

Implementing a new Crypto Algorithm – Mistry1

Software: NetSim Standard v13.1 (64-bit), Visual Studio 2019, Wireshark

Project Download Link:

https://github.com/NetSim-TETCOS/MISTY_ENCRYPTION_v13.1/archive/refs/heads/main.zip

Follow the instructions specified in the following link to download and setup the Project in NetSim:

<https://support.tetcos.com/en/support/solutions/articles/14000128666-downloading-and-setting-up-netsim-file-exchange-projects>

Steps to simulate

1. Open the Source codes in Visual Studio by going to Your work-> Source code and Clicking on Open code button in NetSim Home Screen window.
2. Right click on the solution in the solution explorer and select Rebuild.

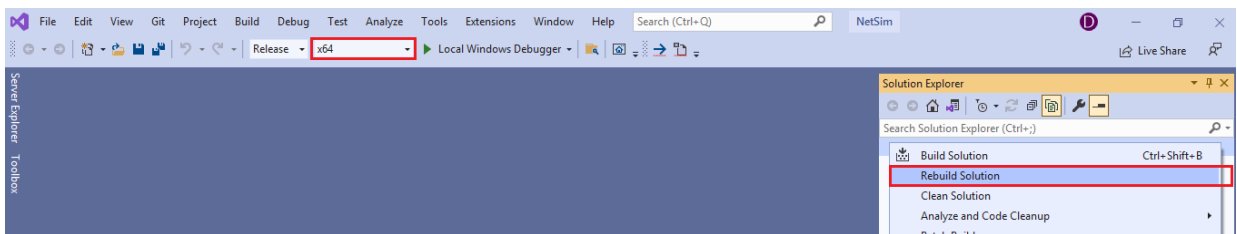


Figure 1: Screen shot of NetSim project source code in Visual Studio

3. Upon successful build modified dll file gets automatically updated in the directory containing NetSim binaries.

Example

1. The **MISTY_ENCRYPTION_WorkSpace** comes with a sample network configuration that are already saved. To open this example, go to Your work in the Home screen of NetSim and click on the **MISTY_ENCRYPTION_Example** from the list of experiments.
2. The Network Scenario mainly consist of 2 Wired Nodes and 1 Router.

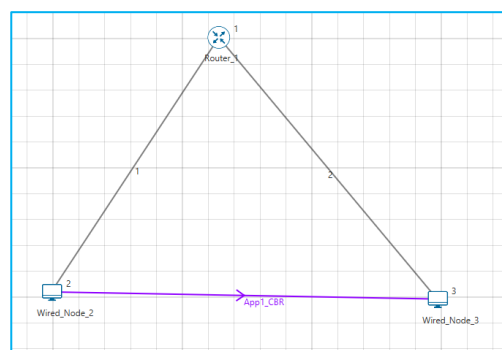


Figure 2: Network Scenario

3. Run Simulation with AES encryption enabled in the Application settings.
4. Now misty1 codes will be running instead of AES256.

Results and discussion

After simulation open metrics window and observe the result.

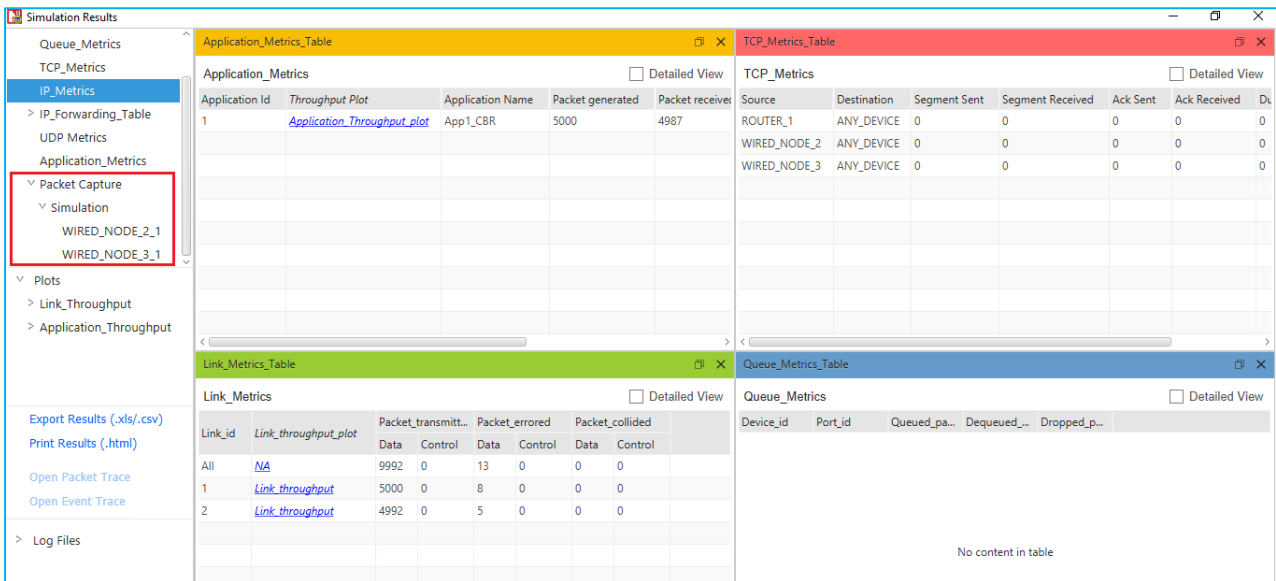


Figure 3: NetSim result dashboard.

You can see the encrypted payload in Wireshark either during simulation if online is set or after the simulation if offline is set in the source or destination nodes.

If Wireshark option is set to offline, then the capture files can be accessed from the results dashboard.

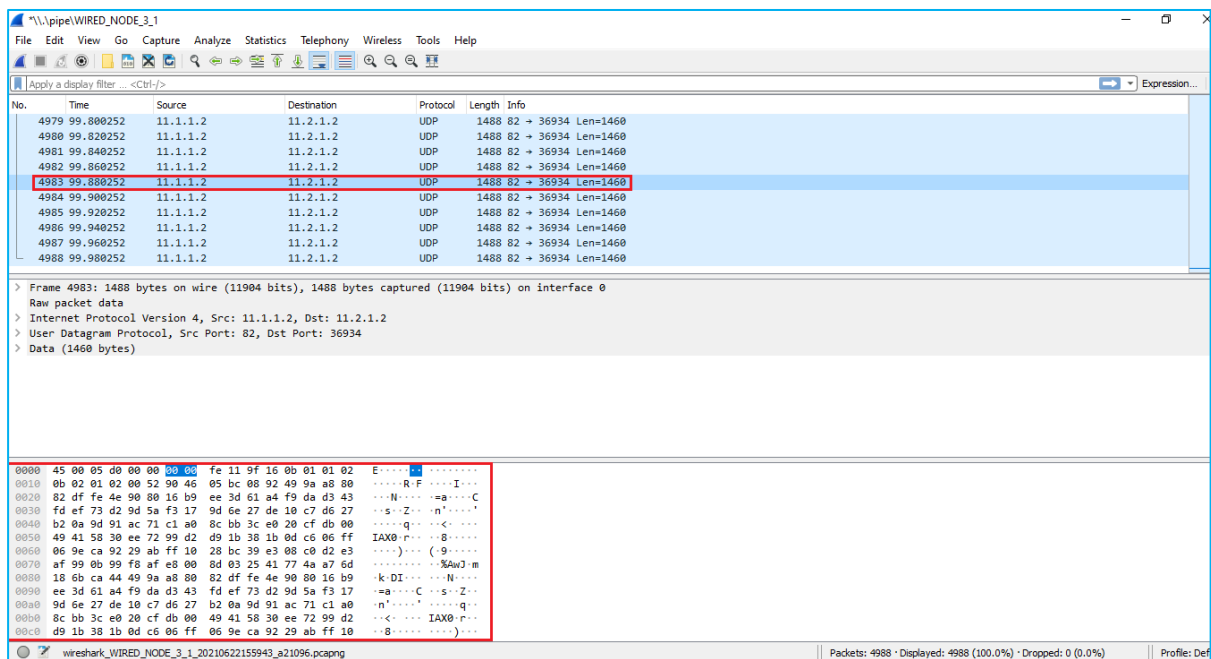


Figure 4: Wireshark window see the data is encrypted

Appendix: NetSim source code modifications

Added code in misty_run.c, within Application project

```
#include <string.h>
#include <stdlib.h>
#include <stdio.h>
#include "application.h"
void misty_run(char* str, int* len)
{
int n;
int l = *len;
unsigned char buf[32];
unsigned char key[32];
for (n = 0; n < *len; n += 16, str += 16, l -= 16)
{
/* Set the plain-text */
memcpy(buf, str, min(16, l));

misty1_main(buf);
memcpy(str, buf, 16);
}
}
```

In the `misty_run()` function inside the `misty_run.c` file we pass the plain text in parts of 16 bytes each time to get it encrypted. This is done because the crypto algorithm accepts a 16-byte plaintext as input. Here the variable `str` contains the packet payload and `len` corresponds to the size of payload in bytes.

Added code in misty1.c, within Application project

- A. Addition of `#include<application.h>` and `#define uint8 unsigned char` to the beginning of the `misty1.c` file

```
#include <stdlib.h>
#include <string.h>
#include "application.h"
typedef unsigned long u4;
typedef unsigned char byte;
#define MISTY1_KEYSIZE 32
#define uint8 unsigned char
```
- B. Removed inline keyword that is present before the functions `fi()`, `fo()`, `fl()` and `flinv()`.

```

misty1.c
Application (Global Scope)
73
74
75 u4 fi(u4 fi_in, u4 fi_key) { ... }
89
90
91 u4 fo(u4 *ek, u4 fo_in, byte k) { ... }
108
109
110 u4 fl(u4 *ek, u4 fl_in, byte k) { ... }
129
130
131 u4 flinv(u4 *ek, u4 fl_in, byte k) { ... }
151
152

```

C. Now go to the main() function in the file and check that line #ifdef TESTMAIN was removed or commented before the main() function and also the associated #endif at the end of the main() function.

D. main() function was renamed to unsigned char* misty1_main(uint8* input)

```

#ifdef TESTMAIN
unsigned char* misty1_main(uint8* input)
{
/*
Key:    00 11 22 33 44 55 66 77 88 99 aa bb cc dd ee ff
Plaintext: 01 23 45 67 89 ab cd ef fe dc ba 98 76 54 32 10
Ciphertext: 8b 1d a5 f5 6a b3 d0 7c 04 b6 82 40 b1 3b e9 5d
*/

/* misty1_keyinit(ek_e,Key);
misty1_encrypt_block(ek_e,&Plaintext[0],&c[0]);
misty1_encrypt_block(ek_e,&Plaintext[2],&c[2]);

if (!memcmp(c,Ciphertext,4 * sizeof(u4))) {
printf("Encryption OK\n");
}
else {
printf("Encryption failed[0x%08lx 0x%08lx 0x%08lx 0x%08lx]\n",
c[0],c[1],c[2],c[3]);
exit(1);
}

misty1_keyinit(ek_d,Key);

if (memcmp(ek_e,ek_d,MISTY1_KEYSIZE*sizeof(u4))) {
printf("Internal Error keysch is wrong\n");
*/

```

```

exit(1);
}

misty1_decrypt_block(ek_d,&Ciphertext[0],&c[0]);
misty1_decrypt_block(ek_d,&Ciphertext[2],&c[2]);

if (!memcmp(c,Plaintext,4 * sizeof(u4))) {
printf("Decryption OK\n");
}
else {

printf("Decryption failed[0x%08lx 0x%08lx 0x%08lx 0x%08lx]\n",
c[0],c[1],c[2],c[3]);
exit(1);
}
*/

```

- E. Commented the declaration of Cipher text, Modify the declaration of Plaintext variable, as shown below:

```

u4 Key[] = { 0x00112233, 0x44556677, 0x8899aabb, 0xccddeeff };
u4 Plaintext[4];
// u4 Ciphertext[]= { 0x8b1da5f5, 0x6ab3d07c, 0x04b68240, 0xb13be95d};
u4 ek_e[MISTY1_KEYSIZE], ek_d[MISTY1_KEYSIZE];
u4 c[4];

```

- F. Now check the commented lines starting from misty1_keyinit() to misty1_key_destroy() as shown below:

```

/* misty1_keyinit(ek_e,Key);
misty1_encrypt_block(ek_e,&Plaintext[0],&c[0]);
misty1_encrypt_block(ek_e,&Plaintext[2],&c[2]);

if (!memcmp(c,Ciphertext,4 * sizeof(u4))) {
printf("Encryption OK\n");
}
else {
printf("Encryption failed[0x%08lx 0x%08lx 0x%08lx 0x%08lx]\n",
c[0],c[1],c[2],c[3]);
exit(1);
}

misty1_keyinit(ek_d,Key);

if (memcmp(ek_e,ek_d,MISTY1_KEYSIZE*sizeof(u4))) {
printf("Internal Error keysch is wrong\n");
exit(1);
}

```

```

misty1_decrypt_block(ek_d,&Ciphertext[0],&c[0]);
misty1_decrypt_block(ek_d,&Ciphertext[2],&c[2]);
if (!memcmp(c,Plaintext,4 * sizeof(u4))) {
printf("Decryption OK\n");
}
else {

printf("Decryption failed[0x%08lx 0x%08lx 0x%08lx 0x%08lx]\n",
c[0],c[1],c[2],c[3]);
exit(1);
}
*/

```

- G. Addition of the following lines of code just above the `misty1_key_destroy(ek_e)`; statement as shown below:

```

// Memcpy is used to equate input which is Char to Plaintext
// which is Unsigned Long

```

```

memcpy(Plaintext, input, 2 * sizeof(u4));
memcpy(&Plaintext[2], &input[8], 2 * sizeof(u4));

misty1_keyinit(ek_e, Key);
misty1_encrypt_block(ek_e, Plaintext, &c[0]);
misty1_encrypt_block(ek_e, &Plaintext[2], &c[2]);

memcpy(input, c, 2 * sizeof(u4));
memcpy(&input[8], &c[2], 2 * sizeof(u4));

misty1_key_destroy(ek_e);
misty1_key_destroy(ek_d);
memset(Key, 0, 4 * sizeof(u4));

```

```

}

```

- H. Inside the `misty1_main` function the above codes were modified to ensure that the plaintext is properly initialized with the 16 bytes of payload received, for the encryption to happen
- I. Here, `memcpy()` is done initially to equate input received as which is char, to the plain text which is unsigned long.

```

memcpy(Plaintext,input,2*sizeof(u4));
memcpy(&Plaintext[2],&input[8],2*sizeof(u4));

```

- J. After the calls to `misty1_encrypt_block()` `memcpy()` is done to equate the encrypted cipher text back to the input.

```

memcpy(input,c,2*sizeof(u4));
memcpy(&input[8],&c[2],2*sizeof(u4));

```

- K. Now double click on the application.c file and make a call to misty_run() function instead of the call to aes256, inside the copy_payload() function.

```
void copy_payload(UINT8 real[],NetSim_PACKET* packet,unsigned int* payload,
ptrAPPLICATION_INFO info)
{
u_short i;
uint32_t key = 16;
if (payload)
{
for (i = 0; i < *payload; i++)
{
if (info->encryption == Encryption_XOR)
real[i] = xor_encrypt('a' + i % 26, 16);
else
real[i] = 'a' + i % 26;
}
if (info->encryption == Encryption_TEA)
encryptBlock(real, payload, &key);
else if (info->encryption == Encryption_AES)
misty_run(real, payload);
//aes256(real,payload);
else if(info->encryption==Encryption_DES)
des(real,payload);
}
}
```