原 RTMPdump（libRTMP）源代码分析 4： 连接第一步——握手（Hand Shake）

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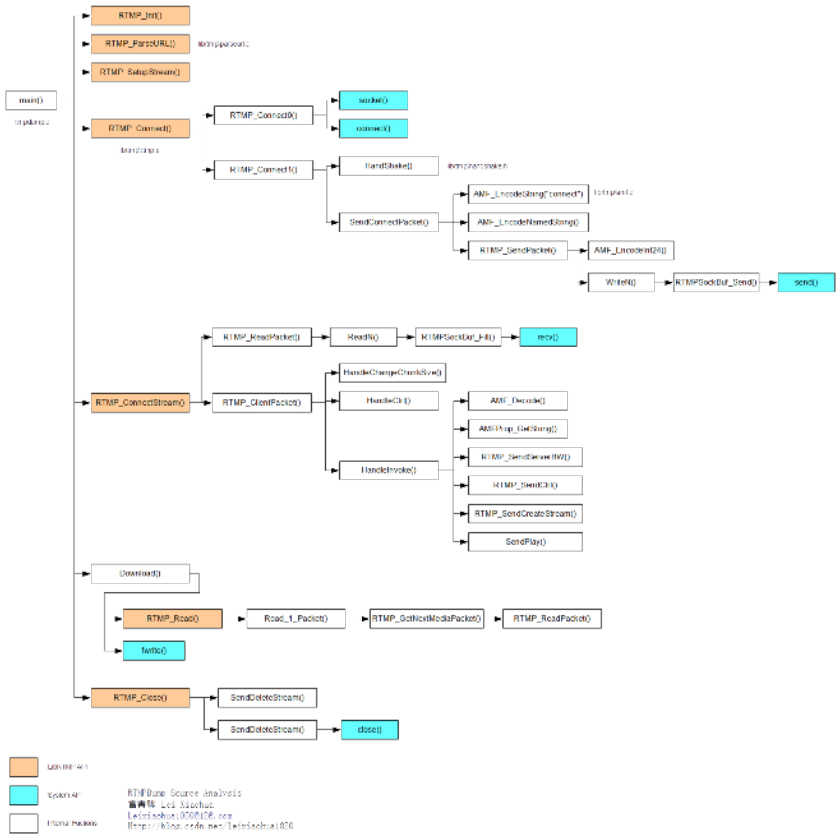
函数调用结构图

RTMPDump (libRTMP)的整体的函数调用结构图如下图所示。



单击查看大图

详细分析

在这里分析一下RTMPdump（libRTMP）连接到支持RTMP协议的服务器的第一步：握手（Hand Shake）。

RTMP连接的过程曾经分析过： RTMP流媒体播放过程

在这里不再细说，分析一下位于handshake.h文件里面实现握手（HandShake）功能的函数：

注意：handshake.h里面代码量很大，但是很多代码都是为了处理RTMP的加密版协议的，例如rtmps；因此在这里就不做过多分析了，我们只考虑普通的RTMP协议。

```cpp
static int
HandShake(RTMP * r, int FP9HandShake)
{
  int i, offalg = 0;
  int dhposClient = 0;
  int digestPosClient = 0;
  int encrypted = r->Link.protocol & RTMP_FEATURE_ENC;

  RC4_handle keyIn = 0;
  RC4_handle keyOut = 0;

  int32_t *ip;
  uint32_t uptime;

  uint8_t clientbuf[RTMP_SIG_SIZE + 4], *clientsig=clientbuf+4;
  uint8_t serversig[RTMP_SIG_SIZE], client2[RTMP_SIG_SIZE], *reply;
  uint8_t type;
  getoff *getdh = NULL, *getdig = NULL;

  if (encrypted || r->Link.SWFSize)
    FP9HandShake = TRUE;
  else
    //普通的
    FP9HandShake = FALSE;

  r->Link.rc4keyIn = r->Link.rc4keyOut = 0;

  if (encrypted)
    {
      clientsig[-1] = 0x06; /* 0x08 is RTMPE as well */
      offalg = 1;
    }
  else
    //0x03代表RTMP协议的版本（客户端要求的）
    //数组竟然能有“-1”下标
    //C0中的字段(1B)
    clientsig[-1] = 0x03;

  uptime = htonl(RTMP_GetTime());
  //void *memcpy(void *dest, const void *src, int n);
  //由src指向地址为起始地址的连续n个字节的数据复制到以dest指向地址为起始地址的空间内
  //把uptime的前4字节（其实一共就4字节）数据拷贝到clientsig指向的地址中
  //C1中的字段(4B)
  memcpy(clientsig, &uptime, 4);

  if (FP9HandShake)
    {
      /* set version to at least 9.0.115.0 */
      if (encrypted)
    {
      clientsig[4] = 128;
      clientsig[6] = 3;
    }
      else
        {
      clientsig[4] = 10;
      clientsig[6] = 45;
    }
      clientsig[5] = 0;
      clientsig[7] = 2;

      RTMP_Log(RTMP_LOGDEBUG, "%s: Client type: %02X", __FUNCTION__, clientsig[-1]);
      getdig = digoff[offalg];
      getdh  = dhoff[offalg];
    }
  else
    {
    //void *memset(void *s, int ch, size_t n);将s中前n个字节替换为ch并返回s；
    //将clientsig[4]开始的4个字节替换为0
    //这是C1的字段
      memset(&clientsig[4], 0, 4);
    }

  /* generate random data */
#ifdef _DEBUG
  //将clientsig+8开始的1528个字节替换为0（这是一种简单的方法）
  //这是C1中的random字段
  memset(clientsig+8, 0, RTMP_SIG_SIZE-8);
#else
```

```
#else
  //实际中使用rand()循环生成1528字节的伪随机数
  ip = (int32_t *)(clientsig+8);
  for (i = 2; i < RTMP_SIG_SIZE/4; i++)
    *ip++ = rand();
#endif

  /* set handshake digest */
  if (FP9HandShake)
    {
      if (encrypted)
    {
      /* generate Diffie-Hellmann parameters */
      r->Link.dh = DHInit(1024);
      if (!r->Link.dh)
        {
          RTMP_Log(RTMP_LOGERROR, "%s: Couldn't initialize Diffie-Hellmann!",
          __FUNCTION__);
          return FALSE;
        }

      dhposClient = getdh(clientsig, RTMP_SIG_SIZE);
      RTMP_Log(RTMP_LOGDEBUG, "%s: DH pubkey position: %d", __FUNCTION__, dhposClient);

      if (!DHGenerateKey((DH *)r->Link.dh))
        {
          RTMP_Log(RTMP_LOGERROR, "%s: Couldn't generate Diffie-Hellmann public key!",
          __FUNCTION__);
          return FALSE;
        }

      if (!DHGetPublicKey((DH *)r->Link.dh, &clientsig[dhposClient], 128))
        {
          RTMP_Log(RTMP_LOGERROR, "%s: Couldn't write public key!", __FUNCTION__);
          return FALSE;
        }
    }

      digestPosClient = getdig(clientsig, RTMP_SIG_SIZE);   /* reuse this value in verification */
      RTMP_Log(RTMP_LOGDEBUG, "%s: Client digest offset: %d", __FUNCTION__,
      digestPosClient);

      CalculateDigest(digestPosClient, clientsig, GenuineFPKey, 30,
              &clientsig[digestPosClient]);

      RTMP_Log(RTMP_LOGDEBUG, "%s: Initial client digest: ", __FUNCTION__);
      RTMP_LogHex(RTMP_LOGDEBUG, clientsig + digestPosClient,
         SHA256_DIGEST_LENGTH);
    }

#ifdef _DEBUG
  RTMP_Log(RTMP_LOGDEBUG, "Clientsig: ");
  RTMP_LogHex(RTMP_LOGDEBUG, clientsig, RTMP_SIG_SIZE);
#endif
  //发送数据报C0+C1
  //从clientsig-1开始发，长度1536+1，两个包合并
  //握手----------
  r->dlg->AppendCInfo("建立连接：第1次连接。发送握手数据C0+C1");
  //----------
  if (!WriteN(r, (char *)clientsig-1, RTMP_SIG_SIZE + 1))
    return FALSE;
  //读取数据报，长度1，存入type
  //是服务器的S0，表示服务器使用的RTMP版本
  if (ReadN(r, (char *)&type, 1) != 1)  /* 0x03 or 0x06 */
    return FALSE;
  //握手----------
  r->dlg->AppendCInfo("建立连接：第1次连接。接收握手数据S0");
  //----------
  RTMP_Log(RTMP_LOGDEBUG, "%s: Type Answer   : %02X", __FUNCTION__, type);
  //客户端要求的版本和服务器提供的版本不同
  if (type != clientsig[-1])
    RTMP_Log(RTMP_LOGWARNING, "%s: Type mismatch: client sent %d, server answered %d",
    __FUNCTION__, clientsig[-1], type);
  //握手----------
  r->dlg->AppendCInfo("建立连接：第1次连接。成功接收握手数据S0，服务器和客户端版本相同");
  //----------
  //客户端和服务端随机序列长度是否相同
  //握手----------
  r->dlg->AppendCInfo("建立连接：第1次连接。接收握手数据S1");
  //----------
  if (ReadN(r, (char *)serversig, RTMP_SIG_SIZE) != RTMP_SIG_SIZE)
    return FALSE;

  /* decode server response */
  //把serversig的前四个字节赋值给uptime
  memcpy(&uptime, serversig, 4);
  //大端转小端
  uptime = ntohl(uptime);

  RTMP_Log(RTMP_LOGDEBUG, "%s: Server Uptime : %d", __FUNCTION__, uptime);
  RTMP_Log(RTMP_LOGDEBUG, "%s: FMS Version   : %d.%d.%d.%d", __FUNCTION__, serversig[4],
      serversig[5], serversig[6], serversig[7]);
```

```
171.
172.   if (FP9HandShake && type == 3 && !serversig[4])
173.     FP9HandShake = FALSE;
174.
175. #ifdef _DEBUG
176.   RTMP_Log(RTMP_LOGDEBUG, "Server signature:");
177.   RTMP_LogHex(RTMP_LOGDEBUG, serversig, RTMP_SIG_SIZE);
178. #endif
179.
180.   if (FP9HandShake)
181.     {
182.       uint8_t digestResp[SHA256_DIGEST_LENGTH];
183.       uint8_t *signatureResp = NULL;
184.
185.       /* we have to use this signature now to find the correct algorithms for getting the digest and DH positions */
186.       int digestPosServer = getdig(serversig, RTMP_SIG_SIZE);
187.
188.       if (!VerifyDigest(digestPosServer, serversig, GenuineFMSKey, 36))
189.     {
190.       RTMP_Log(RTMP_LOGWARNING, "Trying different position for server digest!");
191.       offalg ^= 1;
192.       getdig = digoff[offalg];
193.       getdh  = dhoff[offalg];
194.       digestPosServer = getdig(serversig, RTMP_SIG_SIZE);
195.
196.       if (!VerifyDigest(digestPosServer, serversig, GenuineFMSKey, 36))
197.         {
198.           RTMP_Log(RTMP_LOGERROR, "Couldn't verify the server digest"); /* continuing anyway will probably fail */
199.           return FALSE;
200.         }
201.     }
202.
203.       /* generate SWFVerification token (SHA256 HMAC hash of decompressed SWF, key are the last 32 bytes of the server handshake) */
204.       if (r->Link.SWFSize)
205.     {
206.       const char swfVerify[] = { 0x01, 0x01 };
207.       char *vend = r->Link.SWFVerificationResponse+sizeof(r->Link.SWFVerificationResponse);
208.
209.       memcpy(r->Link.SWFVerificationResponse, swfVerify, 2);
210.       AMF_EncodeInt32(&r->Link.SWFVerificationResponse[2], vend, r->Link.SWFSize);
211.       AMF_EncodeInt32(&r->Link.SWFVerificationResponse[6], vend, r->Link.SWFSize);
212.       HMACsha256(r->Link.SWFHash, SHA256_DIGEST_LENGTH,
213.              &serversig[RTMP_SIG_SIZE - SHA256_DIGEST_LENGTH],
214.              SHA256_DIGEST_LENGTH,
215.              (uint8_t *)&r->Link.SWFVerificationResponse[10]);
216.     }
217.
218.       /* do Diffie-Hellmann Key exchange for encrypted RTMP */
219.       if (encrypted)
220.     {
221.       /* compute secret key */
222.       uint8_t secretKey[128] = { 0 };
223.       int len, dhposServer;
224.
225.       dhposServer = getdh(serversig, RTMP_SIG_SIZE);
226.       RTMP_Log(RTMP_LOGDEBUG, "%s: Server DH public key offset: %d", __FUNCTION__,
227.         dhposServer);
228.       len = DHComputeSharedSecretKey((DH *)r->Link.dh, &serversig[dhposServer],
229.                      128, secretKey);
230.       if (len < 0)
231.         {
232.           RTMP_Log(RTMP_LOGDEBUG, "%s: Wrong secret key position!", __FUNCTION__);
233.           return FALSE;
234.         }
235.
236.       RTMP_Log(RTMP_LOGDEBUG, "%s: Secret key: ", __FUNCTION__);
237.       RTMP_LogHex(RTMP_LOGDEBUG, secretKey, 128);
238.
239.       InitRC4Encryption(secretKey,
240.                 (uint8_t *) & serversig[dhposServer],
241.                 (uint8_t *) & clientsig[dhposClient],
242.                 &keyIn, &keyOut);
243.     }
244.
245.
246.       reply = client2;
247. #ifdef _DEBUG
248.       memset(reply, 0xff, RTMP_SIG_SIZE);
249. #else
250.       ip = (int32_t *)reply;
251.       for (i = 0; i < RTMP_SIG_SIZE/4; i++)
252.         *ip++ = rand();
253. #endif
254.       /* calculate response now */
255.       signatureResp = reply+RTMP_SIG_SIZE-SHA256_DIGEST_LENGTH;
256.
257.       HMACsha256(&serversig[digestPosServer], SHA256_DIGEST_LENGTH,
258.          GenuineFPKey, sizeof(GenuineFPKey), digestResp);
259.       HMACsha256(reply, RTMP_SIG_SIZE - SHA256_DIGEST_LENGTH, digestResp,
260.          SHA256_DIGEST_LENGTH, signatureResp);
```

```
261.
262.       /* some info output */
263.       RTMP_Log(RTMP_LOGDEBUG,
264.       "%s: Calculated digest key from secure key and server digest: ",
265.       __FUNCTION__);
266.       RTMP_LogHex(RTMP_LOGDEBUG, digestResp, SHA256_DIGEST_LENGTH);
267.
268. #ifdef FP10
269.       if (type == 8 )
270.         {
271.       uint8_t *dptr = digestResp;
272.       uint8_t *sig = signatureResp;
273.       /* encrypt signatureResp */
274.           for (i=0; i<SHA256_DIGEST_LENGTH; i+=8)
275.         rtmpe8_sig(sig+i, sig+i, dptr[i] % 15);
276.         }
277. #if 0
278.       else if (type == 9))
279.         {
280.       uint8_t *dptr = digestResp;
281.       uint8_t *sig = signatureResp;
282.       /* encrypt signatureResp */
283.           for (i=0; i<SHA256_DIGEST_LENGTH; i+=8)
284.             rtmpe9_sig(sig+i, sig+i, dptr[i] % 15);
285.         }
286. #endif
287. #endif
288.       RTMP_Log(RTMP_LOGDEBUG, "%s: Client signature calculated:", __FUNCTION__);
289.       RTMP_LogHex(RTMP_LOGDEBUG, signatureResp, SHA256_DIGEST_LENGTH);
290.     }
291.   else
292.     {
293.     //直接赋值
294.       reply = serversig;
295. #if 0
296.       uptime = htonl(RTMP_GetTime());
297.       memcpy(reply+4, &uptime, 4);
298. #endif
299.     }
300.
301. #ifdef _DEBUG
302.   RTMP_Log(RTMP_LOGDEBUG, "%s: Sending handshake response: ",
303.     __FUNCTION__);
304.   RTMP_LogHex(RTMP_LOGDEBUG, reply, RTMP_SIG_SIZE);
305. #endif
306.   //把reply中的1536字节数据发送出去
307.   //对应C2
308.   //握手----------
309.   r->dlg->AppendCInfo("建立连接：第1次连接。发送握手数据C2");
310.   //----------------------------
311.   if (!WriteN(r, (char *)reply, RTMP_SIG_SIZE))
312.     return FALSE;
313.
314.   /* 2nd part of handshake */
315.   //读取1536字节数据到serversig
316.   //握手----------
317.   r->dlg->AppendCInfo("建立连接：第1次连接。读取握手数据S2");
318.   //----------------------------
319.   if (ReadN(r, (char *)serversig, RTMP_SIG_SIZE) != RTMP_SIG_SIZE)
320.     return FALSE;
321.
322. #ifdef _DEBUG
323.   RTMP_Log(RTMP_LOGDEBUG, "%s: 2nd handshake: ", __FUNCTION__);
324.   RTMP_LogHex(RTMP_LOGDEBUG, serversig, RTMP_SIG_SIZE);
325. #endif
326.
327.   if (FP9HandShake)
328.     {
329.       uint8_t signature[SHA256_DIGEST_LENGTH];
330.       uint8_t digest[SHA256_DIGEST_LENGTH];
331.
332.       if (serversig[4] == 0 && serversig[5] == 0 && serversig[6] == 0
333.       && serversig[7] == 0)
334.     {
335.       RTMP_Log(RTMP_LOGDEBUG,
336.           "%s: Wait, did the server just refuse signed authentication?",
337.           __FUNCTION__);
338.     }
339.       RTMP_Log(RTMP_LOGDEBUG, "%s: Server sent signature:", __FUNCTION__);
340.       RTMP_LogHex(RTMP_LOGDEBUG, &serversig[RTMP_SIG_SIZE - SHA256_DIGEST_LENGTH],
341.          SHA256_DIGEST_LENGTH);
342.
343.       /* verify server response */
344.       HMACsha256(&clientsig[digestPosClient], SHA256_DIGEST_LENGTH,
345.          GenuineFMSKey, sizeof(GenuineFMSKey), digest);
346.       HMACsha256(serversig, RTMP_SIG_SIZE - SHA256_DIGEST_LENGTH, digest,
347.          SHA256_DIGEST_LENGTH, signature);
348.
349.       /* show some information */
350.       RTMP_Log(RTMP_LOGDEBUG, "%s: Digest key: ", __FUNCTION__);
351.       RTMP_LogHex(RTMP_LOGDEBUG, digest, SHA256_DIGEST_LENGTH);
```

```
352.
353.  #ifdef FP10
354.        if (type == 8 )
355.          {
356.        uint8_t *dptr = digest;
357.        uint8_t *sig = signature;
358.        /* encrypt signature */
359.            for (i=0; i<SHA256_DIGEST_LENGTH; i+=8)
360.          rtmpe8_sig(sig+i, sig+i, dptr[i] % 15);
361.          }
362.  #if 0
363.        else if (type == 9)
364.          {
365.        uint8_t *dptr = digest;
366.        uint8_t *sig = signature;
367.        /* encrypt signatureResp */
368.            for (i=0; i<SHA256_DIGEST_LENGTH; i+=8)
369.              rtmpe9_sig(sig+i, sig+i, dptr[i] % 15);
370.          }
371.  #endif
372.  #endif
373.        RTMP_Log(RTMP_LOGDEBUG, "%s: Signature calculated:", __FUNCTION__);
374.        RTMP_LogHex(RTMP_LOGDEBUG, signature, SHA256_DIGEST_LENGTH);
375.        if (memcmp
376.        (signature, &serversig[RTMP_SIG_SIZE - SHA256_DIGEST_LENGTH],
377.         SHA256_DIGEST_LENGTH) != 0)
378.      {
379.        RTMP_Log(RTMP_LOGWARNING, "%s: Server not genuine Adobe!", __FUNCTION__);
380.        return FALSE;
381.      }
382.        else
383.      {
384.        RTMP_Log(RTMP_LOGDEBUG, "%s: Genuine Adobe Flash Media Server", __FUNCTION__);
385.      }
386.
387.        if (encrypted)
388.      {
389.        char buff[RTMP_SIG_SIZE];
390.        /* set keys for encryption from now on */
391.        r->Link.rc4keyIn = keyIn;
392.        r->Link.rc4keyOut = keyOut;
393.
394.
395.        /* update the keystreams */
396.        if (r->Link.rc4keyIn)
397.          {
398.            RC4_encrypt((RC4_KEY *)r->Link.rc4keyIn, RTMP_SIG_SIZE, (uint8_t *) buff);
399.          }
400.
401.        if (r->Link.rc4keyOut)
402.          {
403.            RC4_encrypt((RC4_KEY *)r->Link.rc4keyOut, RTMP_SIG_SIZE, (uint8_t *) buff);
404.          }
405.      }
406.      }
407.    else
408.      {
409.      //int memcmp(const void *buf1, const void *buf2, unsigned int count); 当buf1=buf2时，返回值=0
410.      //比较serversig和clientsig是否相等
411.          //握手----------------
412.          r->dlg->AppendCInfo("建立连接：第1次连接。比较握手数据签名");
413.          //----------------------------
414.        if (memcmp(serversig, clientsig, RTMP_SIG_SIZE) != 0)
415.      {
416.          //握手----------------
417.          r->dlg->AppendCInfo("建立连接：第1次连接。握手数据签名不匹配！");
418.          //----------------------------
419.        RTMP_Log(RTMP_LOGWARNING, "%s: client signature does not match!",
420.            __FUNCTION__);
421.      }
422.      }
423.    //握手----------------
424.    r->dlg->AppendCInfo("建立连接：第1次连接。握手成功");
425.    //----------------------------
426.    RTMP_Log(RTMP_LOGDEBUG, "%s: Handshaking finished....", __FUNCTION__);
427.    return TRUE;
428.  }
```

rtmpdump源代码（Linux）：http://download.csdn.net/detail/leixiaohua1020/6376561

rtmpdump源代码（VC 2005 工程）：http://download.csdn.net/detail/leixiaohua1020/6563163

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