Department of CEE/ Computer Science

Crack Me If You Can: Using GPU Machines to Crack Passwords

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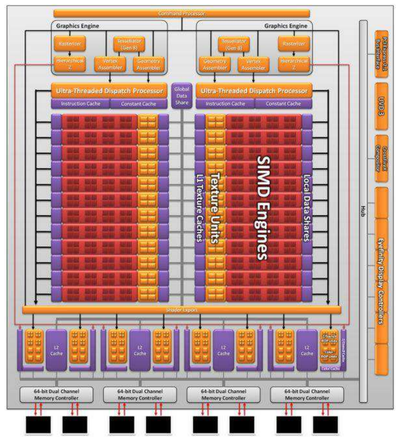
Background

➢**What is a GPU?**

➢GPU, short for graphic processing unit, is an electric circuit used for accelerated image creation; however, due to its increased speed we can use it to crack passwords faster than the normal CPU (central processing unit).



➢ATI Radeon HD6970 diagram (anandtech.com) and picture (pcpro.co.uk)

➢**How do you crack a password?**

➢The first step to cracking a password using a GPU is obtaining the user database containing the different hashed passwords. Afterwards, you can use a GPU to recover the passwords using these attacks:

➢**Dictionary Attack:** It uses a catalog made up of a list of common passwords and/or different dictionary words.

➢**Masks:** It adds to the dictionary attack by generating different sequences of characters either before or after the word from the dictionary attack.

➢**Brute force attacks:** Generates random sequences of characters in order to crack the password.

➢**How is a password encrypted?**

➢**Hashing:** It converts the password into a pseudo-random sequence of characters. The hashes are stored in the user database.

➢**Salts:** It is random data added to the password before it is hashed in order to make the password harder to crack.

Problems

➢People tend to use short and/or common passwords to remember them. They don't realize it makes it easier for GPU cracking.

➢People also use these same passwords in various accounts

Solutions

➢Your password should include symbols, upper and lower case letters, and digits. The password must be at least 15 characters long to have a strong password.

➢**Dice words:** They are compound dictionary words mixed in with other characters in order to make the password easier to remember but harder to crack.

➢**Password locker:** It is a secure database which requires you to remember one complicated password but grants you access to all your other passwords.

Objectives and Methods

➢**Comparing two different GPUs with different stream processors to see the different recovery rates.**

➢NVIDIA – Used with Autocad and other less graphically intensive programs.

➢ATI Radeon – Used for 3D gaming which makes it have a faster recover rate. The 3D gaming operations are more suited for password cracking.

➢**Using different dictionaries to see which one is easier to crack passwords.**

➢example.dict (129,988 words)

➢dic94.txt also known as large.dict on ATI (869,232 words)

➢example.dict & password.lst (133,545 words)

➢**Creating our own user data base with easy, medium, and hard passwords and seeing what the ATI machine is able to crack.**

➢We all chose a password we thought was easy, medium, and hard, and we used sha1 algorithm to generate the hashes.

➢With the generated database, we used dictionary, a6, a7, and a3 attacks to crack the passwords.

➢A6: add characters at the end of the dictionary word

➢A7: add characters at the beginning of the dictionary word

➢A3: brute force attack

➢**Comparing different recovery rates of hashing algorithms.**

➢sha1: Stands for secure hash algorithms and is the most used algorithms. In an attack in 2005, it took less than 2^{69} operations to brute force the algorithm.

➢sha256: Designed by the NSA and is over a decade old.

➢sha512: Is one of the slowest out of the sha family.

➢md5: It is considered cryptographically broken and unsuitable for further use.

Results and Conclusions

Table 1: NVIDIA VS. ATI with large.dict

Algorithm	Attack	NVIDIA	ATI
sha1	Dictionary	4 min 44 sec.	15 sec. 60004/s
	Append 1 character	1 hr. 32 min 4899/s	34 sec. 1396.7k/s
	Append 2 characters	2 days 4963/s	14 min 31 sec 1691.1k/s
sha256	Dictionary	8 min 6 sec 1823/s	21 sec 82368/s
	Append 1 character	3 hr. 13 min 2349/s	1 min 21 sec. 621.8k/s
	Append 2 characters	4 days 6 hr. 2361/s	23 min 17 sec. 639.3k/s
sha512	Dictionary	34 min 22 sec. 416/s	40 sec 23337/s
	Append 1 character	15 hr 34 min 286/s	4 min 20 sec. 111.5k/s
	Append 2 characters	20 days 15 hr 488/s	2 hr. 23 min 111.0k/s
md5	Dictionary	2 min 56 sec 5284/s	14 sec 134.9k/s
	Append 1 character	38 min 57 sec 11445/s	22 sec. 2210.5k/s
	Append 2 characters	20 hr. 7 min 11795/s	8 min 10 sec 2935.5k/s

The ATI was much faster than the NVIDIA because of these two reasons:

➢ATI had two GPU cards while NVIDIA had only one

➢People have made GPU rigs with 25 ATI cards to increase the cracking rate.

➢ATI is more suited for cracking passwords while NVIDIA is more for Autocad graphics and architectural drawing.

Table 2: NIVIDIA with example.dict and password.lst

Attack	md5	sha1
Dictionary	49 sec. 2743/s	1 min 7 sec. 1935/s
-a 6 ?l	5 min 35 sec 10886/s	12 min 27 sec 4775/s
-a 6 ?d	2 min 34 sec 9161/s	5 min 15 sec 4376/s
-a 6 ?u	5 min 34 sec 10865/s	Approx. 12 min 13 sec
-a 7 ?d or ?l or ?u	50 min 45 sec 1139/s	Approx. 2 hr. 6 min
-a 6 ?l?l or ?u?u	2 hr. 6 min	Approx. 5 hr. 3 min
-a 6 ?d?d	19 min 14 sec	Approx. 45 min 35 sec
-a 7 ?l?l or ?u?u	2 hr. 6 min	5 hr. 10 min
-a 7 ?d?d		2 hr. 1 min

➢**The md5 algorithm was a lot faster to crack than the sha1 algorithm.**

➢**It's faster to find characters that are after the dictionary word than it is to find ones that are before the word (with this GPU program).**

➢**Adding more characters is slower due to the combination of characters increasing.**

➢(number of characters in character set)$^{\#\text{ of characters}}$

➢ 1 lower letter = 26^1 combinations

➢ 2 lower letters = 26^2 combinations

Table 3: Recovery Time of Our Chosen Passwords (ATI)

Password	Time	Password	Time
madi	1 sec.	jan2597	1 hr. 35 min 5 sec.
monster	1 sec.	Password	4 hr. 26 min 8 sec.
jennyan	7 sec.	Jan563	4 hr. 29 min 29 sec
mudit	12 sec	Madi97	10 hr. 31 min 55 sec.
apple123	1 min. 4 sec	din436M	6 days 14hr 1m 30s
pizzapie	5 min 2 sec.		

Examples of Strong Passwords:

M@rBr@M238 a24Brg31.hI M@R32vZX2011Aug C0RnT0RtillAr85
my4NQ#4ha90G~7 EnqI80AedpF9Pf2

➢**The strength of the passwords depends on the size of the dictionary and the number of GPU cards used by the cracker.**

➢There are massive dictionaries with hundreds of millions of words including "nonsense words" that may be able to crack these passwords.

Acknowledgements and References

➢Chevron and NSF for funding REVS-UP

➢GPU Program: oclHashcat-plus @ http://hashcat.net/oclhashcat-plus/

A portion of the 25 GPU rig. The image is from bitcointalk.org.