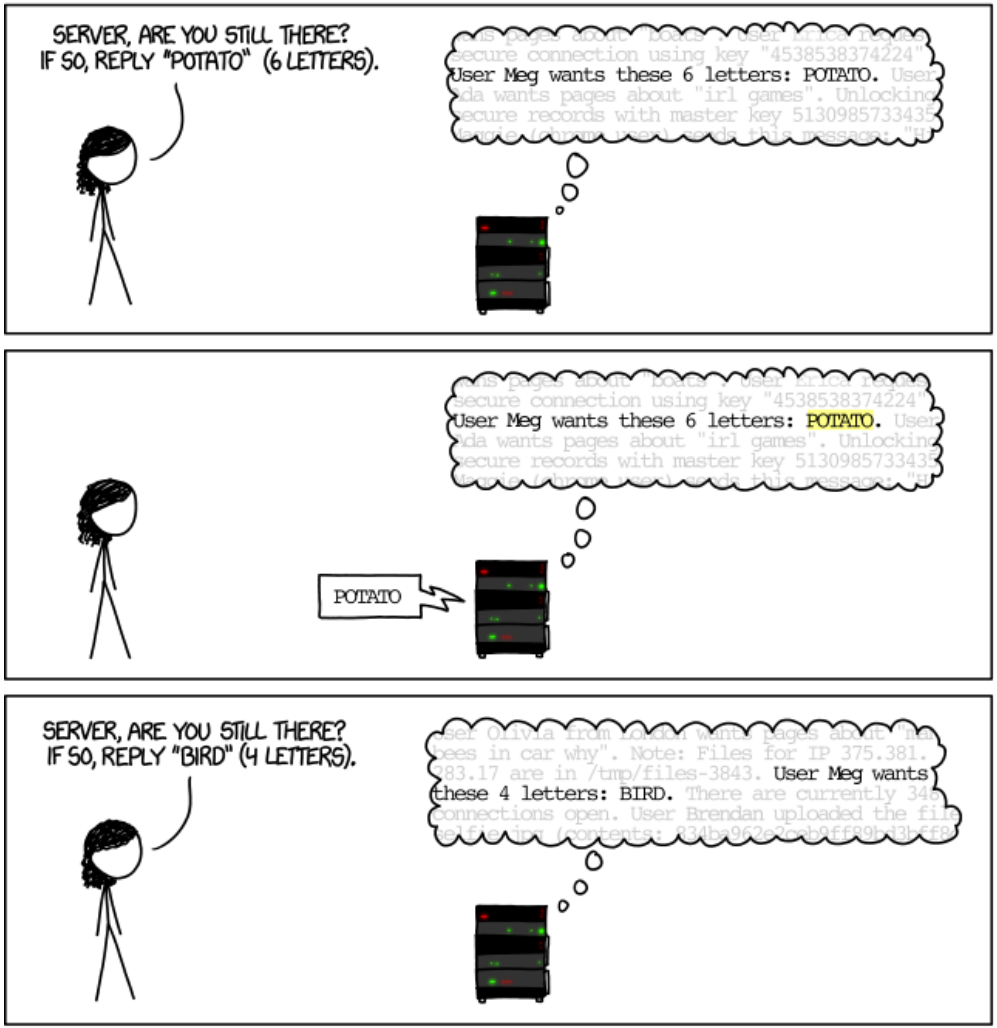
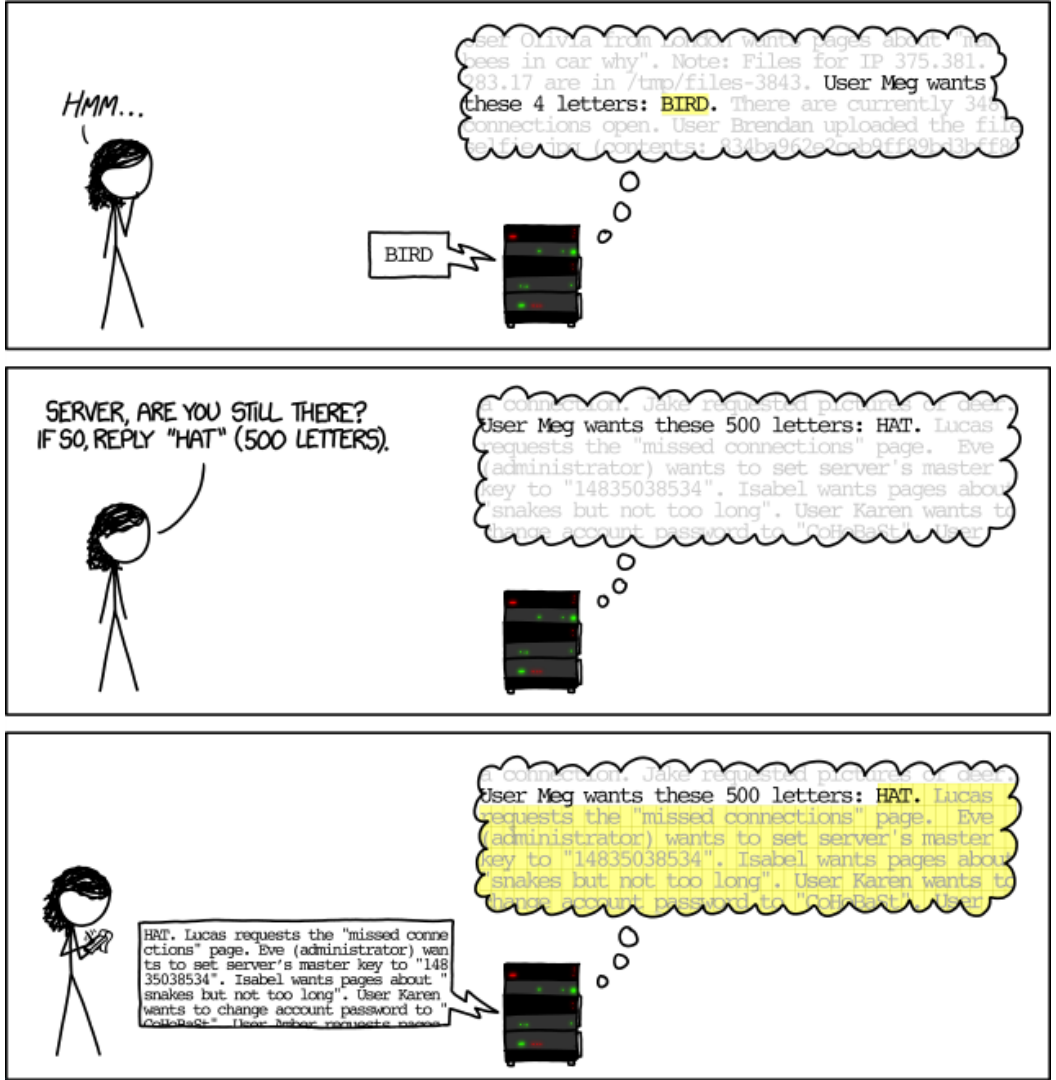
HOW THE HEARTBLEED BUG WORKS:




HMM...
BIRD
User Meg wants these 4 letters: BIRD.
SERVER, ARE YOU STILL THERE? IF SO, REPLY "HAT" (500 LETTERS).
User Meg wants these 500 letters: HAT.
HAT. Lucas requests the "missed connections" page. Eve (administrator) wants to set server's master key to "14835038534". Isabel wants pages about "snakes but not too long". User Karen wants to change account password to "
User Meg wants these 500 letters: HAT. Lucas requests the "missed connections" page. Eve (administrator) wants to set server's master key to "14835038534". Isabel wants pages about "snakes but not too long". User Karen wants to

But what is heartbeat exactly?

- Contains a payload(data) and the size of that payload
- For keeping a TLS connection alive, if there is a communication-gap
- “Heartbeat”-packets == a way of saying:”Are you there?” to the server
- Is intended for use over UDP(or other connectionless protocol) == no guarantee that the packet won’t be lost
- Arbitrarily-sized payload == too much flexibility for most users

The good news

Implementation error

Not an error by design

The bug

- Programmer forgot to check the payload size
- Returns up to 64kb of additional RAM-data
- Etc. send payload of 1b, with size of 60.000b, rinse and repeat
- That could be:
  - Database information
  - Server side code
  - Privat encryption keys
  - Basically anything in the RAM

Demonstration

$ python hb-test.py localhost

Affected versions

- OpenSSL 1.0.1 through 1.0.1f (inclusive) are vulnerable
- OpenSSL 1.0.1g is NOT vulnerable
- OpenSSL 1.0.0 branch is NOT vulnerable
- OpenSSL 0.9.8 branch is NOT vulnerable

Vulnerable for almost 2 years

The discovery

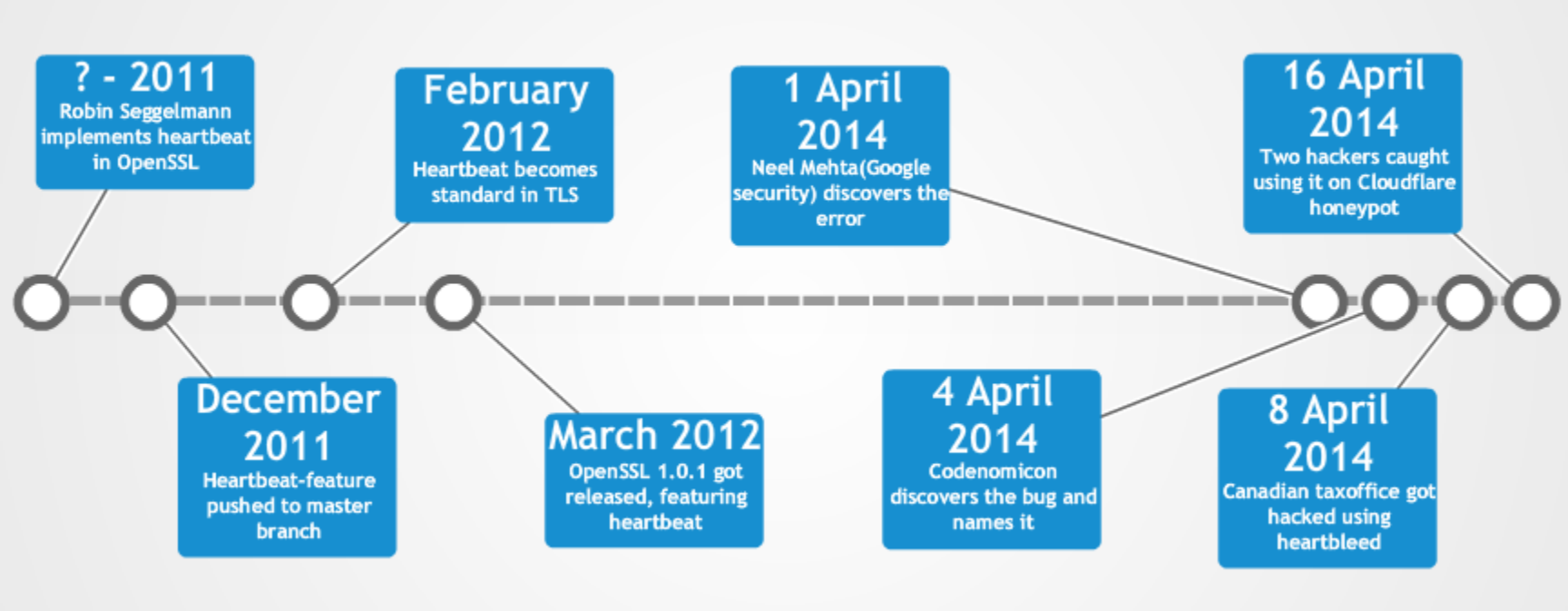
Discovered independently by:

- Codenomicon(security team consisting of 3 people)
- Neel Mehta(Google security)

Reported to OpenSSL

Analyzed and verified by “The National Cyber Security Centre Finland”

Timeline


? - 2011
Robin Seggelmann implements heartbeat in OpenSSL
December 2011
Heartbeat-feature pushed to master branch
February 2012
Heartbeat becomes standard in TLS
March 2012
OpenSSL 1.0.1 got released, featuring heartbeat
1 April 2014
Neel Mehta(Google security) discovers the error
4 April 2014
Codenomicon discovers the bug and names it
16 April 2014
Two hackers caught using it on Cloudflare honeypot
8 April 2014
Canadian taxoffice got hacked using heartbleed

Scale and Impact

- Shutdown costs caused by Heartbleed are estimated to be 500 million US dollars
- Many major websites, such as fx. GitHub, Pinterest, Reddit, SourceForge and Tumblr were affected
- Android v 4.1.1 is still susceptible to Heartbleed. There is 50 million devices still using that version

How could it happen?

- OpenSSL was operating solely on donations totalling $841
- OpenSSL defied the standards of OpenBSD and programmed their own memory management
- OpenSSL is maintained by a single full-time worker and a tiny number of volunteers
- Because of lack of funding OpenSSL never had proper security audits. Nobody checked if Heartbleed was there

The Future

- Experts predict more vulnerabilities like Heartbleed will be found
- The Linux Foundation has started a multi-million dollar project to fund initiatives such as OpenSSL