Adventures in Disclosure:
A Look at the Legal Exploit Sales Market

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Who am I

- Principal Analyst, Independent Security Evaluators
- Previously, 5 years at National Security Agency (USA)
- PhD, University of Notre Dame
- Security Researcher
  - Find Bugs: iPhone, SecondLife, Safari, QuickTime...
  - Won CanSecWest Pwn2Own contest
  - Write papers, books; give talks, etc

Questions

- A security researcher discovers a vulnerability in a widely deployed application
  - What do they do with it?
  - What influences their decision?
- What is the impact of these answers on Internet security in general

Facts

- Zero Day Initiative (ZDI) offers approximately $5000 for high profile vulnerabilities
- iDefense Labs has offered various challenges including
  - $16-24k for each vulnerability found in applications such as Apache httpd, OpenSSH, Sendmail, IIS (Q2-Q3 2007)
  - $8-12k for email clients and servers (Q4 2007)
- In 2006, the U.S. Department of Homeland Security gave $1.24 million to Stanford and Coverity to hunt bugs in open source software

Agenda

- Why are researchers always causing trouble?
- All about disclosure
- So you don’t want to disclose?
- Case studies: adventures in (non)disclosure

Reasons you break things

- You are responsible for the system's security
- Someone hired you to test the security of a system
- You are a researcher
- Proving utility of new analysis technique
- Raising your profile
- Someone says their product is unbreakable
- You have nothing better to do

Unbreakable

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Username

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Sign In

Lost your password? Click here

All about disclosure

- No disclosure
- Full disclosure
- Responsible disclosure

No disclosure

- Can mean a few things
  - Don’t tell anyone
  - Just sit on it
  - Tell your friends
  - Sell information to interested third party

No disclosure (cont.)

- Pros
  - Little chance of legal action
  - Requires little work - easy
  - Possible financial gain
- Cons
  - Consumers may not be protected
    - Fails the “grandmother rule”

Full disclosure

- Reveal information without previously contacting vendor
  - Post on mailing list
  - Give talk at conference
- Vendors really hate this!

Full disclosure (cont.)

- Pros
  - Vendors tend to react quickly to this information
  - Trivial to do
  - Can raise your profile - for good or bad
- Cons
  - Puts consumers at risk until patch is developed
  - Can provide recipe for bad guys

Responsible disclosure

- Contact vendor with vulnerability details
- Wait for vendor to develop patch, fix, or new version of product
- Coordinate release of vulnerability information

Responsible disclosure (cont.)

- Pros:
  - Consumers are protected at all times
  - Can develop good relationship with vendor
- Cons:
  - Vendor may not be cooperative
  - Vendor may not understand the severity of the vulnerability
  - Vendor may not develop patch in a timely manner
    - Oracle has taken over two years to patch

When responsible disclosure is a bad idea

- You want the vendor to work quickly

ZDI-CAN-226	Symantec	High	2007-09-14, 195 days ago
ZDI-CAN-211	Microsoft	High	2007-07-20, 251 days ago
ZDI-CAN-206	Hewlett-Packard	High	2007-07-17, 254 days ago
ZDI-CAN-224	Oracle / PeopleSoft	High	2007-07-13, 258 days ago
ZDI-CAN-222	Motorola	High	2007-07-10, 261 days ago
ZDI-CAN-200	IBM	High	2007-05-22, 310 days ago
ZDI-CAN-185	Hewlett-Packard	High	2007-05-22, 310 days ago
ZDI-CAN-174	Symantec	High	2007-05-22, 310 days ago
ZDI-CAN-186	Microsoft	High	2007-03-29, 364 days ago
ZDI-CAN-177	Hewlett-Packard	High	2007-03-19, 374 days ago
ZDI-CAN-175	Microsoft	High	2007-03-19, 374 days ago
ZDI-CAN-165	Novell	High	2007-03-09, 384 days ago
ZDI-CAN-160	Oracle / PeopleSoft	High	2007-01-29, 423 days ago
ZDI-CAN-105	Hewlett-Packard	High	2006-10-10, 534 days ago
ZDI-CAN-103	Microsoft	High	2006-09-14, 560 days ago
ZDI-CAN-088	Computer Associates	High	2006-09-12, 562 days ago
ZDI-CAN-063	Computer Associates	High	2006-09-12, 562 days ago

- You fear legal prosecution
  - http://www.securityfocus.com/columnists/466/4

The system is broken

- Responsible disclosure
  - Get credit for your discovery (hopefully)
  - Must convince the company there is a bug
  - Typically, wait for company to fix the bug at their pace
  - Worst case, the company threatens to sue you or you could face possible criminal action

The system is broken (cont.)

- No disclosure
  - You don’t get credit for discovering it (publish a hash...)
  - You possibly get lots of money
    - See my new kitchen, bathroom
  - You don’t get sued
  - You don’t have to deal with companies

So you don’t want to disclose...

- Vulnerabilities have been bought and sold for many years
- A few programs exist which pay researchers for vulnerability information:
  - Zero Day Initiative (TippingPoint)
  - Vulnerability Contributor Program (iDefense)
  - Exploit Acquisition Program (SNOsoft)
- Some companies sell tools or packages containing 0-day exploits
  - Ultimate 0day Exploits Pack (Argeniss)
  - VulnDisco Pack (GLEG)
  - Canvas (IMMUNITY)
- How can a researcher get paid a fair value in the legal vulnerability

Obstacles faced

Time sensitivity

- Vulnerability information is only valuable when it is not widely known
- A patch can make it worthless
- Other technologies, SElinux, /GS flag, other patches, newer versions can reduce the value
- Researcher doesn't have knowledge of when these things will occur (except "Patch Tuesday")
- Therefore, researchers must be able to locate a buyer and complete a sale quickly

No pricing transparency

Vulnerability/Exploit	Value	Source
“Some exploits”	$200,000 - $250,000	A government official referring to what “some people” pay
Vista Remote	$200,000	Unnamed contractor
a “real good” exploit	over $100,000	Official from SNOsoft research team
Flash or PDF exploit	$75,000	Price I brokered with contractor
Vista exploit	$50,000	Raimund Genes, Trend Micro
“Weaponized exploit”	$20,000-$30,000	David Maynor, SecureWorks
ZDI, iDefense purchases	$2,000-$10,000	David Maynor, SecureWorks
WMF exploit	$4000	Alexander Gostev, Kaspersky
Microsoft Excel	> $1200	Ebay auction site
Mozilla	$500	Mozilla bug bounty program

Difficulty finding buyers

- No public marketplace (mostly)
- Must contact many potential buyers
- Companies do not advertise that they buy vulnerabilities
- Good luck contacting the government
- Perhaps vendors should buy this information...

Checking the buyer

- How does the researcher verify that a buyer is legitimate, i.e. not a terrorist or criminal?
  - Scenario: Sell an OpenSSH exploit used by terrorist to attack nuclear reactor systems... Welcome to gitmo!
- Need trusted third parties

Value cannot be demonstrated without loss

- Once the vulnerability is shown to a potential buyer, why should they pay for it?
- Demonstrating via exploit is no better
- Giving too much vague information can reveal the vulnerability
  - Version
  - Authentication
  - Stability
- Typically, buyers require seeing the exploit/vulnerability information before they send payment (or even make an offer)

Exclusivity

- How does the researcher guarantee exclusivity of rights?
- “Sometimes we get burnt, sometimes not” - Dave Aitel, Immunity Security Inc.

Solutions

Small steps

- Post a hash of the exploit
- “Mutually assured destruction”
- Proving the exploit exists
  - can be done in person

Market place solutions

- Of the 5 market types suggested by Bohme in "Vulnerability Markets", only one
  - Doesn't require vendor initiation and
  - Has immediate incentive for researcher
- Exploit derivatives
  - Contracts which pay based on whether vulnerability events occur
  - Researchers benefit with "insider" knowledge
  - Advantage: no exploits need to actually be sold.
  - Disadvantage: unclear how much researchers could make.
  - Requires a TTP

Direct auction

- Sell exploit to the highest bidder(s)
- Has been tried via Ebay
- Could use “reputational” system
- Could offer escrow services
- Visibility into pricing and vulnerability information is obtained
- Drawbacks: legality, exclusivity

WabiSabiLabi

- Its a buyer's market...

Code	Time to live	Title	System	Offer type	Last bid	
ZD-00000223	5d 6h 7m	AbleDating	Web application	Auction Buy now at	0€ 0 bid(s) 300€	info
ZD-00000222	5d 6h 7m	phpFoX	Web application	Auction Buy now at	0€ 0 bid(s) 300€	info
ZD-00000220	5d 6h 7m	Camfrog	Windows Vista	Auction	0€ 0 bid(s)	info
ZD-00000218	5d 6h 7m	PHP-Nuke	Web application	Auction	0€ 0 bid(s)	info
ZD-00000199	5d 6h 7m	Avaya	Windows Server 2003	Auction Buy now at	0€ 0 bid(s) 500€	info
ZD-00000190	5d 6h 7m	phpShop #2	PHP	Auction Buy now at	0€ 0 bid(s) 1,000€	info
ZD-00000183	5d 6h 7m	CA ARCserve Backup for Laptops & Desktops	Windows XP	Auction Buy now at	0€ 0 bid(s) 900€	info
ZD-00000117	5d 6h 7m	Phpauction	Windows Server 2003	Auction	0€ 0 bid(s)	info
ZD-00000077	5d 6h 7m	GemStone	Linux	Auction	0€ 0 bid(s)	info
ZD-00000072	5d 6h 7m	DWebPro	Windows Server 2003	Auction	0€ 0 bid(s)	info
ZD-00000065	5d 6h 7m	Weird Solutions BOOTPTurbo	Windows XP	Auction Buy exclusively at	0€ 0 bid(s) 500€	info
ZD-00000031	5d 6h 7m	ElectroServer	Linux	Auction	0€ 0 bid(s)	info
ZD-00000029	5d 6h 7m	3Com FTP server	Windows XP	Auction	0€ 0 bid(s)	info
ZD-00000017	8d 6h 7m	MailEnable	Windows 2000	Auction Buy now at	0€ 0 bid(s) 500€	info

WabiSabiLabi statistics

- Total received submissions for evaluation from July 2007 to date: 223
- Total vulnerabilities accepted and listed to the marketplace : 81
- Vulnerabilities sold: 32

More statistics (Euros)

- Average sale price: 1821
- Median sale price: 650
- Minimum sale price: 100
- Maximum sale price: 5100
- 13 unique buyers
- 97% of auctions had only one bidder

Who visits this site?

- 10. SAP
- 9. Verisign
- 8. Oracle
- 7. US Army
- 6. F-Secure
- 5. Symantec
- 4. Veritas
- 3. IBM
- 2. Microsoft
- 1. Cisco

Case studies

Case Study #1 - Samba

- Samba is an open source set of programs that impliments Server Message Block (SMB) / Common Internet File System (CIFS) protocol for UNIX systems.
- Used for interoperability of Unix and Windows systems
- Has a history of bugs
- I found one such bug in the Summer of 2005

What's all the fuss about

```
static BOOL lsa_io_trans_names(const char *desc, LSA_TRANS_NAME_ENUM2 *trn,
prs_struct *ps, int depth)
{
...
        if(!prs_uint32("num_entries    ", ps, depth, &trn->num_entries))
...
        if (trn->ptr_trans_names != 0) {
                if(!prs_uint32("num_entries2   ", ps, depth, &trn-
>num_entries2))
                        return False;
....
                if (UNMARSHALLING(ps)) {
                        if ((trn->name = PRS_ALLOC_MEM(ps, LSA_TRANS_NAME2, trn-
>num_entries)) == NULL) {
                                return False;
...
                }
                for (i = 0; i < trn->num_entries2; i++) {
...
                        if(!lsa_io_trans_name2(t, &trn->name[i], ps, depth))
```

This bugs is a...

- Remote, pre authentication, root exploit against Unix systems running it
- Any reasonable network wouldn’t allow these ports through a firewall
- Would be useful once inside a network

Timeline

6/2005 ⟷ 5/2007

Timeline

Discovered 6/2005

Timeline

Discovered 6/2005

6/2005

5/2007

Timeline

Discovered 6/2005

Submitted for review - 11/7/05

6/2005

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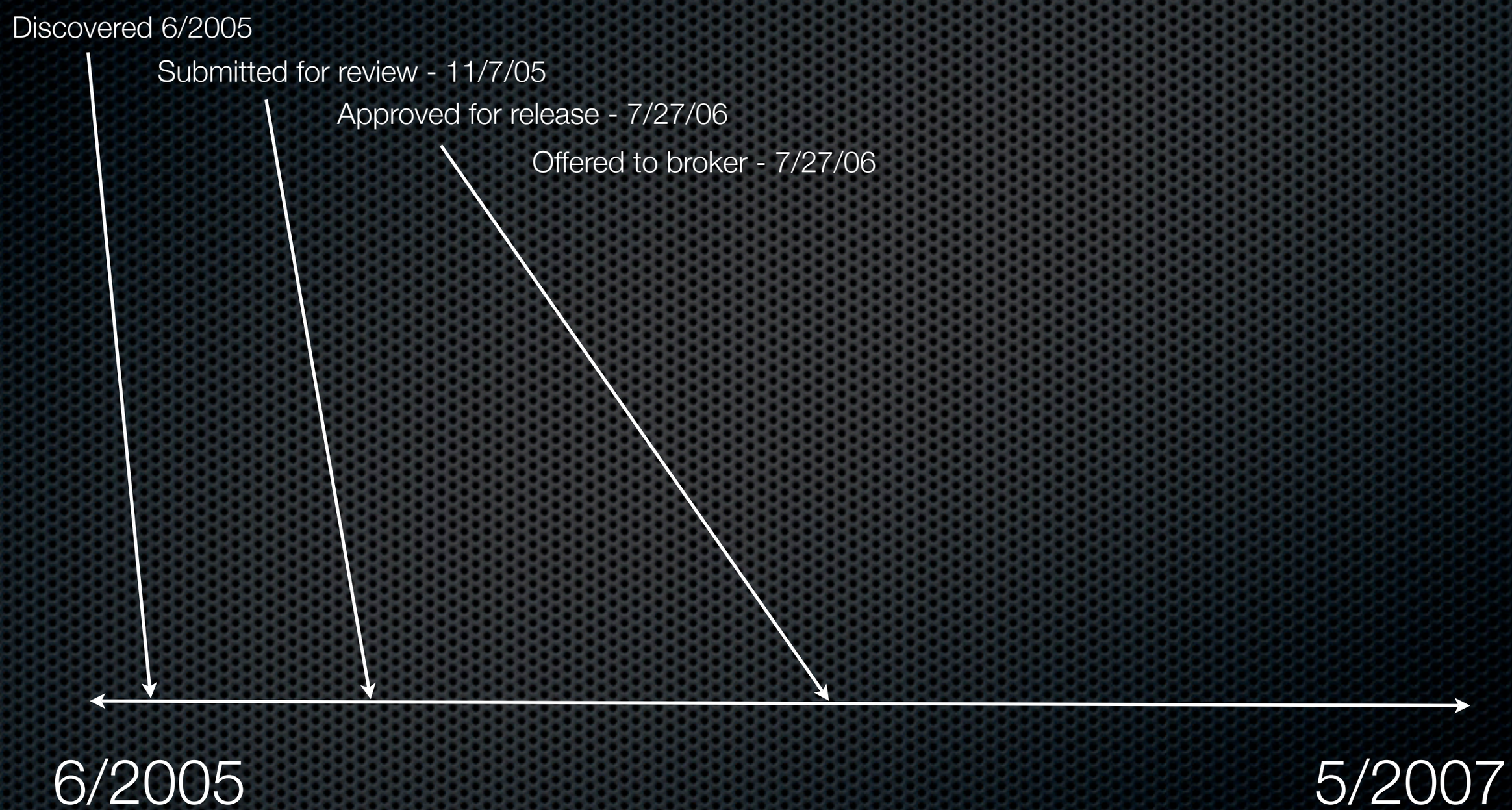
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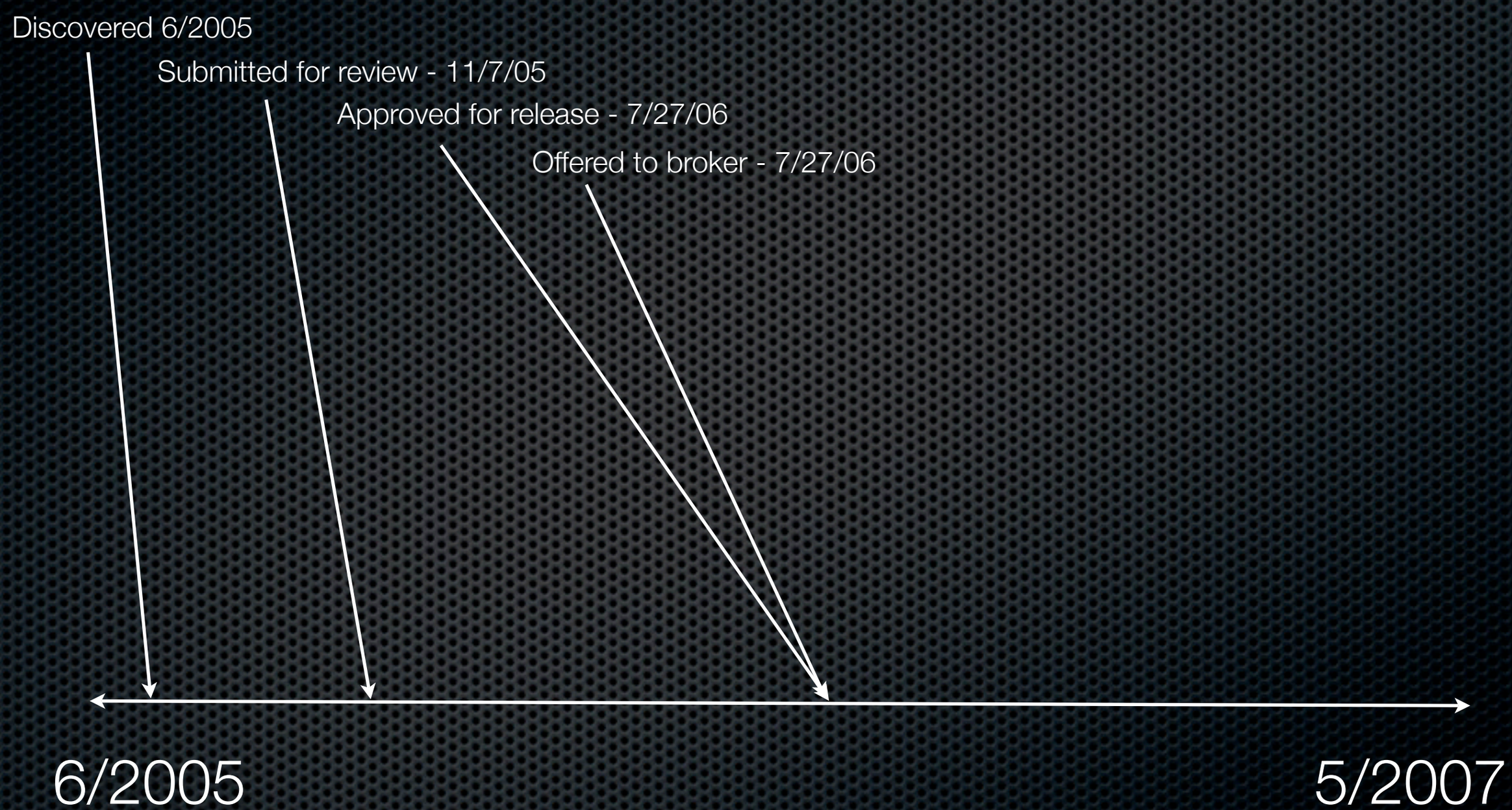
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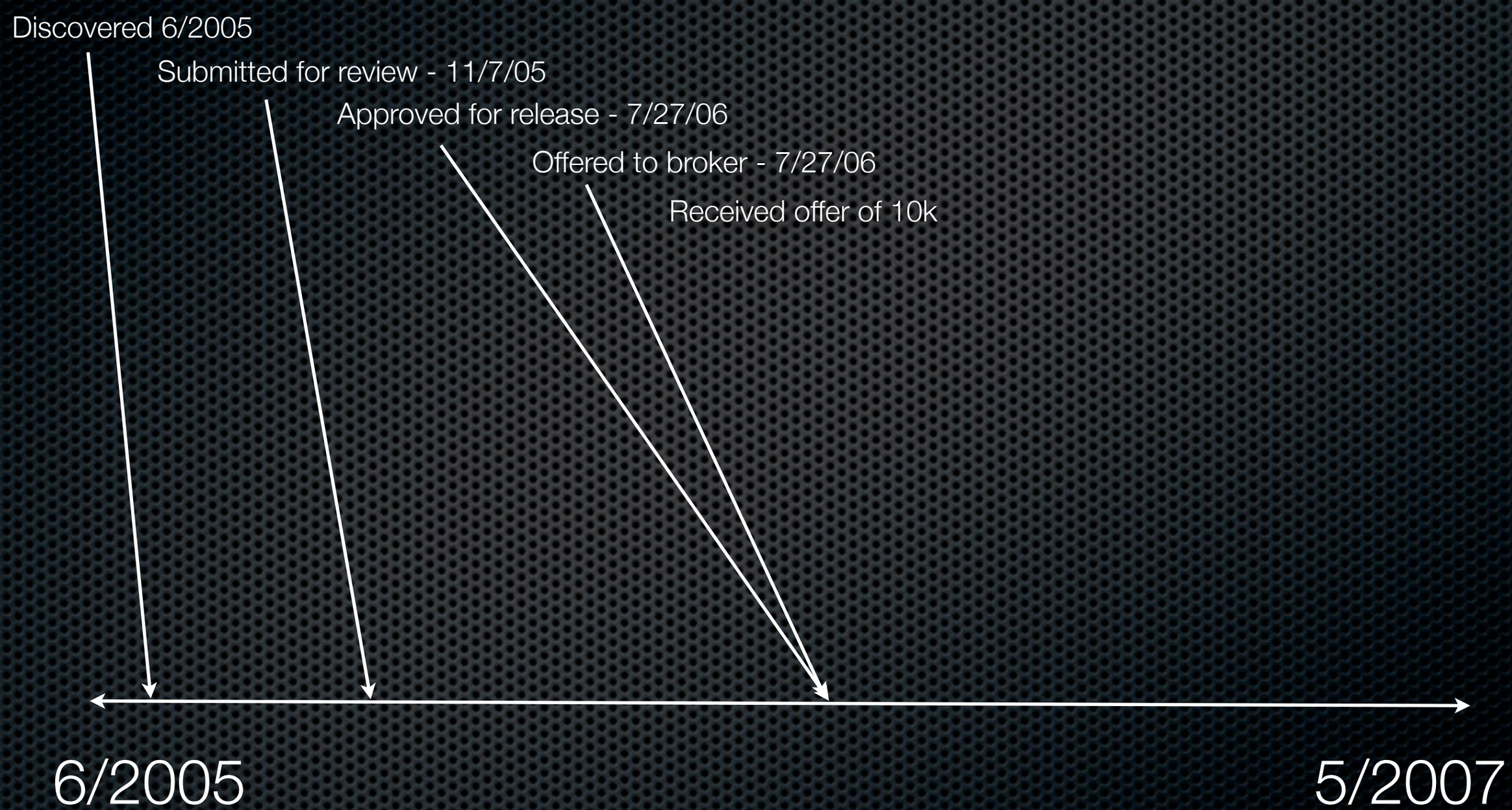
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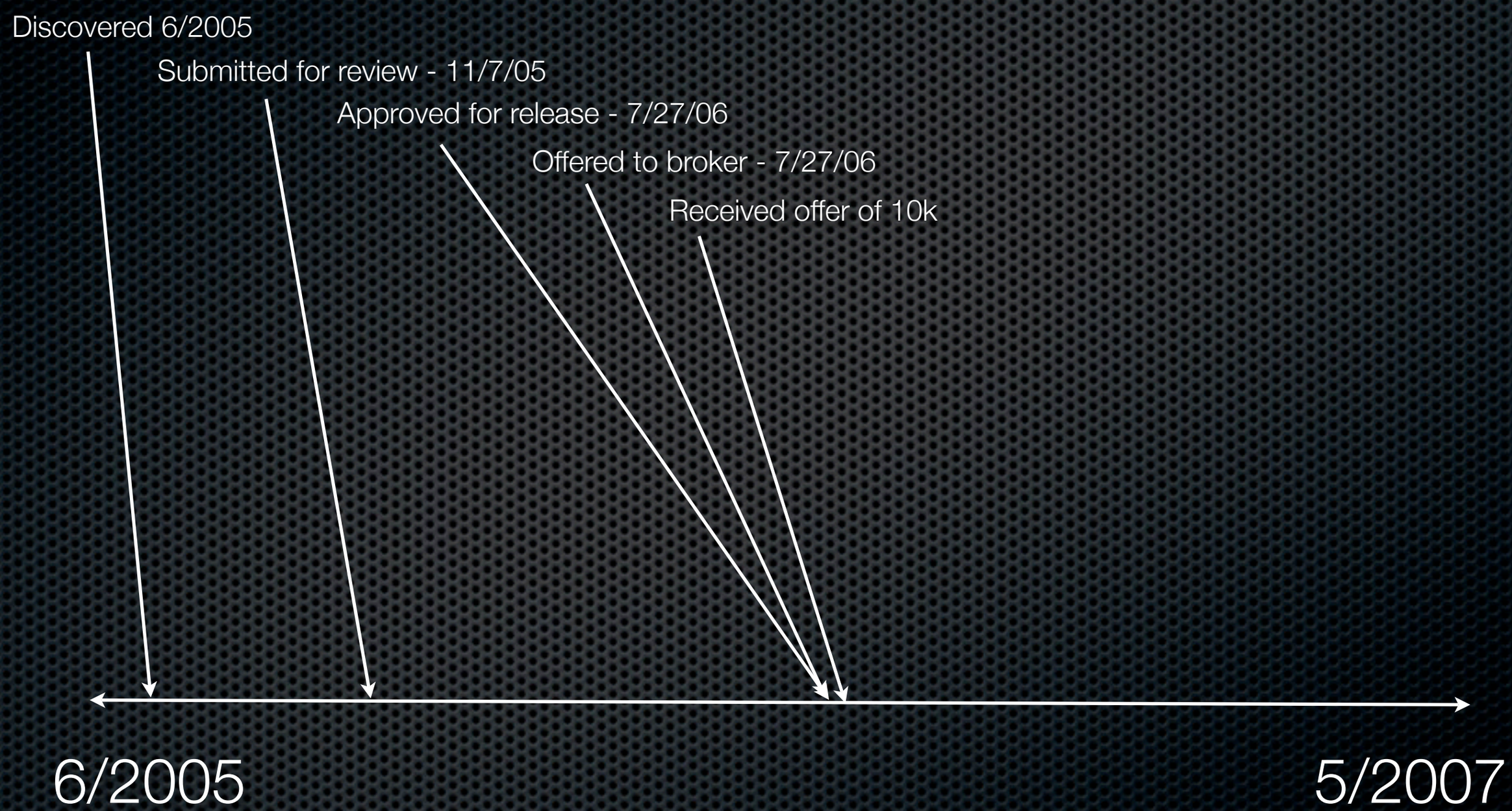
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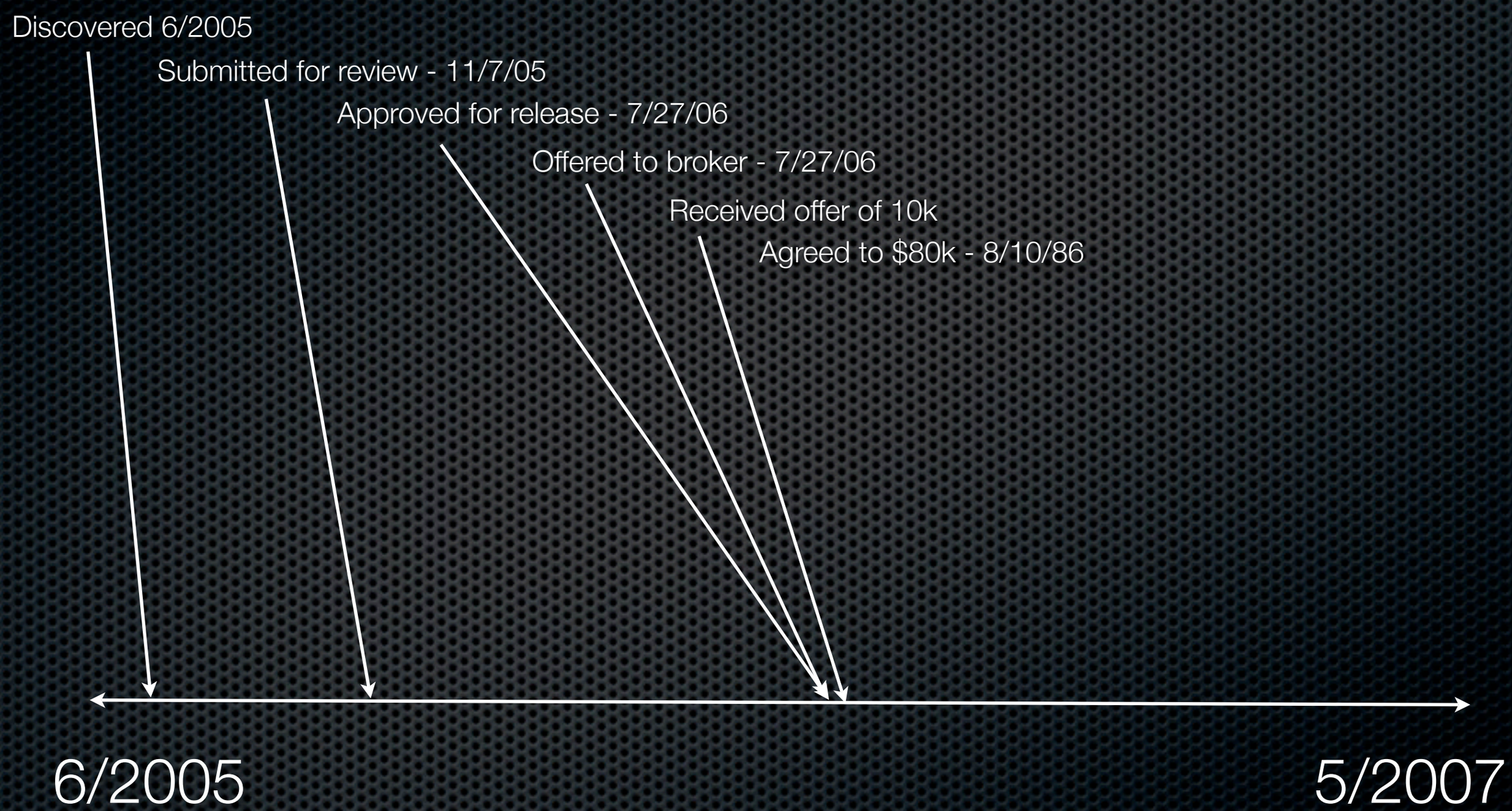
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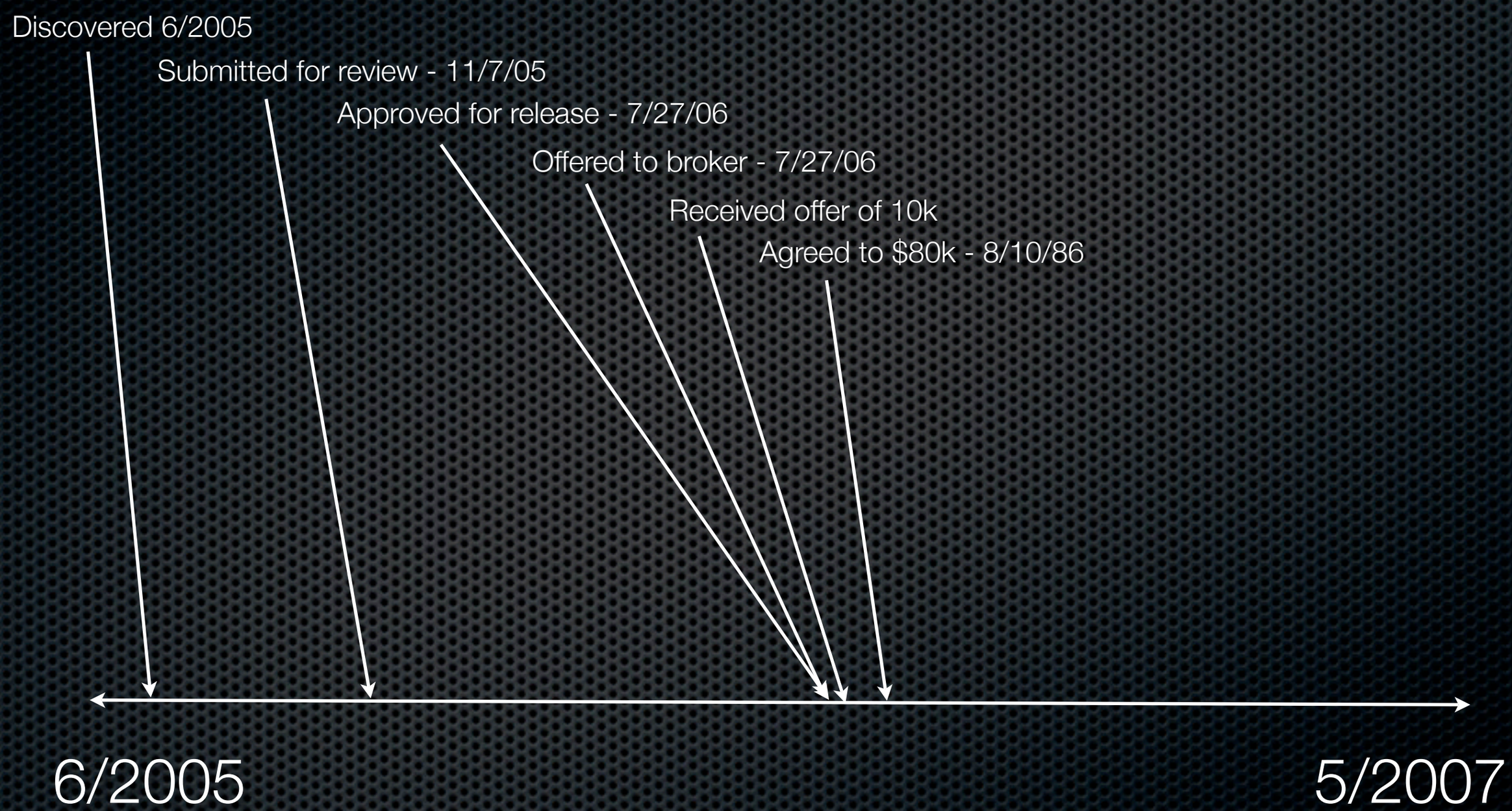
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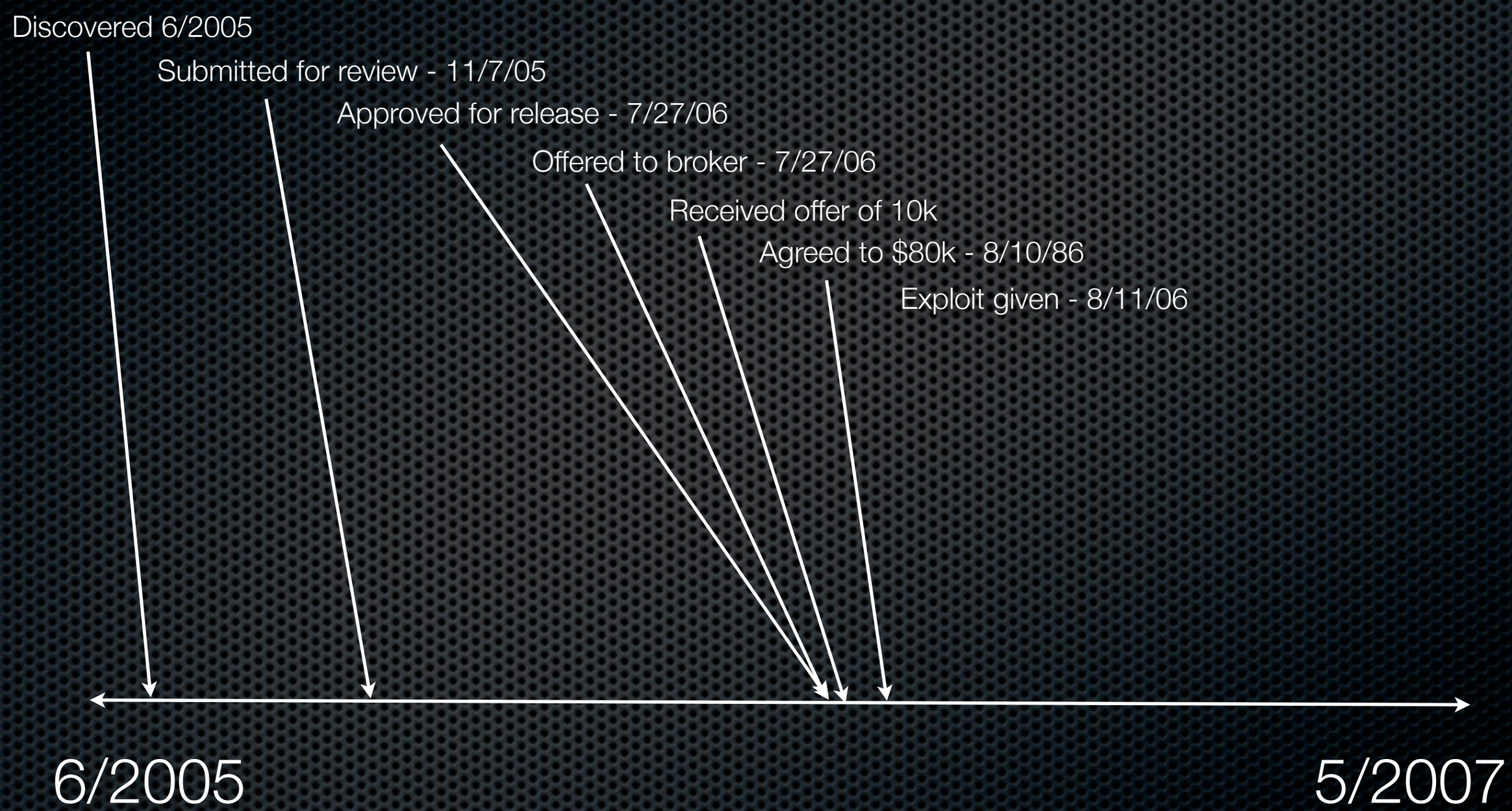
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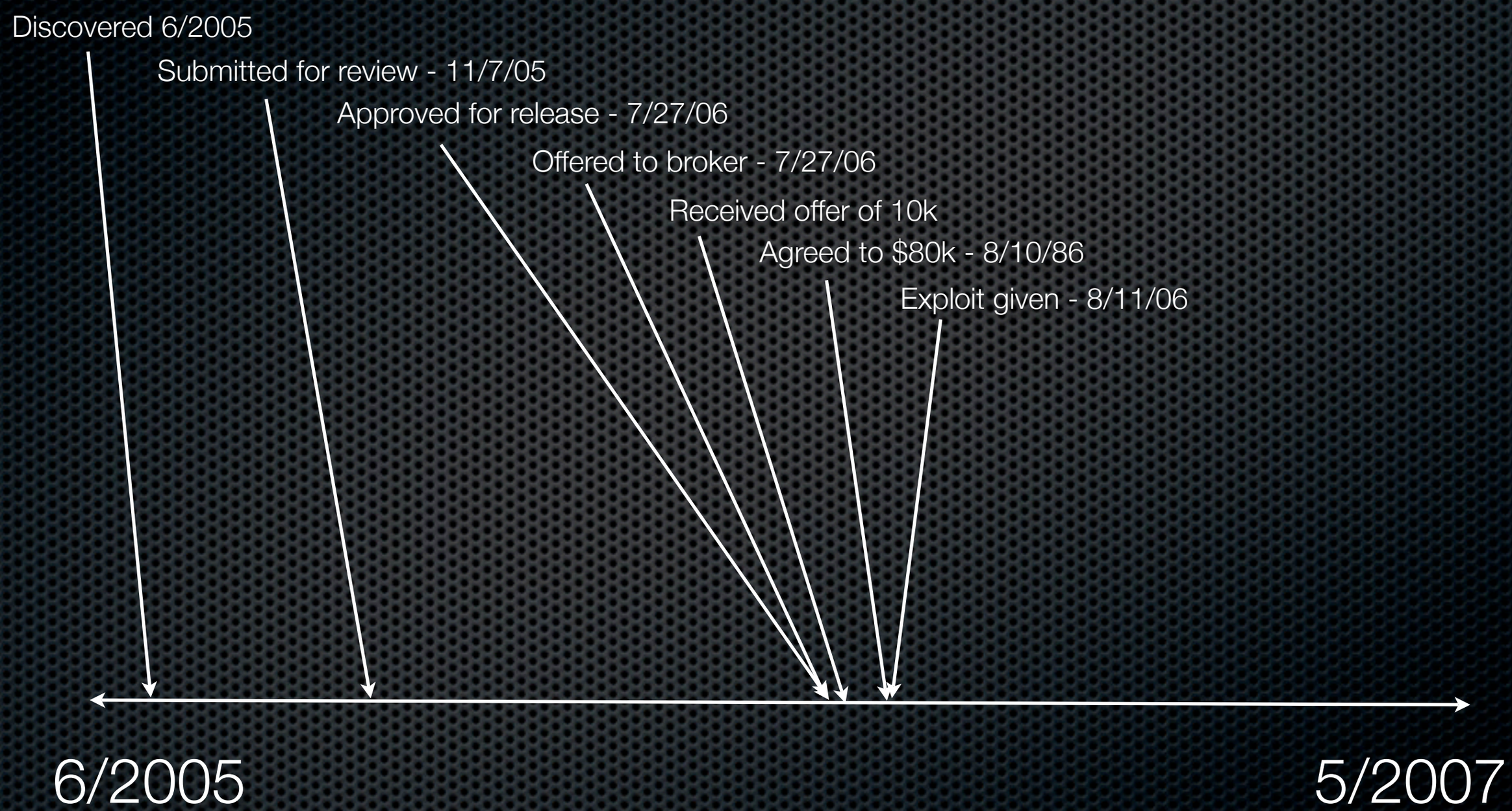
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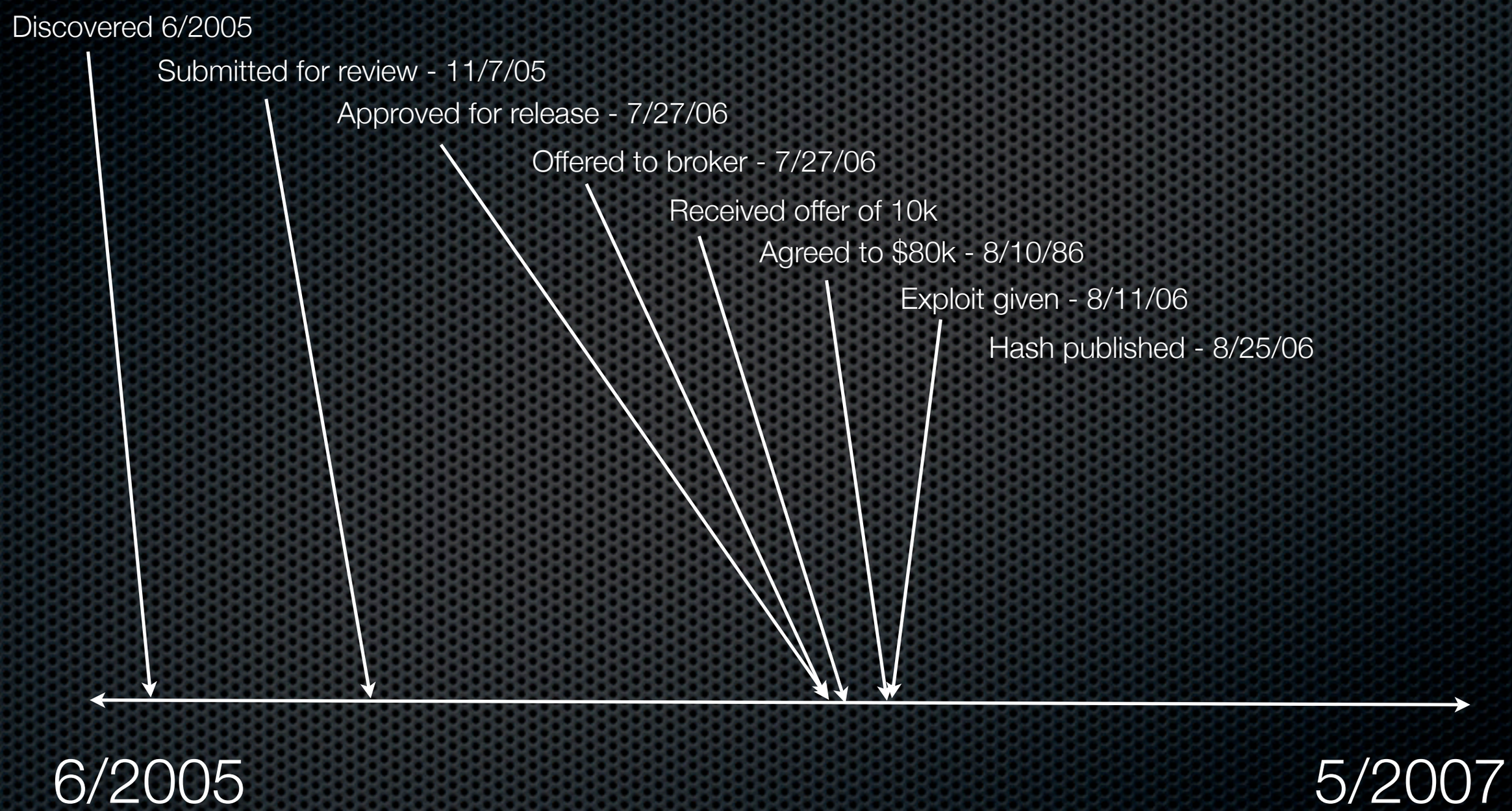
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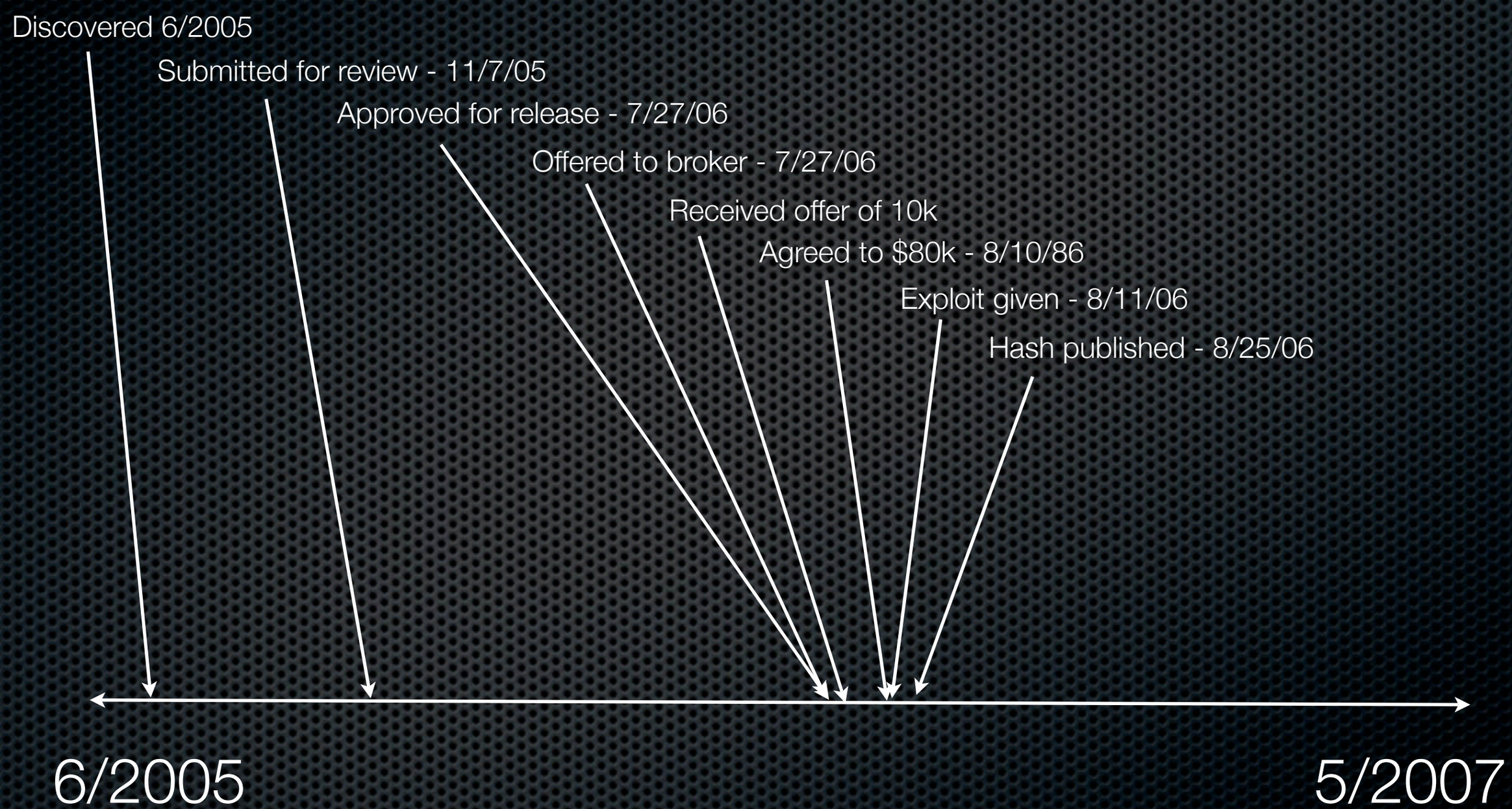
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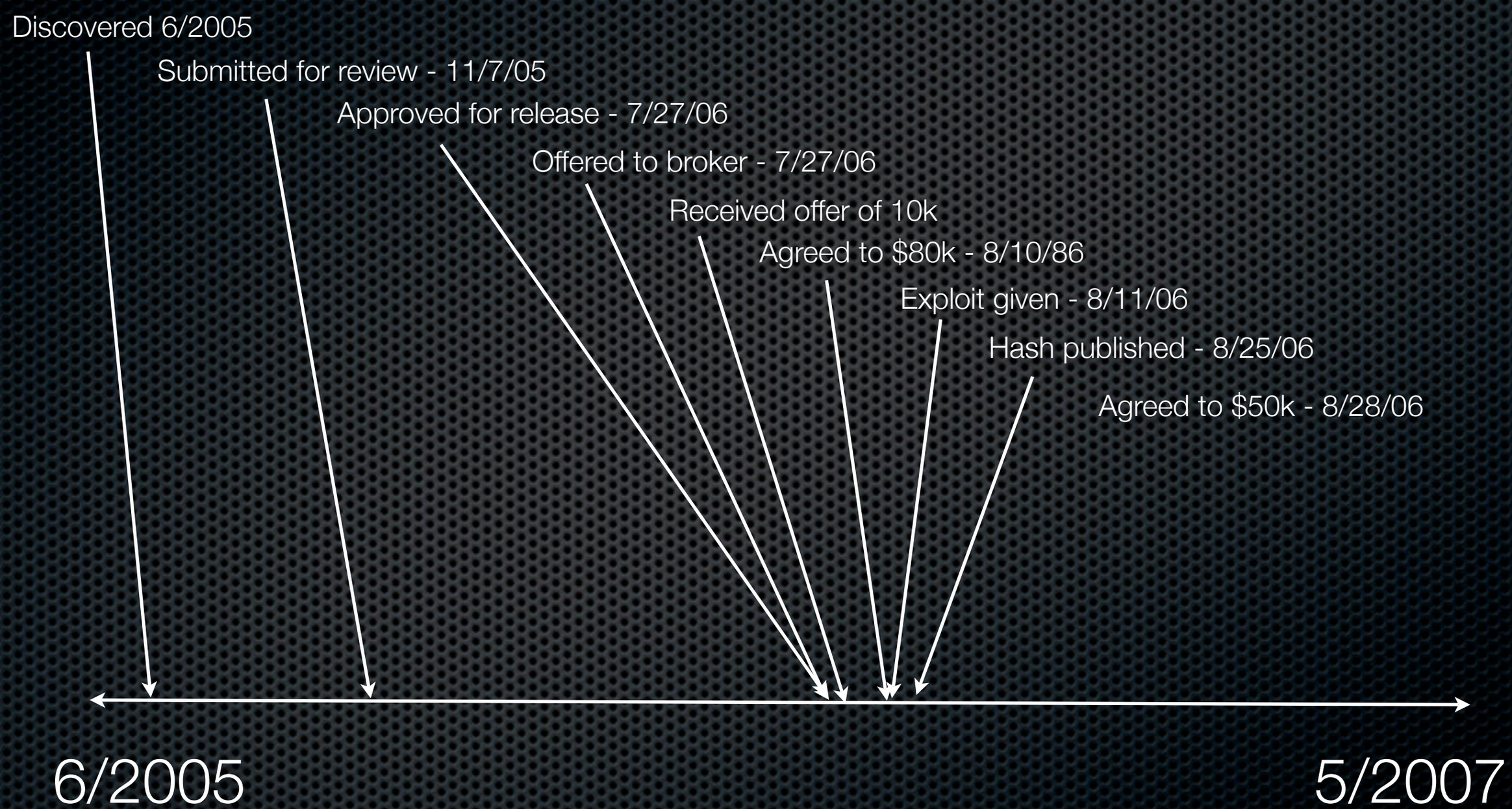
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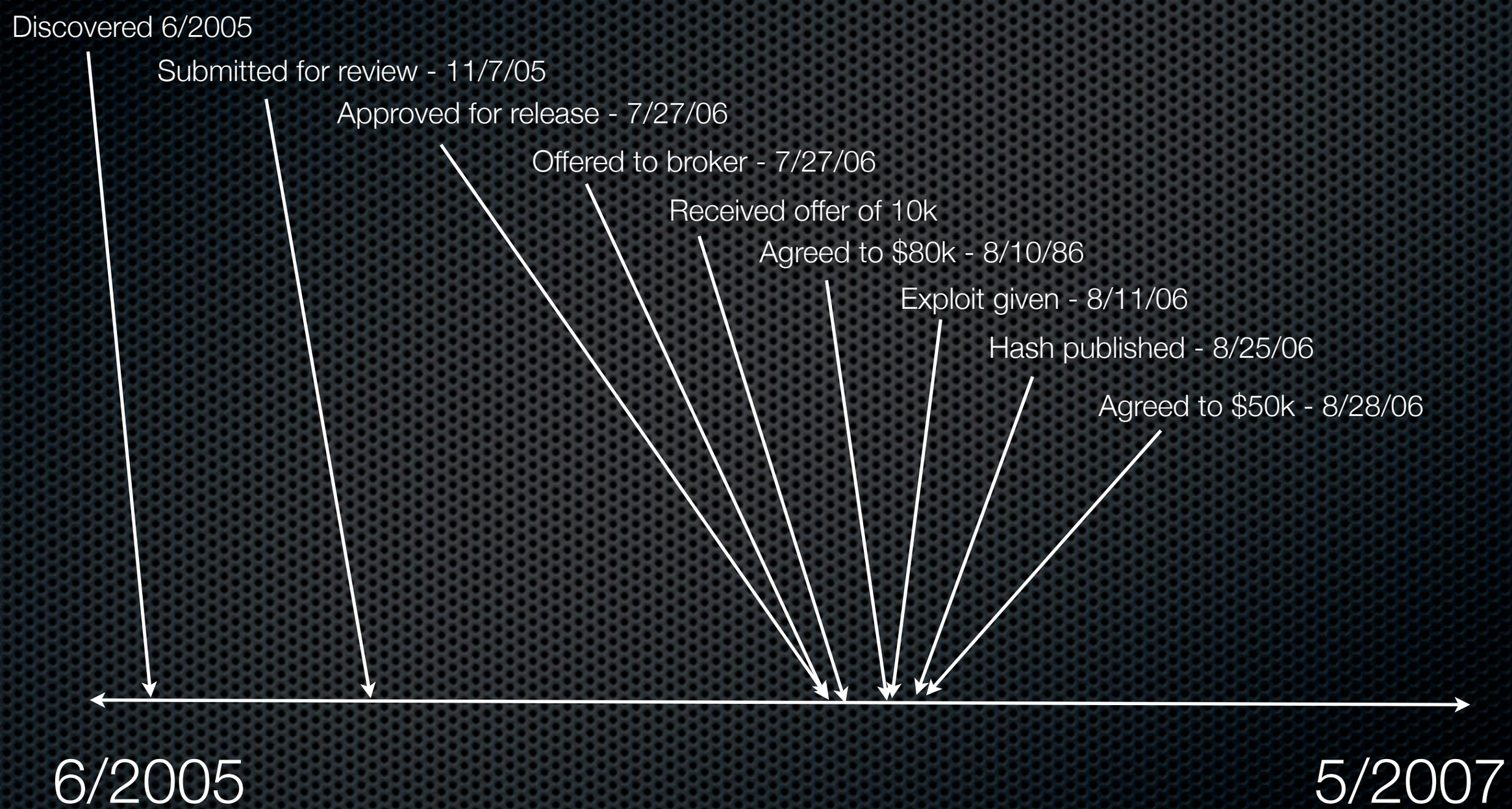
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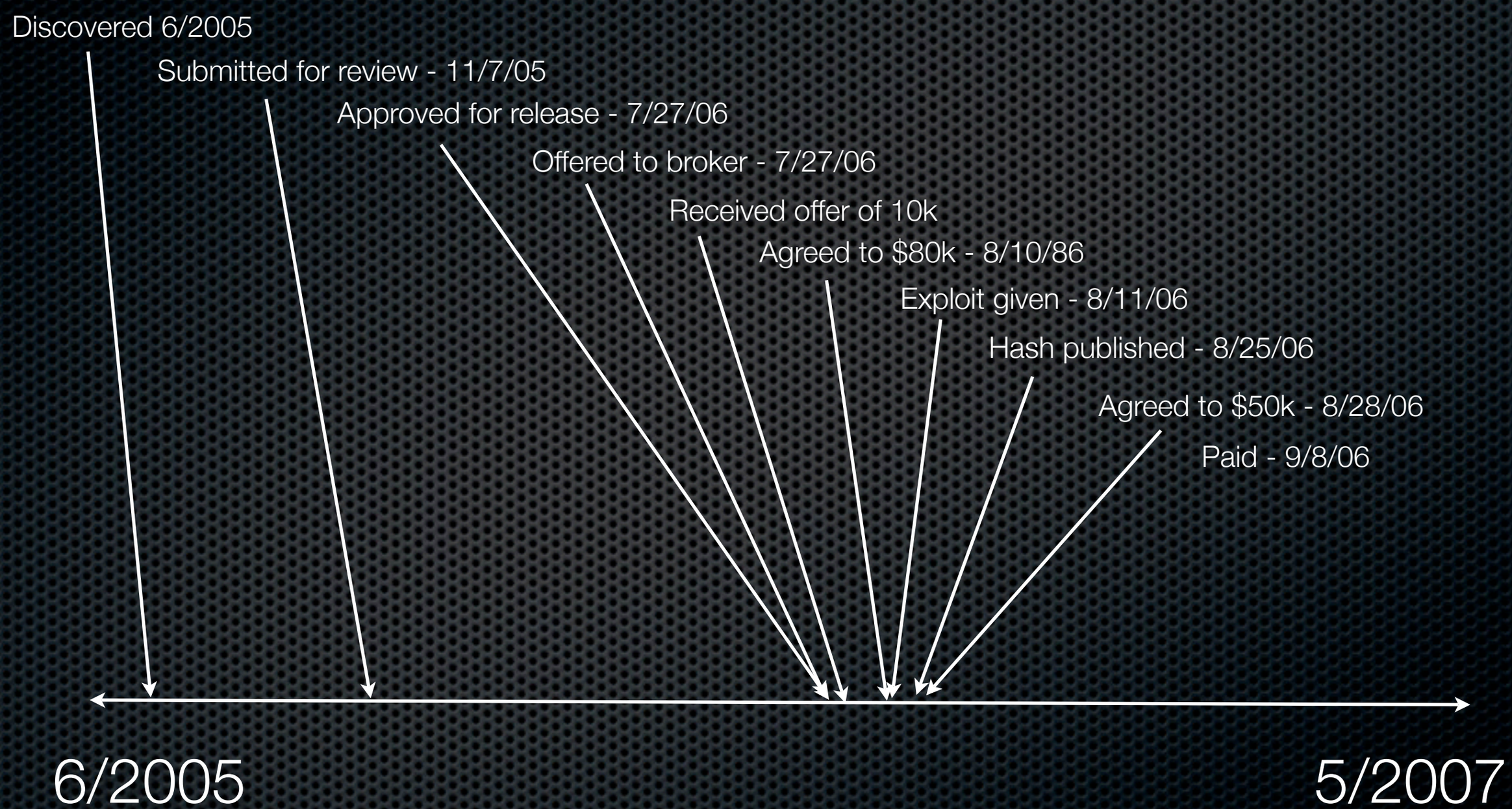
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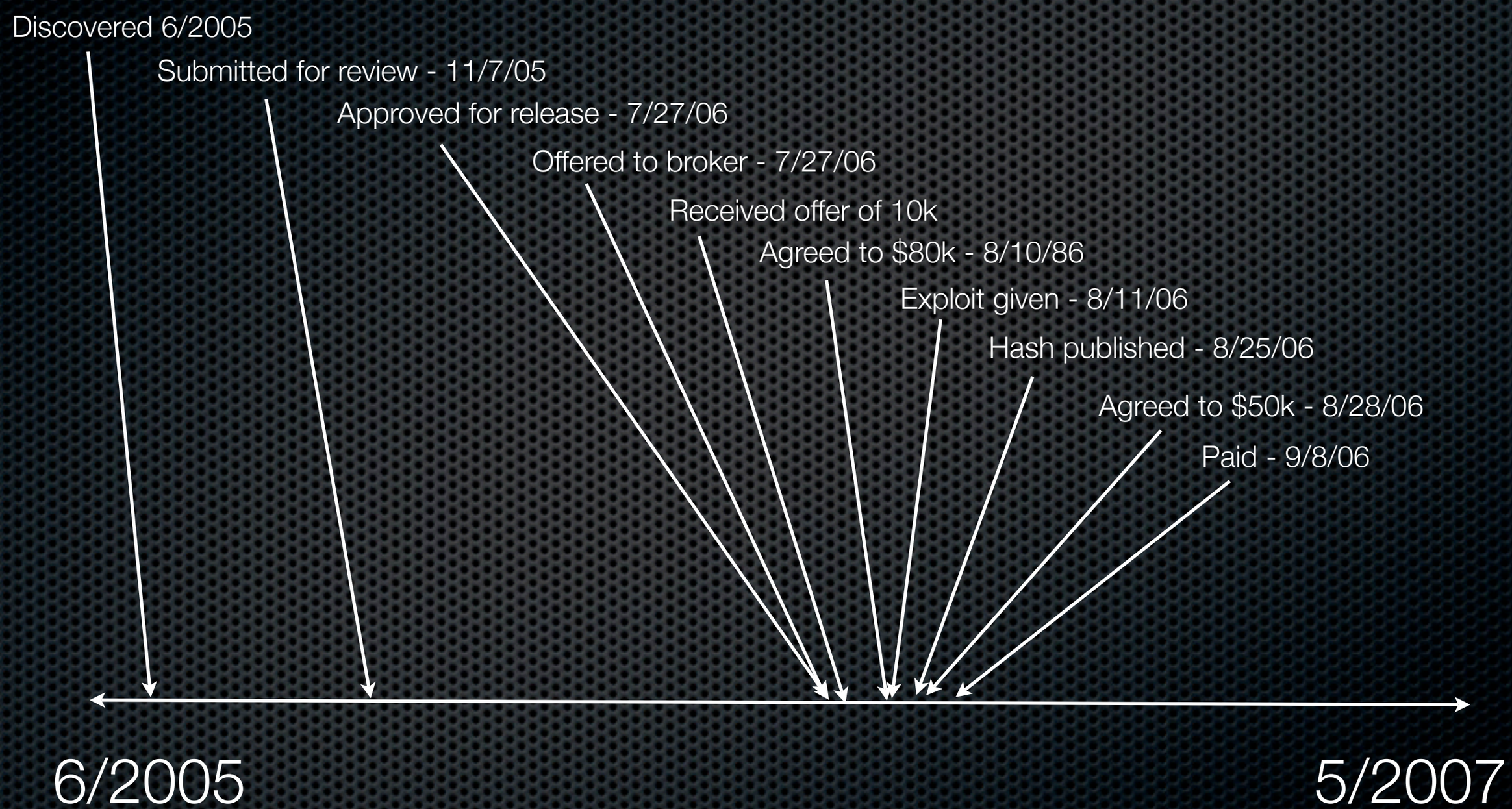
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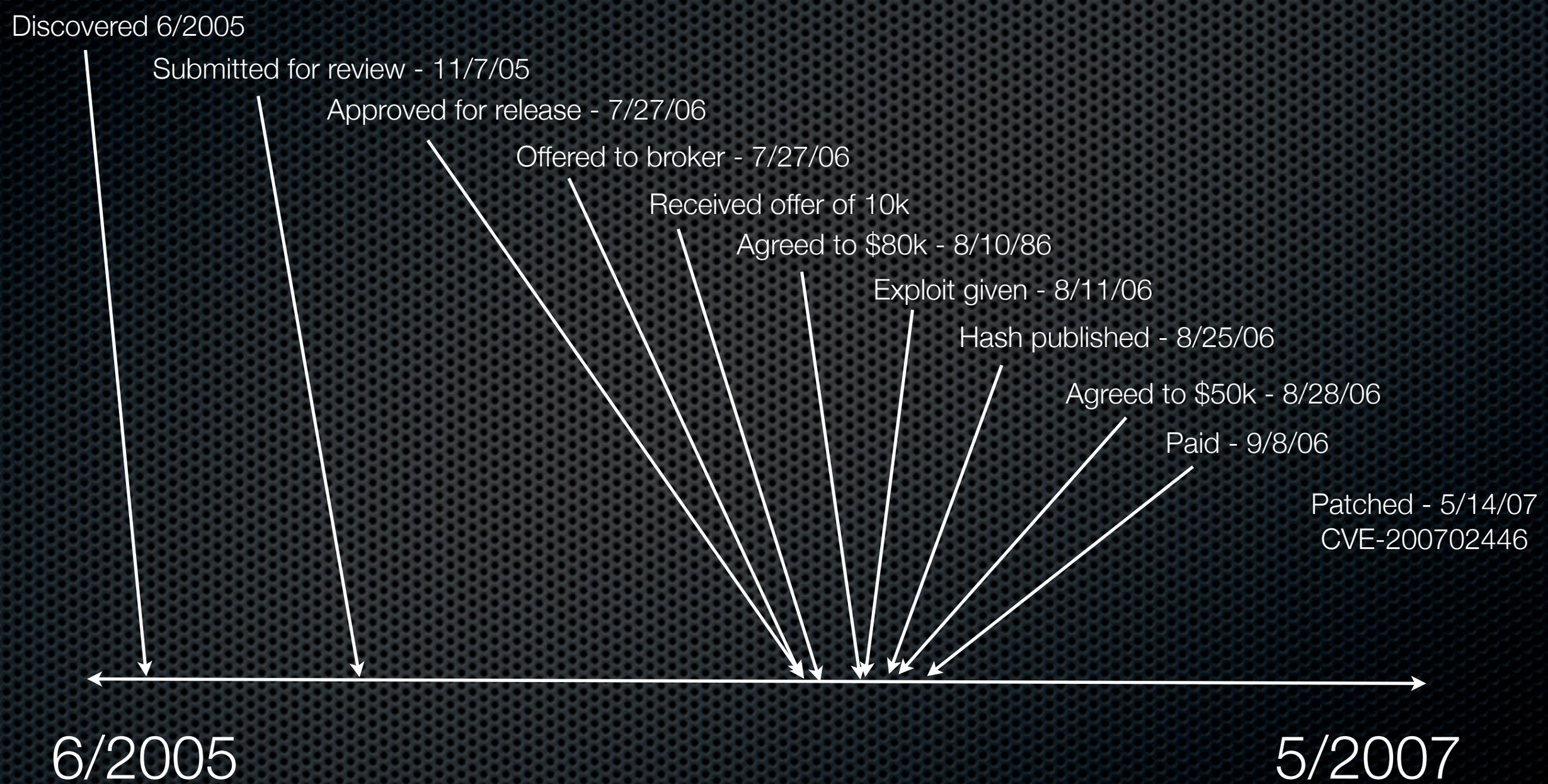
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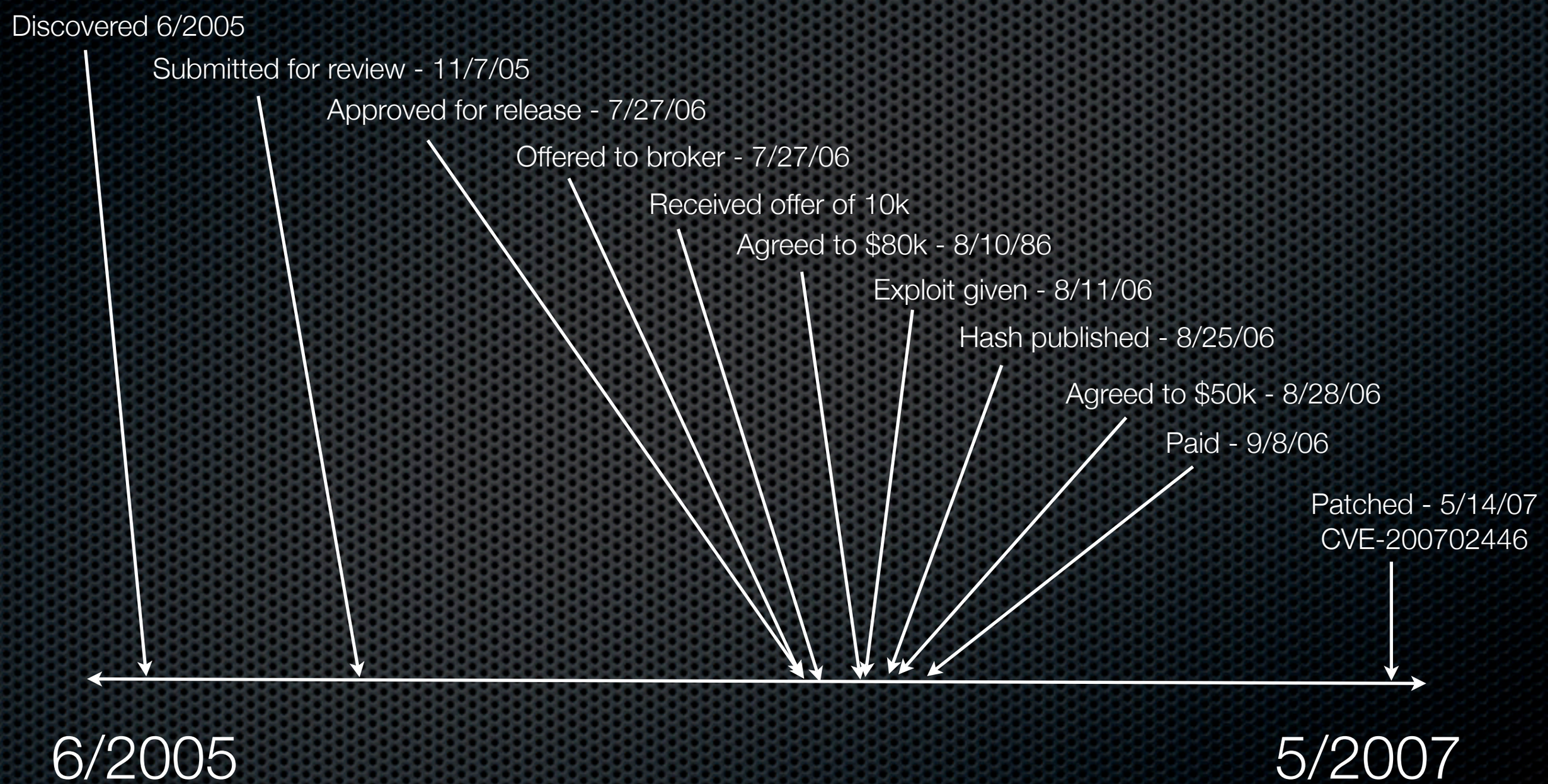
Paid - 9/8/06
Patched - 5/14/07
CVE-200702446
6/2005
5/2007

Timeline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Patched - 5/14/07
CVE-200702446
6/2005
5/2007

Hashing for verification

```
echo "Charlie Miller found a vulnerability in Samba in the
function lsa_io_trans_names where trn->num_entries and trn-
>num_entries2 are of different sizes." | md5sum
e9a4f234e0f5d3e587c3d27e709b7eda  -
```

[Full-disclosure] Security researcher

From: asdfasf (*zerodayinithotmail.com*)
Date: Fri Aug 25 2006 - 09:01:39 CDT

Messages sorted by: [date] [thread] [subject] [author]

I'm looking for a security researcher named "Gobbles". If anyone could send me his contact information I would appreciate it.

sadf
e9a4f234e0f5d3e587c3d27e709b7eda

Full-Disclosure - We believe in it.
Charter: http://lists.grok.org.uk/full-disclosure-charter.html
Hosted and sponsored by Secunia - http://secunia.com/

The result

3-7615/360

282643

Date September 08, 2006

Pay Amount ***$50,000.00***

Pay ****FIFTY THOUSAND AND XX / 100 DOLLAR****

To The Order of **CHARLES MILLER**

Authorized Signature

Summary of bug #1

- Due to no centralized place of contact, information sat for 5 months
- The government is slow....
- Had no idea of a fair market value
- Forced to give 10% to broker
- Only found broker due to personal contacts
- Sale helped by personal contacts
- Exploit given before any payment or signed contract
- *Sale occurred despite the market*

Case study #2: powerpoint

- Approached by friend to help him sell a 0-day Microsoft Powerpoint vulnerability
- This time, not so lucky

Timeline

1/20/07 ⟷ 2/13/07

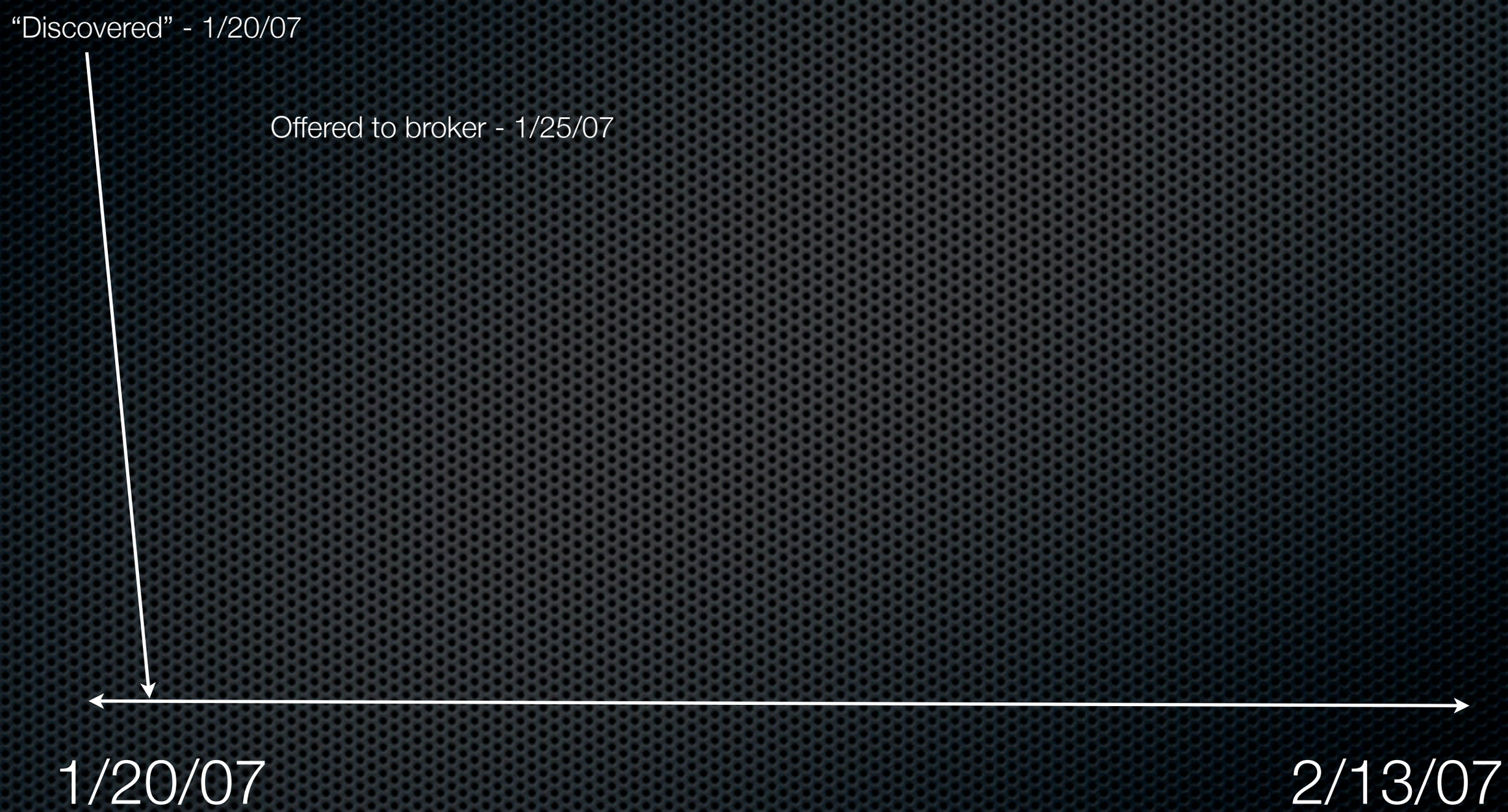
Timeline

“Discovered” - 1/20/07

1/20/07 ⟷ 2/13/07

Timeline

Timeline



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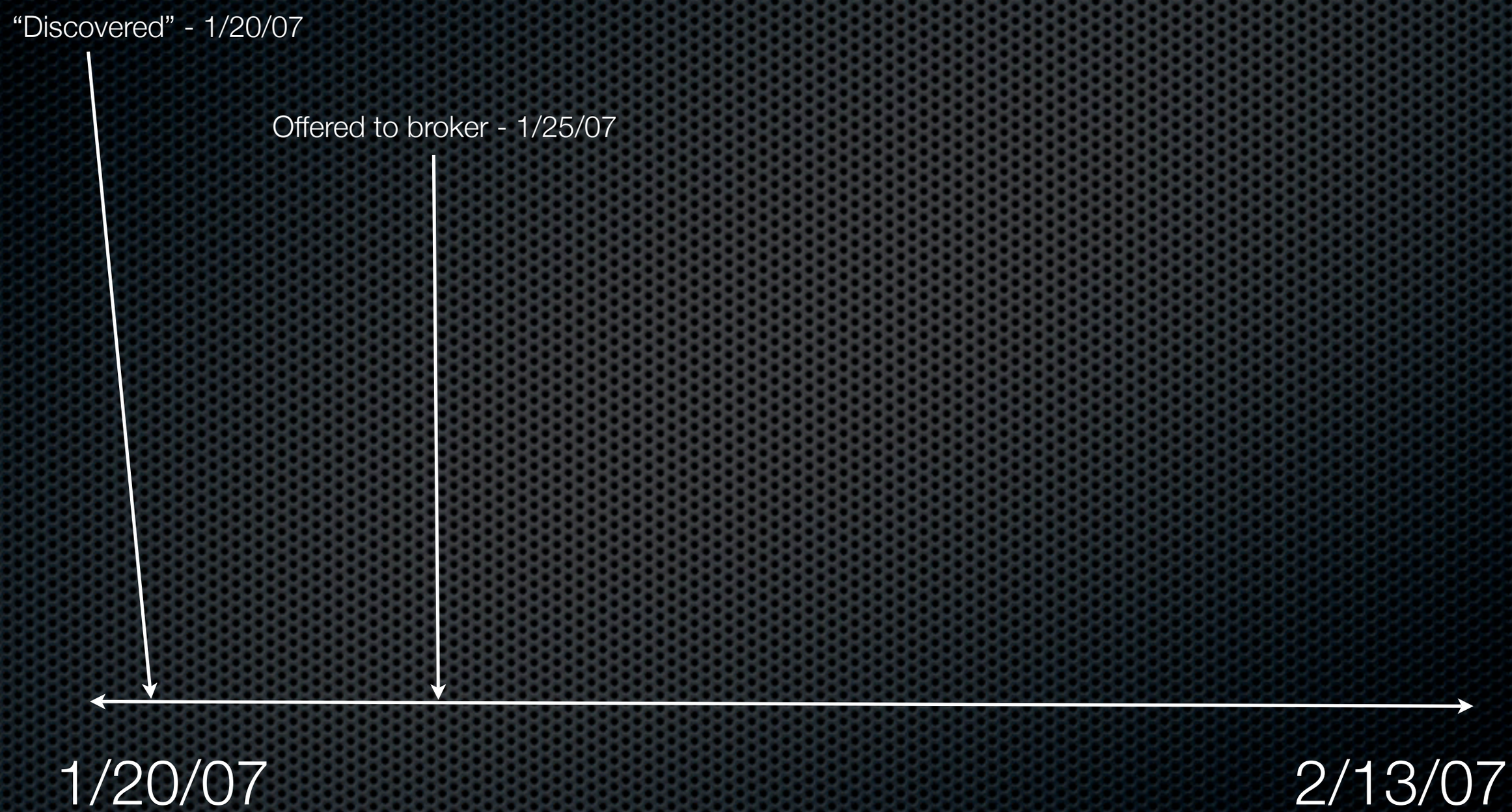

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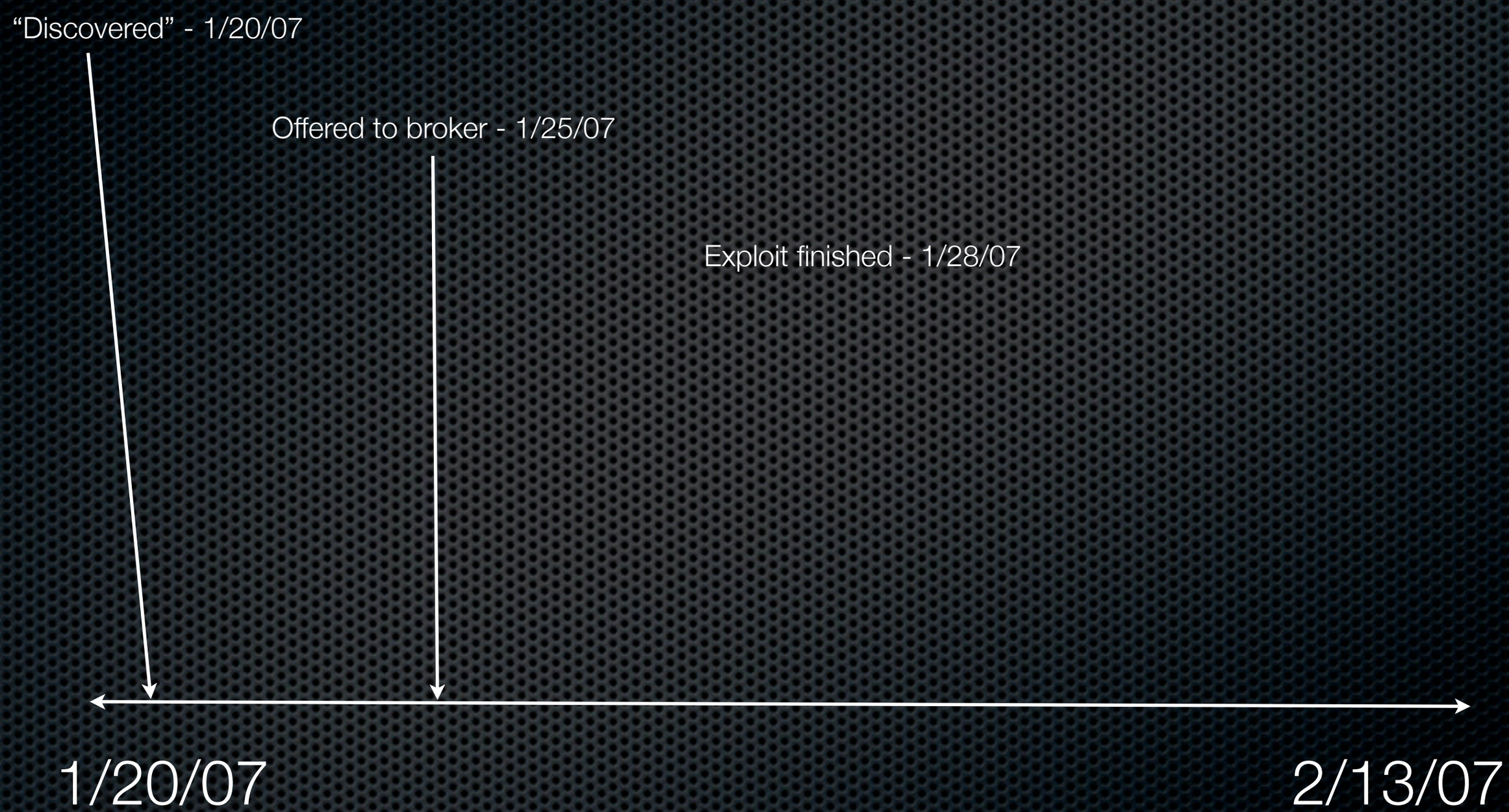
"Discovered" - 1/20/07
Offered to broker - 1/25/07
Exploit finished - 1/28/07
1/20/07
2/13/07

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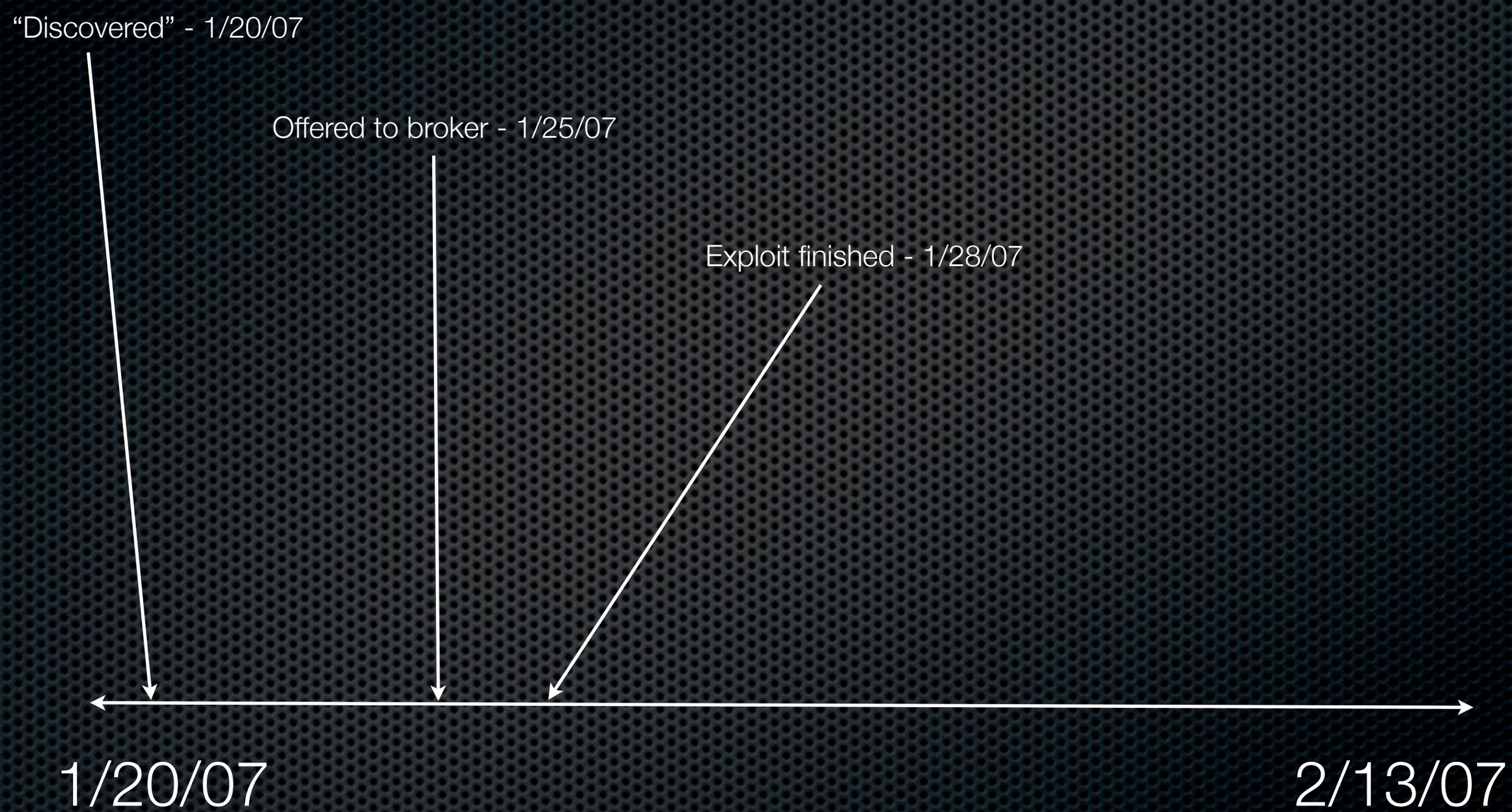
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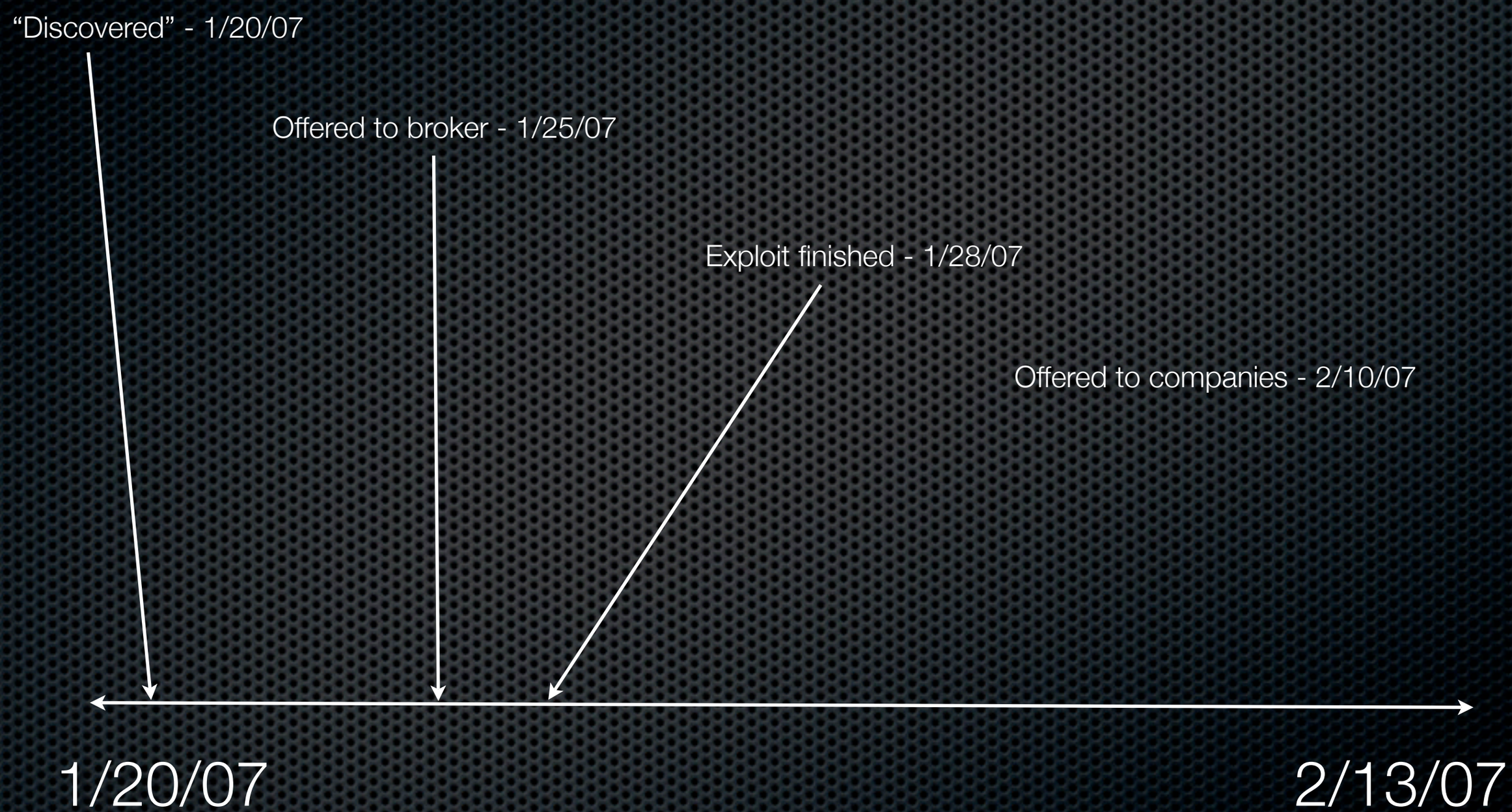
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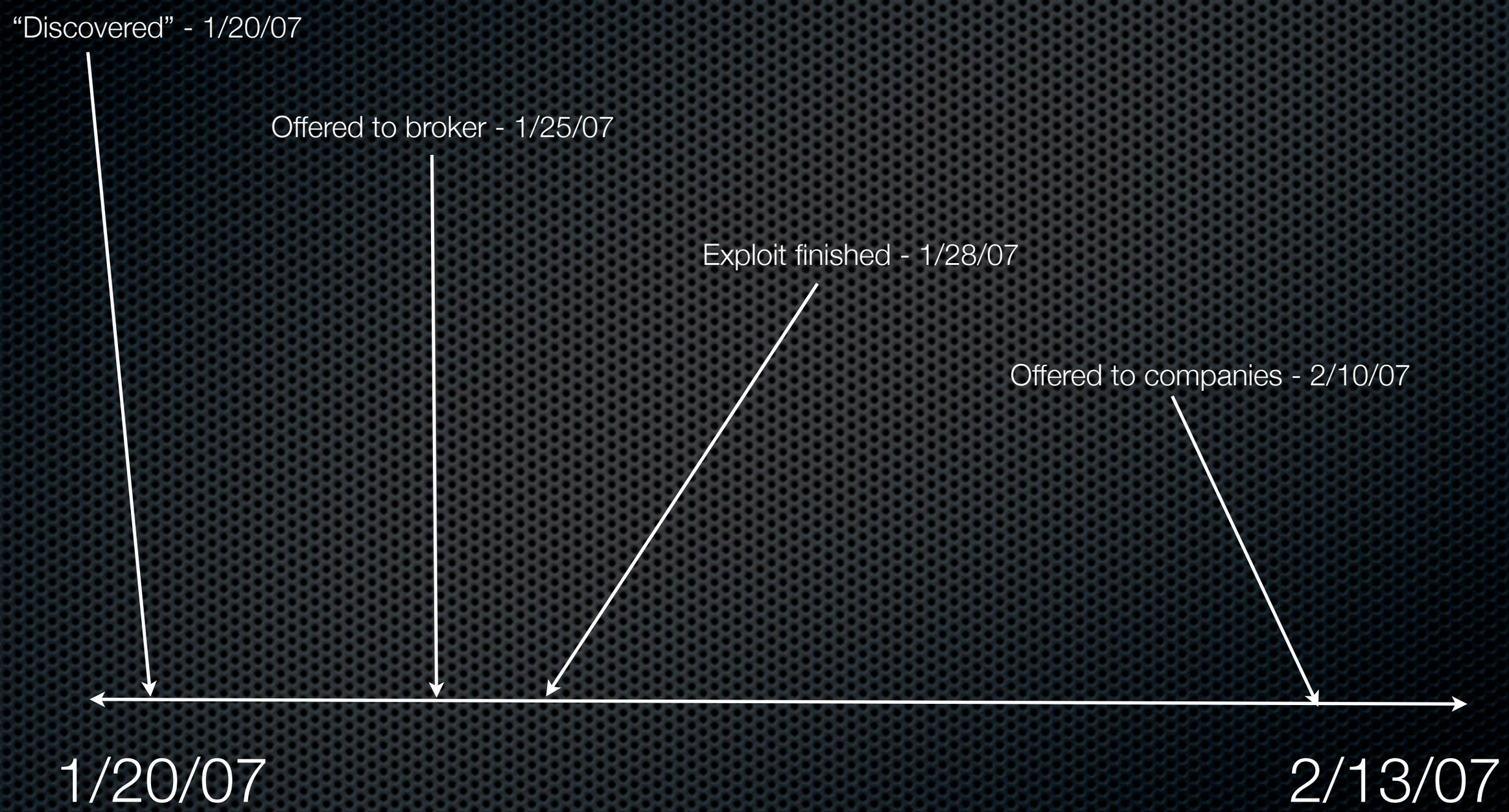
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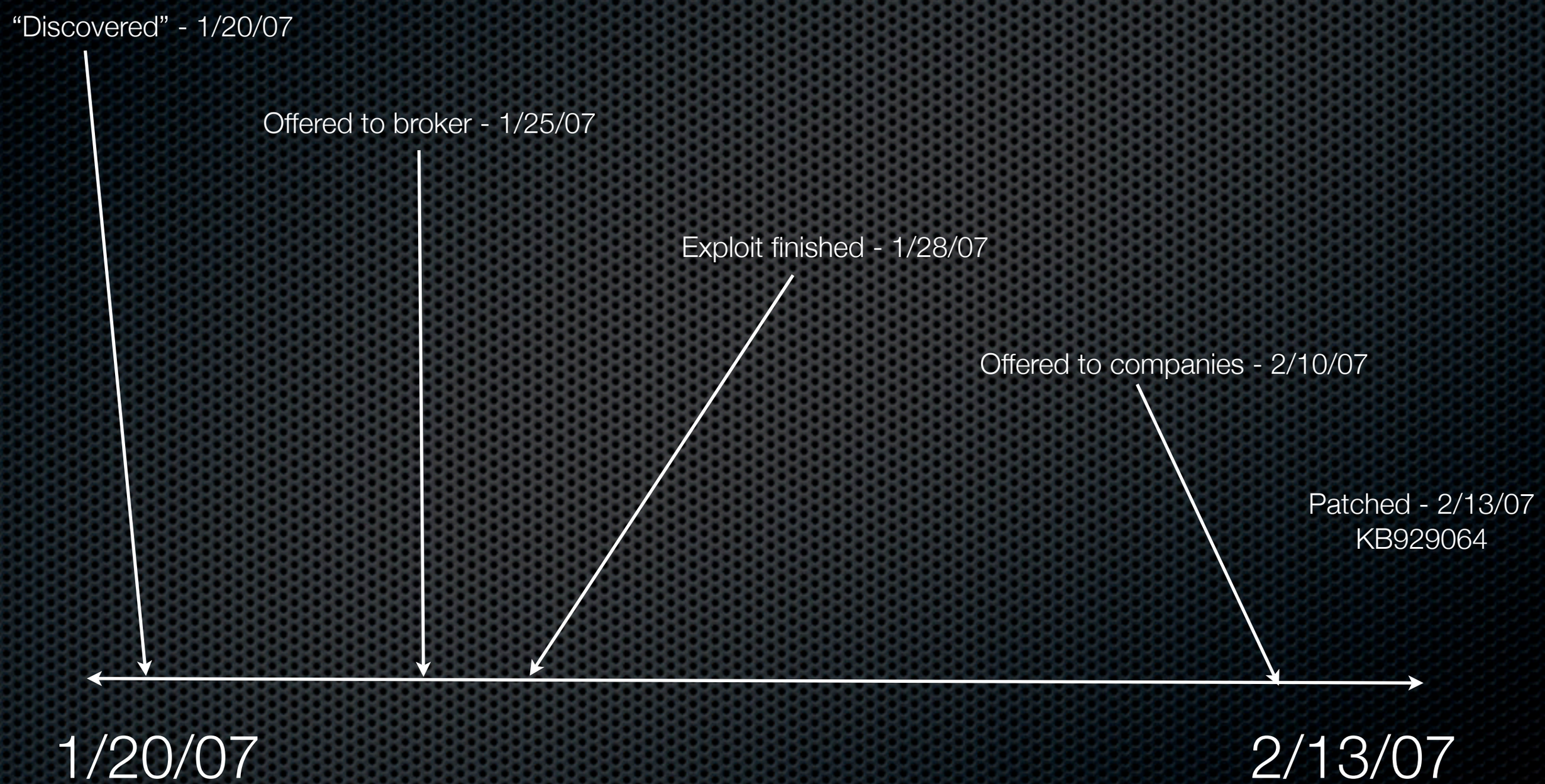
Timeline


"Discovered" - 1/20/07
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Exploit finished - 1/28/07
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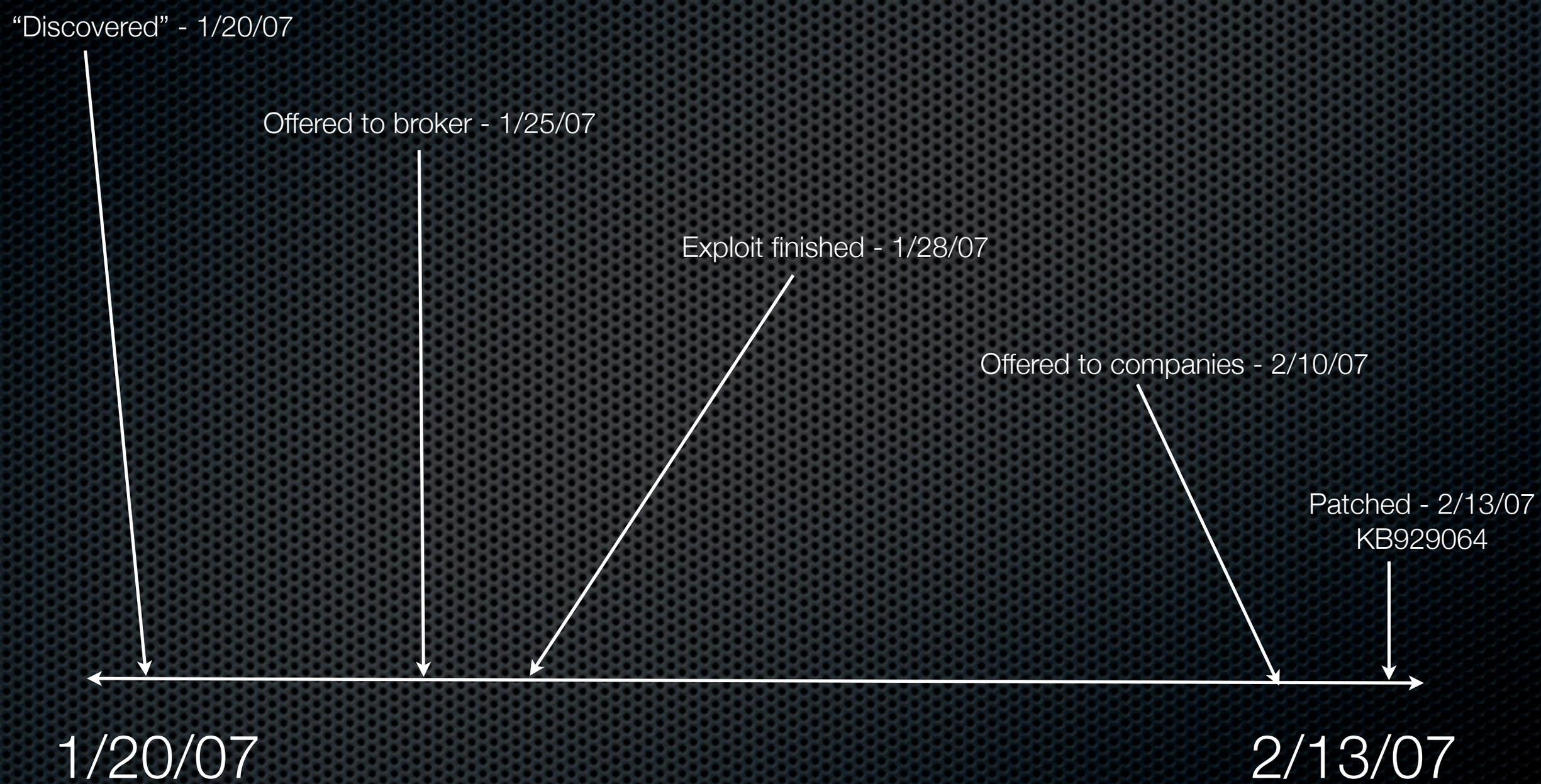
Patched - 2/13/07
KB929064
1/20/07
2/13/07

Timeline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KB929064
1/20/07
2/13/07

Value

- I felt it was worth $20k
- I received offers as low as $5k
- I negotiated with a company from $8k up to $12k

Summary of bug #2

- Lack of transparency meant pricing was basically arbitrary
- Lack of speed finding a buyer ruined sale
  - The negotiation with the final company went quickly but started too late
- Sale could not proceed without shared personal contacts
- Exploit was to be sent before payment

Implications to Internet security

- Summarizing
  - Researchers forced to act in secret
  - Buyers that pay the most (by a factor of 10) for vulnerability information do not release it to the vendor
  - Vendors do not pay researchers
- Therefore
  - Researchers have an economic incentive not to inform vendor or anyone who will
  - “Privileged” parties are aware of vulnerability information months or years ahead of the vendor - and public.
  - Researchers not motivated to find vulnerabilities

Conclusions

- Secrecy of market hurts security researchers
- Difficult to:
  - Find a buyer
  - Determine price
  - Prove value of vulnerability/exploit
  - Exchange goods for money

Conclusions

- No TTP leaves researchers vulnerable to losing their vulnerability information
- Time sensitivity compounds problems
- Some solutions exist but implementation remains far off
- 0-days exist
- vulnerabilities ***are*** rediscovered!
- The implication of “high end” vulnerability sales is that the Internet is a less safe place - *vendors need to pay researchers!*

Final Thoughts

- We need to make responsible disclosure easier and more pleasant
- We need to reward researchers for their work
- The community needs to make it so that responsible disclosure is the preferred method by any measurement
  - Not the method researchers have to make sacrifices to use

Final Final Thought

- Samba story revisited
  - If the anonymous researcher had been offered $80,000 for his Samba bug, instead of (an estimated) $5000 + disclosure, would he have taken it?
- Researchers shouldn’t be put in this position
- Internet security shouldn’t depend on the results of 19 year old Eastern Europeans earning $8000/year making this decision...

Questions?

- Please contact me at: cmiller@securityevaulators.com