user, so we can log in this newly created user’s space. In user’s space, you can see all the servers which this user can log in. We can see it from the following graphs.

Login page:



alexander-pc/login.html

Spark View 2.6

Spark Gateway:	alexander-pc
Domain\user name:	Ao
Password:	•••••••••••••

Sign in

80 is default port of Spark Gateway if it's not specified (ip:port).

What's new

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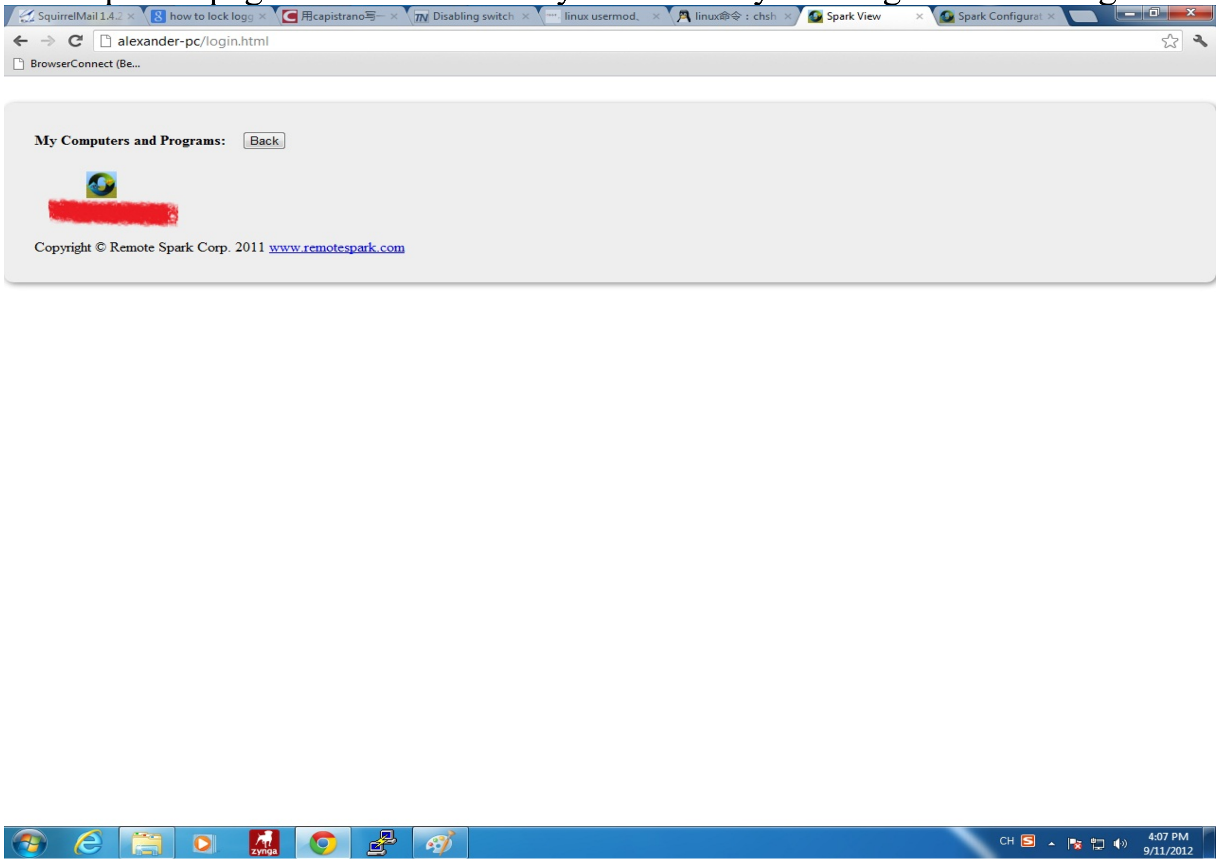
User Space's page: You can enter in your server by clicking one of the logos.



alexander-pc/login.html

My Computers and Programs: Back

[redacted]

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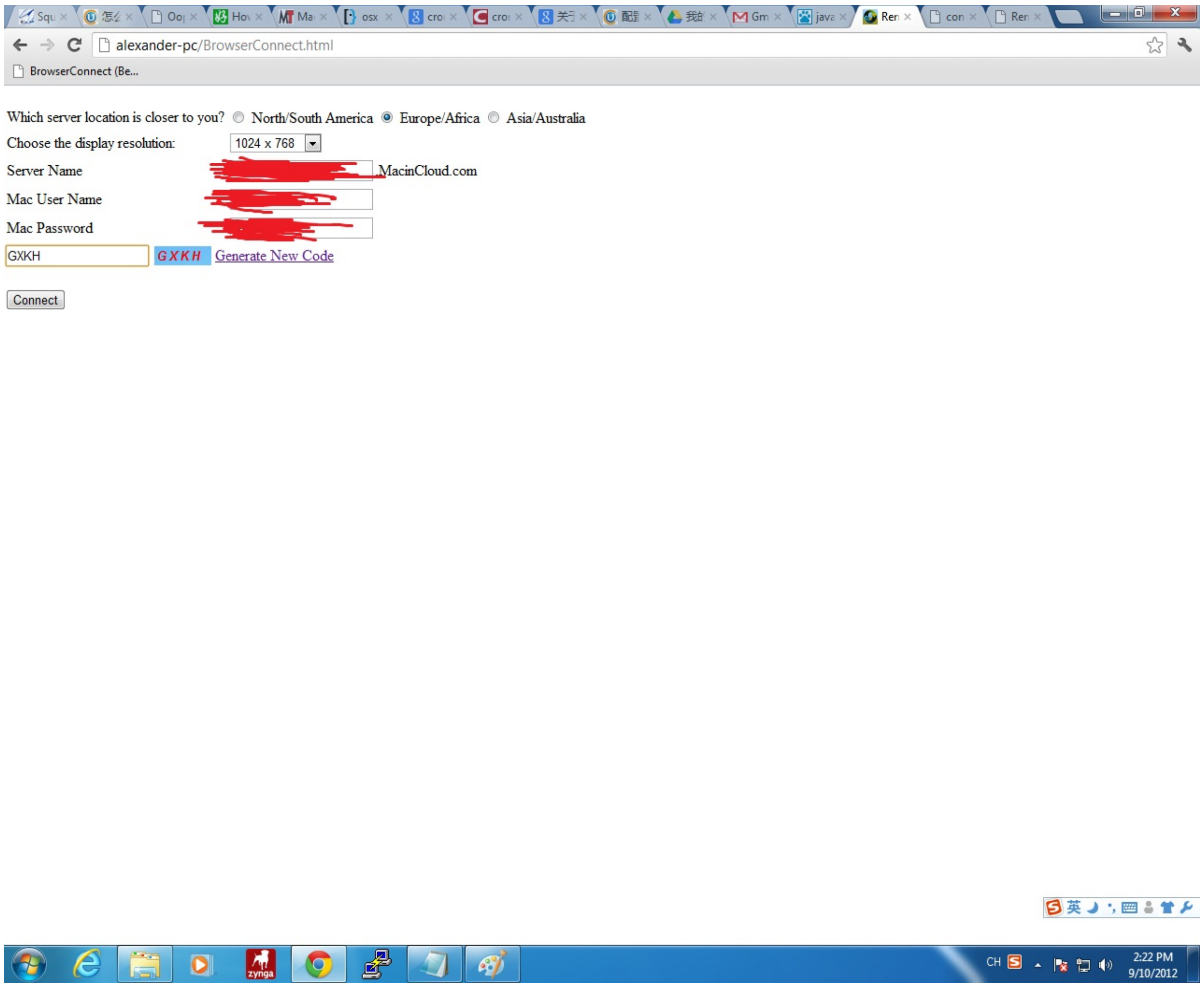
7, We can also write our own login webpage as long as we put it into the right folder in the server. I write a simple login webpage using “Dreamweaver” and pass the parameter in the form of cookie to another webpage called “rail.html” in the web container. When loading “rail.html”, it will use the parameters in the cookie to connect to real host server which contains the user’s content and present it to the user.


alexander-pc/BrowserConnect.html

BrowserConnect (Be...

Which server location is closer to you? ○ North/South America ● Europe/Africa ○ Asia/Australia

Choose the display resolution: 1024 x 768

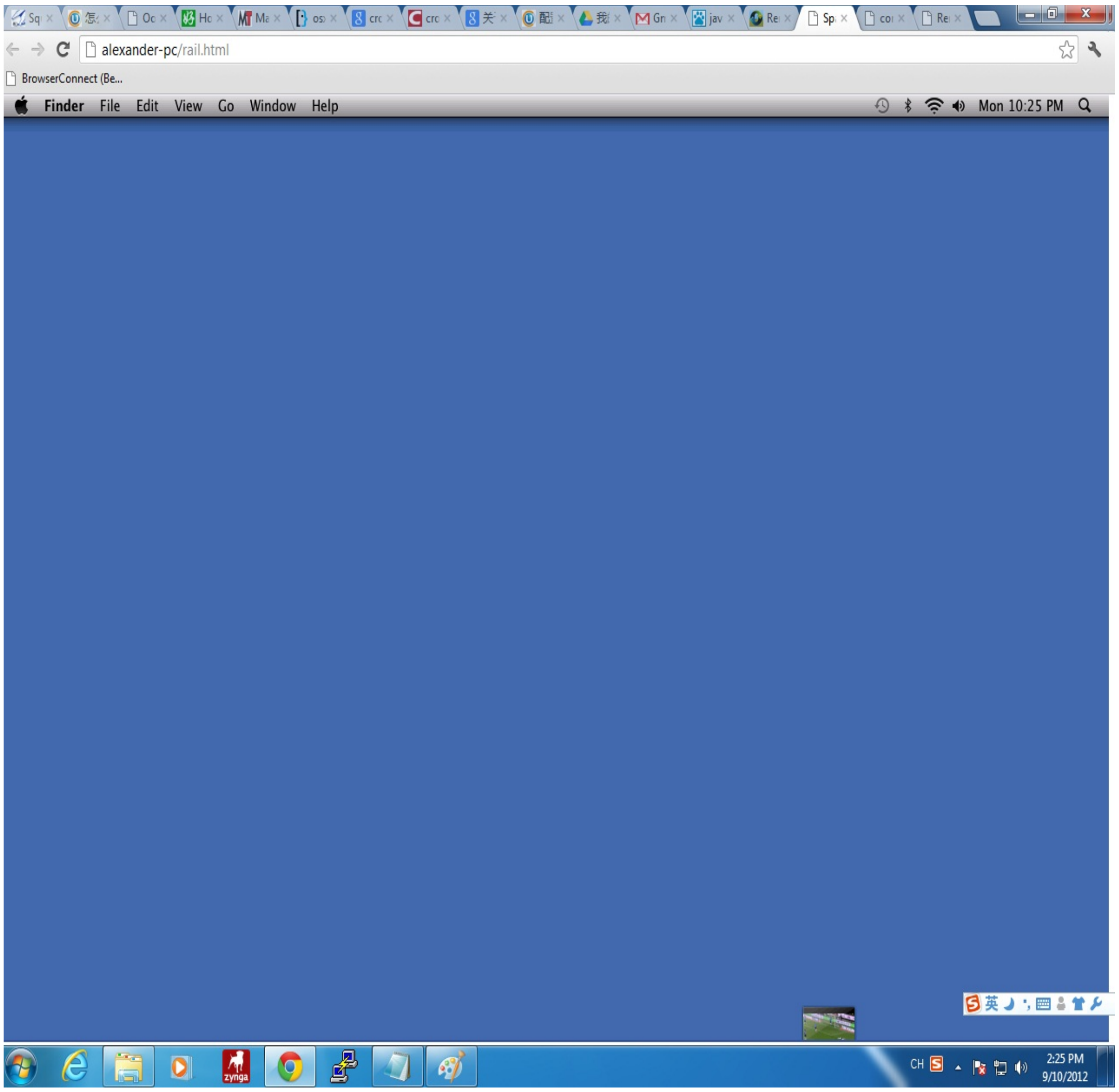
Server Name [redacted] MacinCloud.com

Mac User Name [redacted]

Mac Password [redacted]

GXKH GXKH Generate New Code

Connect



Of all the steps above, we must operate them under one specific gateway server and the parameters are strictly transmitted within the web container, not among different gateway servers, otherwise the parameters will be missing!!!

Reference:
1,http://www.remotespark.com/view/AdminManual.pdf
2,http://www.virtualizationadmin.com/articles-tutorials/terminal-services/performance/poor-bandwidth-latency.html