LibreSSL

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About Me

- sys admin and developer @ SNB
- OpenBSD developer
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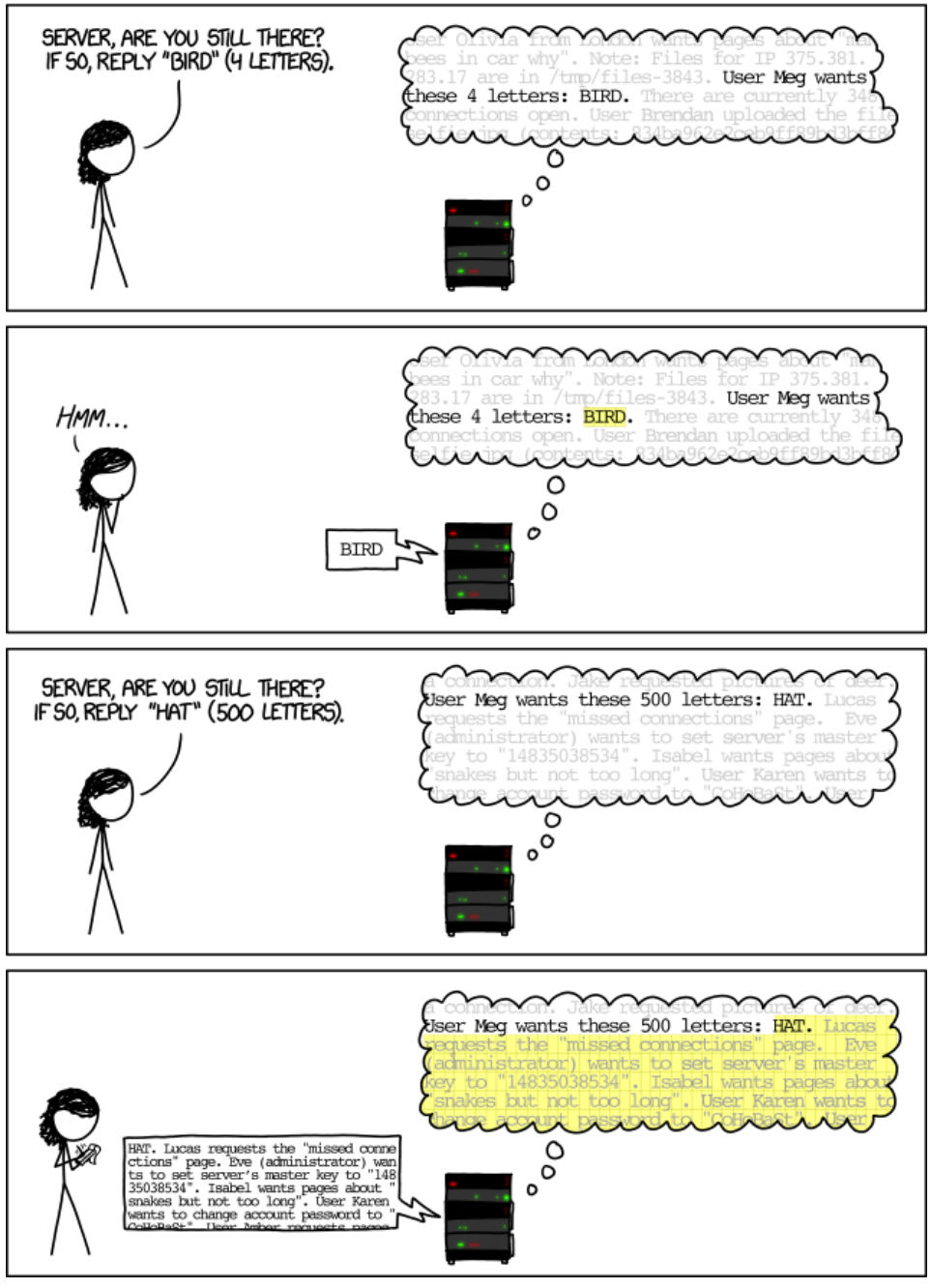
CVE-2014-0160

How the Heartbleed bug works:



why Heartbleed happened ?

- horrible code, once you look at it, you'll go somewhere else
- developers only interested in adding features, not fixing code
- fixes are not merged upstream
- bugs (and fixes) sleep for years in the bug tracker

OpenSSL malloc replacement

- it never frees memory (tools cannot spot bugs)
- it uses LIFO recycling (no 'use after free' problems)
- includes a debugging malloc that send private info to logs
- includes the ability to replace the malloc/free at runtime

What's wrong with OpenSSL code ?

- quite all OpenSSL API headers are public
- it is developed using "OpenSSL C"
- it uses its own functions instead of those provided by libc BIO_free(3), BIO_strdup
- crazy compile options (in OpenSSL both NO_OLD_ASN1 and NO_ASN1_OLD compile options are present but their meaning is slightly different)

OpenSSL code

```
#include "des_locl.h"

/* HAS BUGS! DON'T USE - this is only present for use in des.c */
void DES_3cbc_encrypt(DES_cblock *input, DES_cblock *output, long length,
     DES_key_schedule ks1, DES_key_schedule ks2, DES_cblock *iv1,
     DES_cblock *iv2, int enc)
```

OpenSSL code

```
Index: e_aes.c
===================================================================
RCS file: /cvs/src/lib/libssl/src/crypto/evp/e_aes.c,v
retrieving revision 1.13
retrieving revision 1.14
diff -u -p -u -p -r1.13 -r1.14
--- e_aes.c     8 May 2014 15:13:06 -0000       1.13
+++ e_aes.c     8 May 2014 15:29:00 -0000       1.14
@@ -56,7 +56,6 @@
 #include <assert.h>
 #include <openssl/aes.h>
 #include "evp_locl.h"
-#ifndef OPENSSL_FIPS
 #include "modes_lcl.h"
 #include <openssl/rand.h>

@@ -692,11 +691,6 @@ aes_gcm_ctrl(EVP_CIPHER_CTX *c, int type
        case EVP_CTRL_GCM_SET_IVLEN:
                if (arg <= 0)
                        return 0;
-#ifdef OPENSSL_FIPS
-               if (FIPS_module_mode() &&
-                   !(c->flags & EVP_CIPH_FLAG_NON_FIPS_ALLOW) && arg < 12)
-                       return 0;
-#endif
```

OpenSSL code

```
===================================================================
RCS file: /cvs/src/lib/libssl/src/crypto/sha/sha512.c,v
retrieving revision 1.2
retrieving revision 1.3
diff -u -r1.2 -r1.3
--- src/lib/libssl/src/crypto/sha/sha512.c 2013/12/19 22:09:26 1.2
+++ src/lib/libssl/src/crypto/sha/sha512.c 2014/04/17 21:07:05 1.3
@@ -318,13 +318,11 @@
   : "=r"(ret) \
   : "J"(n),"0"(a) \
   : "cc"); ret; })
-#   if !defined(B_ENDIAN)
 #    define PULL64(x) ({ SHA_LONG64 ret=*((const SHA_LONG64 *)(&(x))); \
   asm ("bswapq %0" \
   : "=r"(ret) \
   : "0"(ret)); ret; })
-#   endif
-#  elif (defined(__i386) || defined(__i386__)) && !defined(B_ENDIAN)
+#  elif (defined(__i386) || defined(__i386__))
 #   if defined(I386_ONLY)
 #    define PULL64(x) ({ const unsigned int *p=(const unsigned int *)(&(x));\
    unsigned int hi=p[0],lo=p[1];
```

OpenSSL code

```
===================================================================
RCS file: /var/cvs/src/lib/libssl/src/apps/Attic/s_socket.c,v
retrieving revision 1.31
retrieving revision 1.32
diff -u -p -r1.31 -r1.32
--- apps/s_socket.c     19 Apr 2014 13:13:01 -0000      1.31
+++ apps/s_socket.c     19 Apr 2014 16:38:04 -0000      1.32
@@ -77,7 +77,6 @@
 #ifndef OPENSSL_NO_SOCK


-static struct hostent *GetHostByName(char *name);
 static int ssl_sock_init(void);
 static int init_server(int *sock, int port, int type);
 static int init_server_long(int *sock, int port, char *ip, int type);
@@ -296,7 +295,7 @@ redoit:
                        return (0);
                }

-               h2 = GetHostByName(*host);
+               h2 = gethostbyname(*host);
                if (h2 == NULL) {
                        BIO_printf(bio_err, "gethostbyname failure\n");
```

LibreSSL

- very young project, development started on April 2014
- mostly developed by OpenBSD
- forked from OpenSSL 1.0.1g

LibreSSL goals

- preserve API/ABI compatibility with OpenSSL
- bring more people into working with the codebase (+KNF, -#ifdef)
- fix bugs asap, use modern coding practices
- do portability the right way™

Some differences between LibreSSL and OpenSSL

- 90000 lines of code less but same functionalities
- does not support VMS, MsDos nor MacOS 9
- does not add FIPS support
- different set of ciphers (-MD2, -SRP, +ChaCha, +poly1305)
- BIO_* functions do the right thing^{TM}
- malloc(x*y) has been converted to reallocarray(x,y)

How OpenSSL does portable

- use and abuse of internal functions that behaves "more or less" the same as libc counterpart
- #ifdef and #ifndef everywhere
- support for as many combinations of operating systems and compilers out there

How OpenSSH (and LibreSSL) does portable

- assume a sane target OS (OpenBSD) and code with his standards
- build and maintain code on the main target OS, using modern C
- provide portability code only to provide functions that other OS's don't provide
- do not reimplement libc
- put as few #ifdefs as possible in the code

LibreSSL API, ftp client

```
-               if (inet_pton(AF_INET,  host, &addrbuf) != 1 &&
-                   inet_pton(AF_INET6, host, &addrbuf) != 1) {
-                       if (SSL_set_tlsext_host_name(ssl, host) == 0) {
-                               ERR_print_errors_fp(ttyout);
-                               goto cleanup_url_get;
-                       }
-               }
-               if (SSL_connect(ssl) <= 0) {
-                       ERR_print_errors_fp(ttyout);
+               if (ressl_connect_socket(ssl, s, host) != 0) {
+                       fprintf(ttyout, "SSL failure: %s\n", ressl_error(ssl));
                        goto cleanup_url_get;
                }
-               if (ssl_verify) {
-                       X509    *cert;
-
-                       cert = SSL_get_peer_certificate(ssl);
-                       if (cert == NULL) {
-                               fprintf(ttyout, "%s: no server certificate\n",
-                                   getprogname());
-                               goto cleanup_url_get;
-                       }
-
-                       if (ssl_check_hostname(cert, host) != 0) {
-                               X509_free(cert);
-                               fprintf(ttyout, "%s: host `%s' not present in"
-                                   " server certificate\n",
-                                   getprogname(), host);
-                               goto cleanup_url_get;
-                       }
-
-                       X509_free(cert);
```

What should we have learned ?

- fix bugs ASAP, do not let them sleep fo years
- use as few workarounds as possible in your code
- review your code
- look at your old code and fix horrors sleeping there
- do not reinvent the wheel

Thanks