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Expliot – IoT Security Testing and Exploitation Framework

BY ASEEM JAKHAR

About Me

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    - null – The open security community
    - nullcon Security Conference
    - hardwear.io Security Conference
- Open source Developer
  - Jugaad - https://bitbucket.org/aseemjakhar/jugaad/src/master/README.TXT
  - Indroid - https://bitbucket.org/aseemjakhar/indroid/src/master/README.TXT
  - Dexfuzzer - https://bitbucket.org/aseemjakhar/dexfuzzer/src/master/
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hardwear.io
Hardware Security Conference and Training

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Agenda

- IoT Security issues
- IoT Attack Surface
- Problem Statement
- Meet expliot!
- Demos

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IoT Security Issues

- Speed to market
- No/low motivation for security
- Little awareness about security issues
- Power/Cost limitation of security implementation
- Protocol
  - Custom protocols
  - No or default Authentication
  - Discovery mechanisms aid in recon
- Implementations still not that mature
- Cloud
  - Trust in telemetry data

IoT Attack Surface

- High level view

IoT Attack Surface

- **Device**

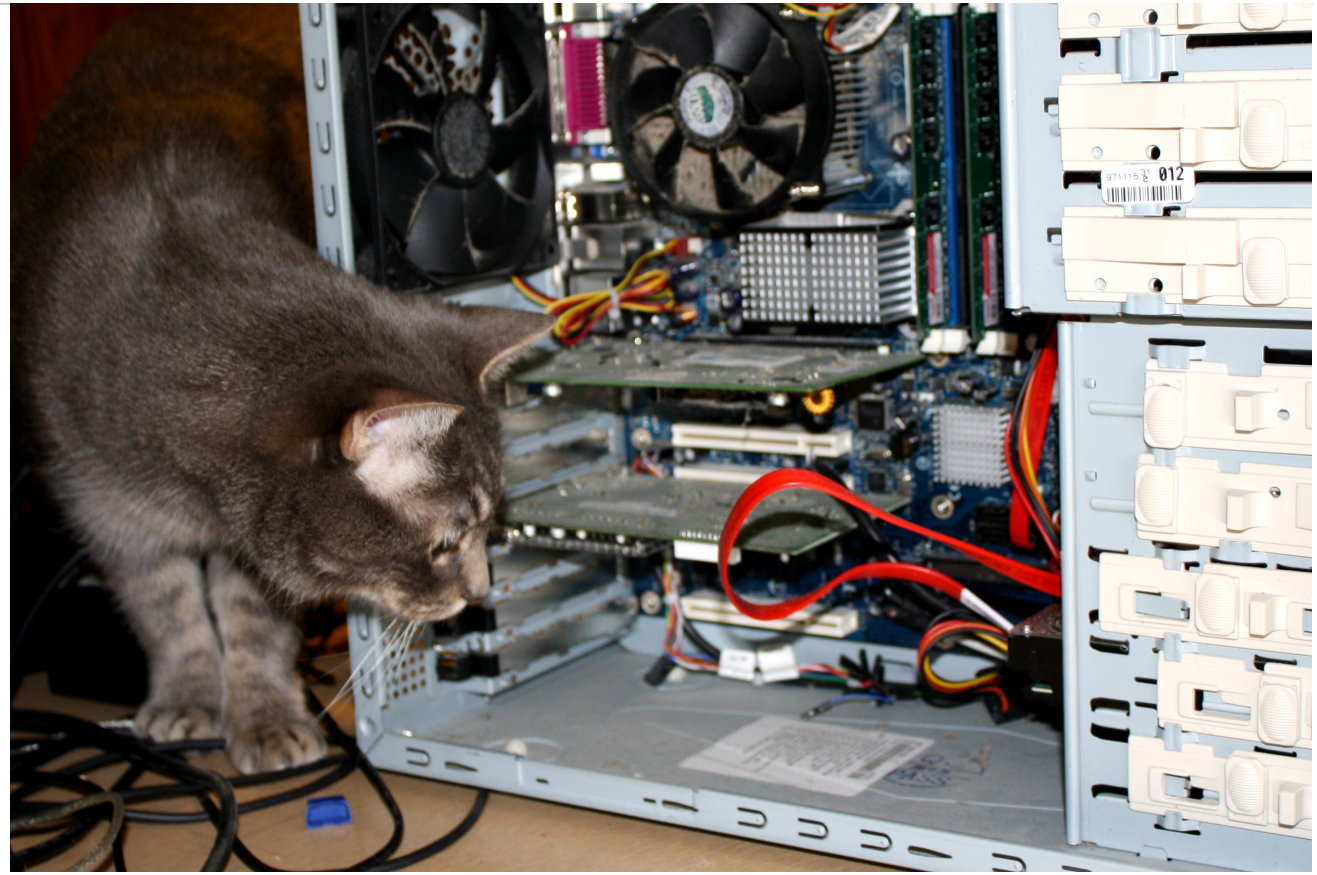
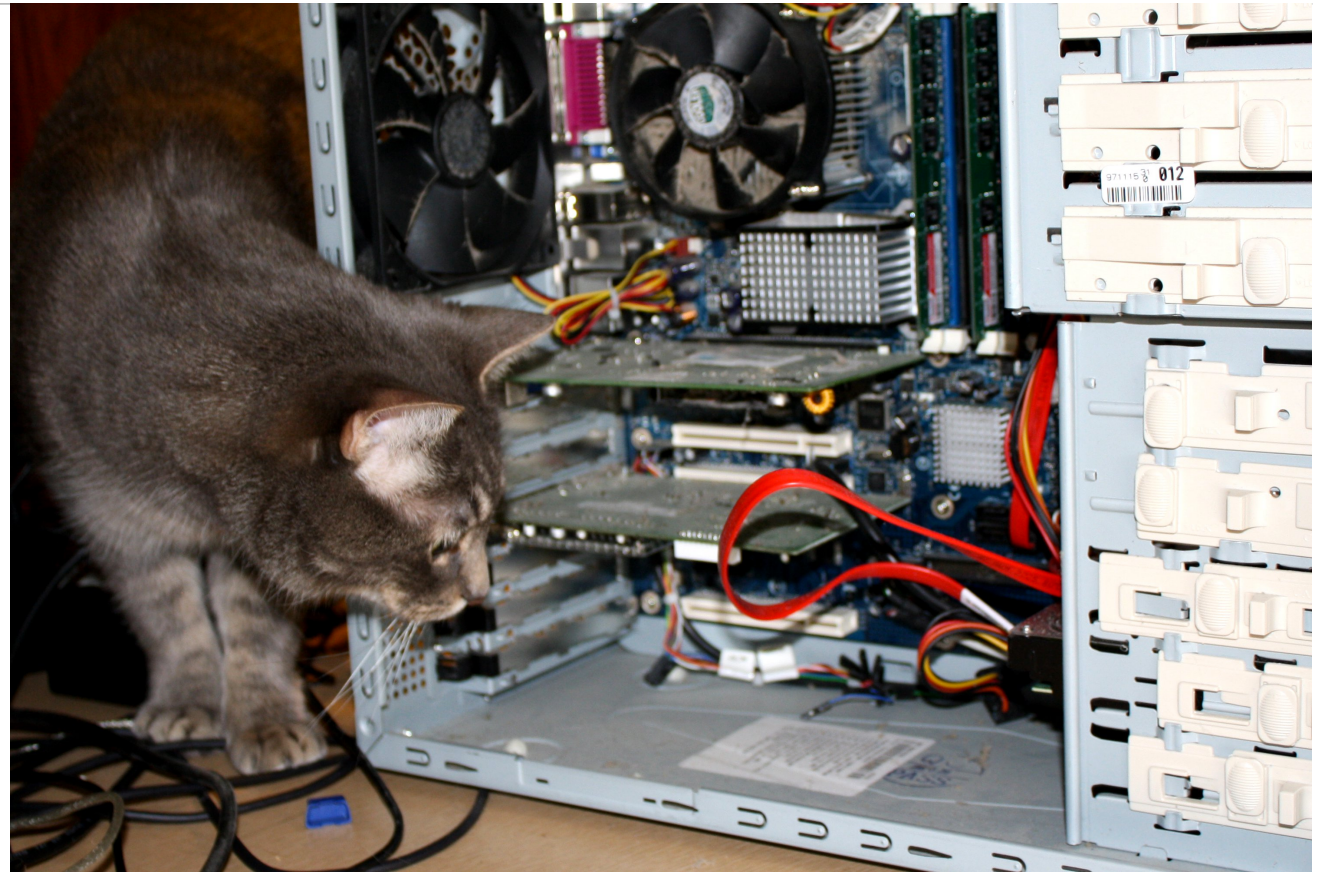


Image source: http://www.photos-public-domain.com/wp-content/uploads/2012/01/funny-cat-peering-into-open-desktop-computer-case.jpg

IoT Attack Surface

- **Device**
- Services
  - SSH, Telnet
  - Web
  - Proprietary services
- Storage
  - SD Card
  - USB
- Firmware
  - Encryption
  - Modification
- Hardware
  - Debug ports - UART/JTAG
  - Memory - Flash/EEPROM
  - Radio



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IoT Attack Surface

- **Cloud**

Image source: https://s-media-cache-ak0.pinimg.com/564x/2f/3e/52/2f3e520f1b0465388d85732e6b2367a6.jpg

IoT Attack Surface

- **Cloud**
  - Communication
  - Storage
- Business logic flaws
  - Domain specific flaws
  - Owasp Web Top 10
    - Standard Web security issues

Image source: https://s-media-cache-ak0.pinimg.com/564x/2f/3e/52/2f3e520f1b0465388d85732e6b2367a6.jpg

IoT Attack Surface

- **Mobile**

Image Source: http://www.electronicsbiz.com/wp-content/uploads/2014/07/cat-using-ipad.jpg

IoT Attack Surface

- **Mobile**
- Communication
- Storage
- Business logic flaws
  - Domain specific flaws
- OWASP Mobile Top 10
  - Standard mobile security issues

Image Source: http://www.electronicsbiz.com/wp-content/uploads/2014/07/cat-using-ipad.jpg

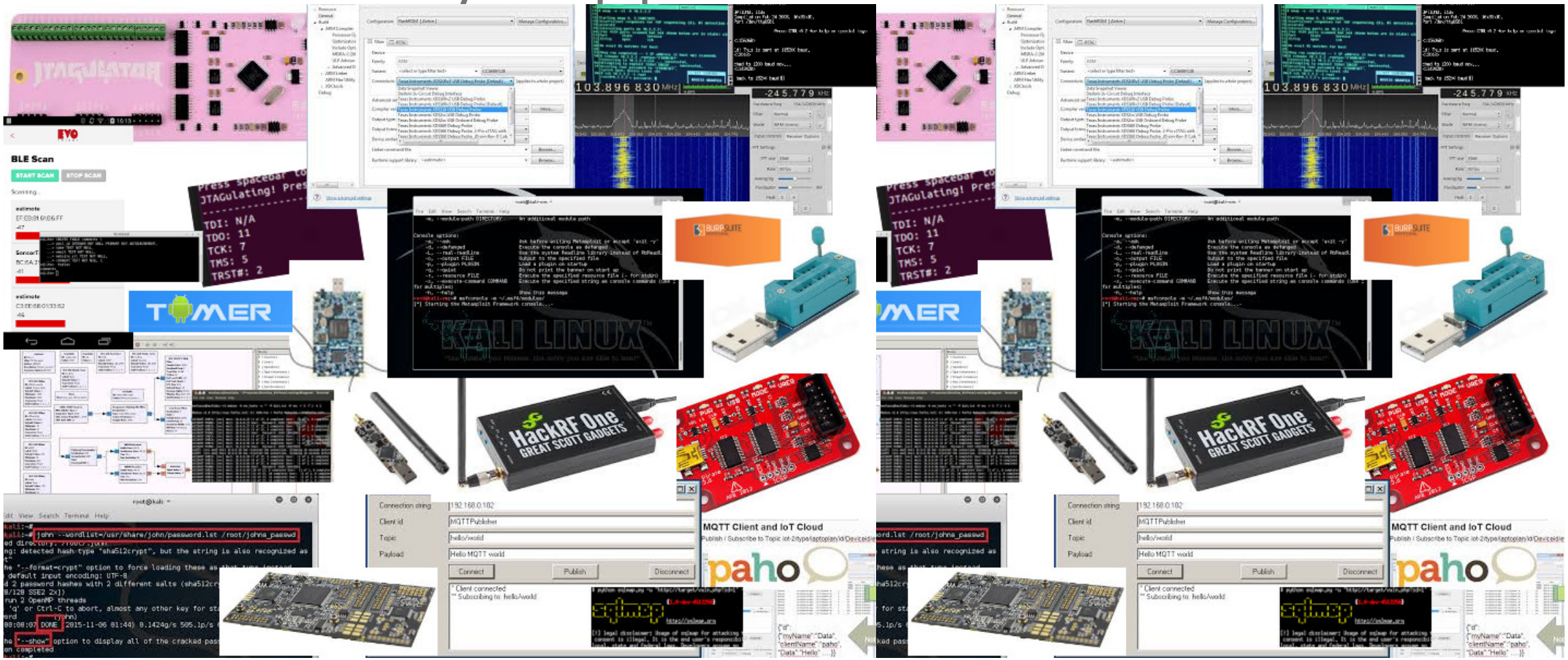
Getting ready for an IoT Pentest

Image Source: http://cdn.memecats.com/media/thumbs/embedded/398.jpg

What you think?

Image Source: http://static.boredpanda.com/blog/wp-content/uploads/2015/01/ninja-cat-hiding-funny-105__605.jpg

What actually happens!



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Problem Statement

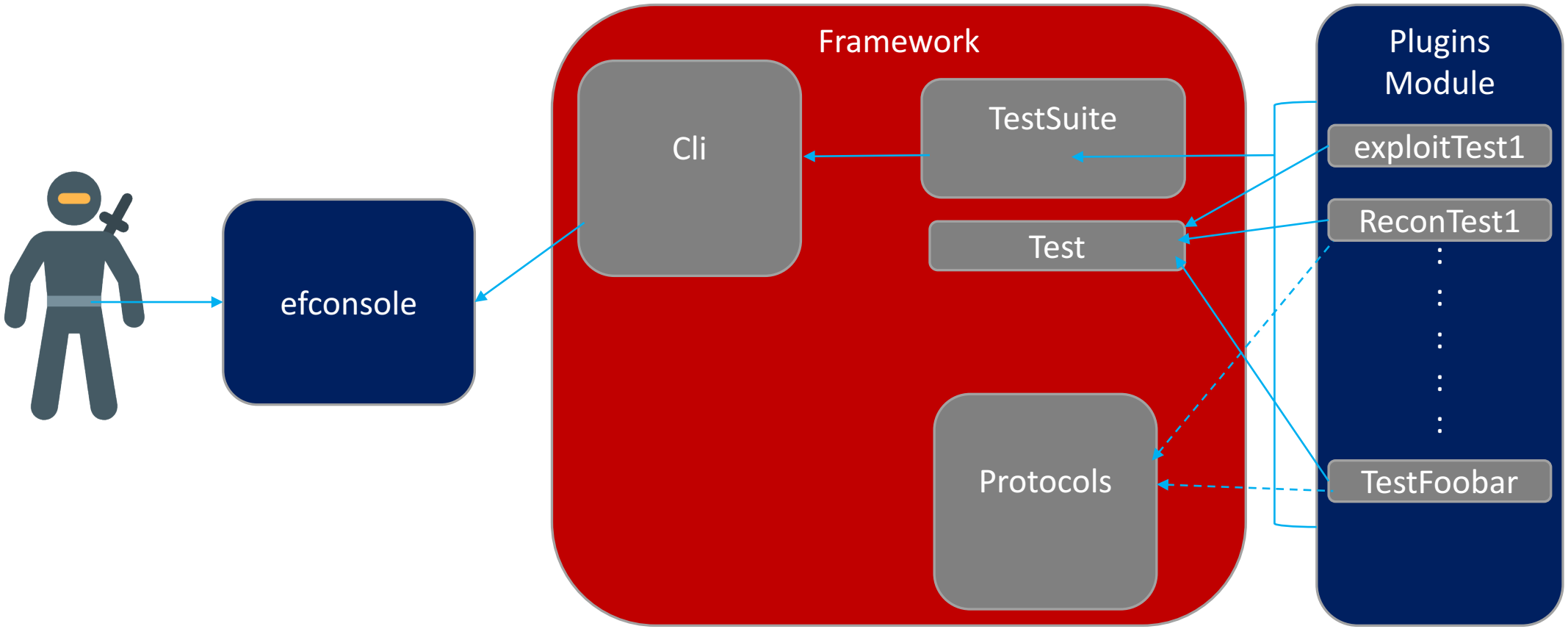
- Too many interfaces
- Tooooo many tools

Meet expliot!

- Pronounced expliot (expl-aa-yo-tee)
- Framework
  - IoT exploitation
  - IoT Penetration Testing
- Design Goals/Motivation
  - Simple to use
  - Extendable
  - Easy to write test cases
- Source code
  - https://gitlab.com/expliot_framework/expliot

Image Source: http://www.funnycatsite.com/pictures/robo_cat.jpg

Expliot Architecture



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Expliot Plugin

- Simple to implement
- Inherit from the relevant base Test class
- Import protocols only from expliot protocols package
- Only import required stuff from default python library
- Define members
  - Plugin information
  - command-line arguments
- Override 3 methods
  - pre() – Optional. Setup etc.
  - execute() – Mandatory. The main plugin execution code
  - post() – Optional. Cleanup etc.


```python
from expliot.core.tests.test import Test, TCategory, TTarget, TLog

class Sample(Test):

    def __init__(self):
        super().__init__(name     = "Sample name",
                         summary  = "Sample Summary",
                         descr    = "Sample Description",
                         author   = "Sample author",
                         email    = "email@example.com",
                         ref      = ["https://example.com", "https://example.dom"],
                         category = TCategory(TCategory.COAP, TCategory.SW, TCategory.EXPLOIT),
                         target   = TTarget(TTarget.GENERIC, TTarget.GENERIC, TTarget.GENERIC))

        self.argparser.add_argument("-r", "--rhost", required=True, help="IP address of the target")
        self.argparser.add_argument("-p", "--rport", default=80, type=int, help="Port number of the target. Default is 80")
        self.argparser.add_argument("-v", "--verbose", action="store_true", help="show verbose output")

    def pre(self):
        TLog.generic("Enter {}.pre()".format(self.id))
        # Only implement this if you need to do some setup etc.
        TLog.generic("Exit {}.pre()".format(self.id))

    def post(self):
        TLog.generic("Enter {}.post()".format(self.id))
        # Only implement this if you need to do some cleanup etc.
        TLog.generic("Exit {}.post()".format(self.id))

    def execute(self):
        TLog.generic("Sending request to server({}) on port({})".format(self.args.rhost, self.args.rport))
        TLog.trydo("Searching imaginary database")
        TLog.success("Found matching entry in db - ({})".format("FooEntry"))
        snd = "GET / HTTP/1.1"
        TLog.generic("Sending command to server ({}) on port ({})".format(self.args.rhost, self.args.rport))
        if self.args.verbose is True:
            TLog.generic("More verbose output. sending payload ({})".format(snd))
        TLog.fail("No response received")
        TLog.generic("Re-sending command")
        rcv = "Response received from the server"
        # In case of failure (Nothing to do in case of success)
        self.result.setstatus(passed=False, reason="Server is not vulnerable")
```

Current Plugins

- BLE
  - Ble scanner
  - Read | Write | Fuzz characteristic values
- MQTT
  - Publish | Subscribe | Auth cracker
- Modbus
  - Read | Write
- CAN
  - Read | Write
- Serial
  - Brute Force | Fuzz
- Exploits
  - Tapplock - Unlock
  - Kankun Smartplug ON/OFF

MQTT – Security issues

- $SYS/# topics
- DoS
- Auth bruteforce
- Malicious telemetry data

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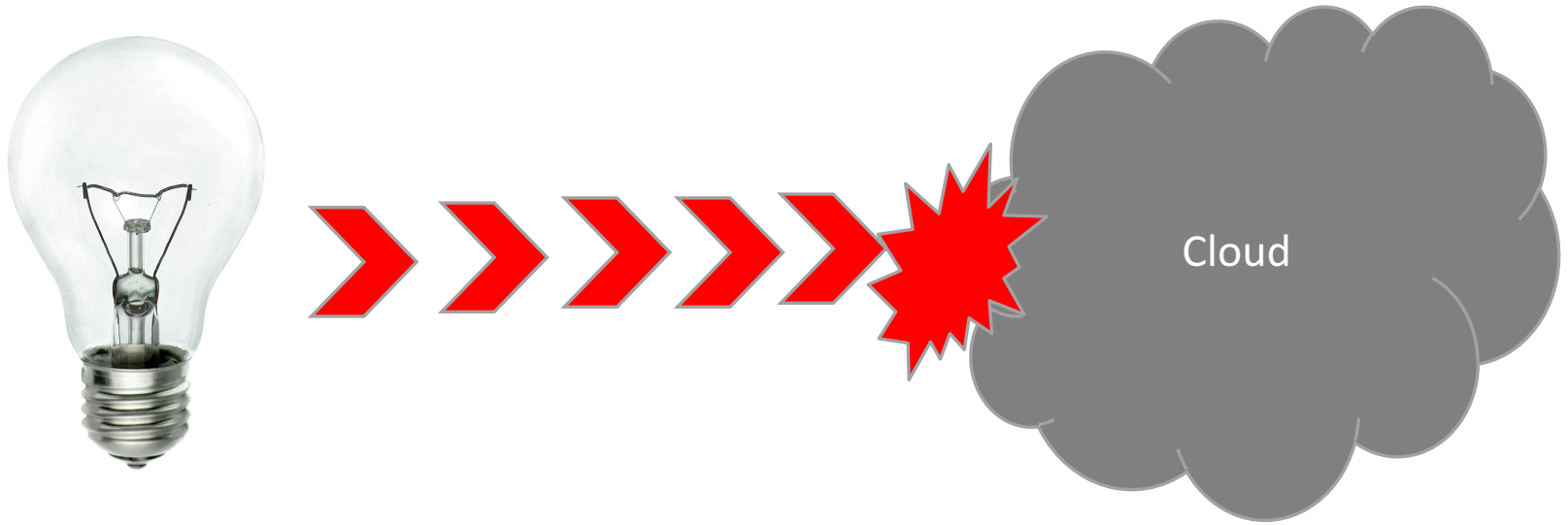
MQTT – Demo Auth Bruteforce

MQTT – Demo Malicious Telemetry data

- Pwn cloud ~ Pwn ecosystem



BLE – Security Issues

- Characteristic value read/write

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BLE – Plugins demo

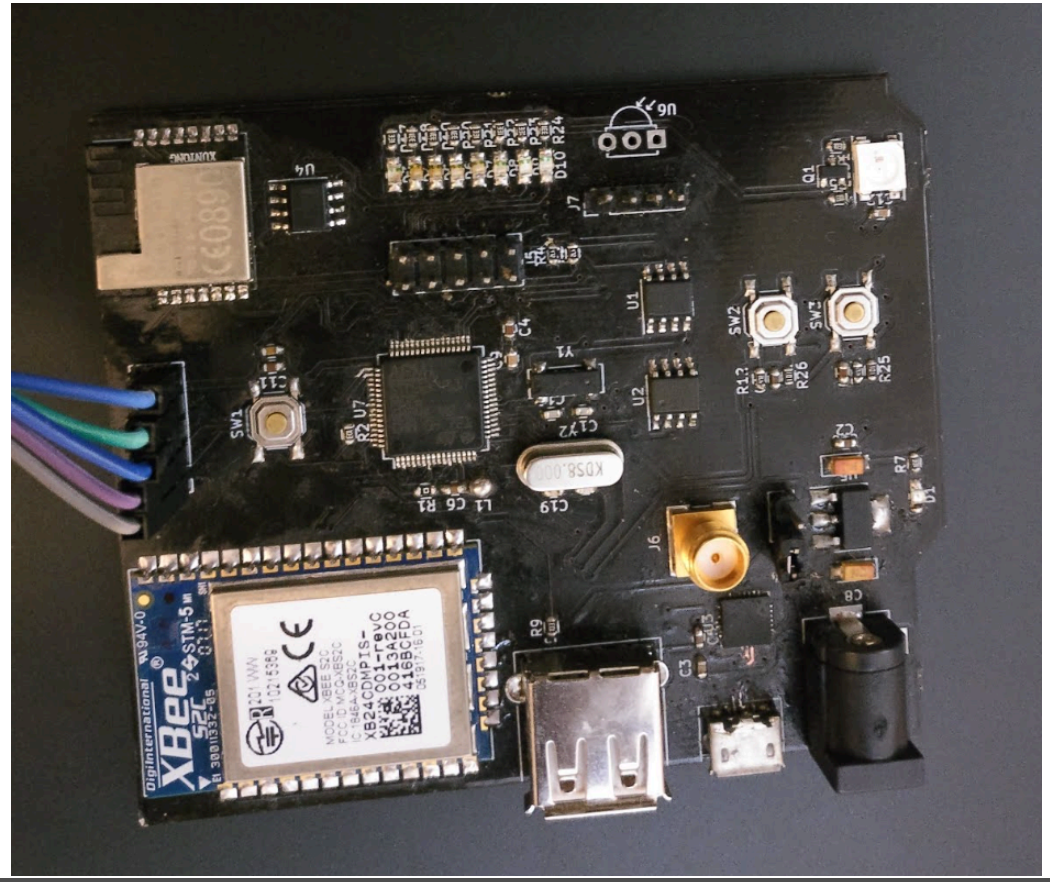
Tapplock – Demo of tappunlock plugin

UART – Security issues

- Root shell
- Custom shell with no input validation
- Hidden commands

UART – Demo Brute force commands

- DIVA IoT Board – Damn Insecure and Vulnerable App IoT



Road map

- Hardware interface for JTAG, SPI, I2C, etc.
- Radio protocol support – zigbee, loRA etc.
- Firmware analysis test cases
- More IoT exploits

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References

- Mosquitto - https://mosquitto.org
- MQTT php example - https://github.com/bluerhinos/phpMQTT/issues/6

Image Credits

- Steam engine image - https://en.wikipedia.org/wiki/File:Triple_expansion_engine_animation.gif
- Jtagulator - http://hackerwarehouse.com/wp-content/uploads/2013/09/parallax-jtagulator-454A5322a-1024.jpg
- Jtagulator GUI - https://www.invincealabs.com/images/2016/05/jtagulator.png
- GNU Radio - http://bhilburn.org/content/images/2014/11/grc-nbfm.png
- gqrx - http://farm6.staticflickr.com/5510/10912568935_e38bcfe964_z.jpg
- Paho - https://www.ibm.com/developerworks/community/blogs/mobileblog/resource/BLOGS_UPLOADED_IMAGES/mqtt-client-and-iot-cloud.png
- bus pirate - https://statics3.seeedstudio.com/images/product/Bus%20Pirate%20v3.6interface.jpg
- mutt client form - https://dutchtechy.files.wordpress.com/2014/03/csharp2.png
- hackrf - https://cdn.sparkfun.com//assets/parts/9/9/5/3/13001-04.jpg
- john - https://blackmoreops.com/wp-content/uploads/2015/11/Cracking-password-using-John-the-Ripper-in-Kali-Linux-blackMORE-Ops-3.jpg
- eeprom reader - http://img.dxcdn.com/productimages/sku_336830_1.jpg
- Tapplock - https://scontent-mrs1-1.xx.fbcdn.net/v/t31.0-8/20247552_135954506993037_5653104370729346590_o.png?_nc_cat=0&oh=af98b07853a69891e5e87e9d14b46b63&oe=5BEC1FE9

Image Credits

- xds debugger - http://processors.wiki.ti.com/images/1/1e/CCS_XDS110_Debug_options.jpg
- metasploit - https://www.offensive-security.com/wp-content/uploads/2015/04/metasploit-unleashed-add-module-path.png
- ble scan app - https://evothings.com/doc/examples/images/ble-scan-screenshot.png
- limesdr - https://www.crowdsupply.com/img/e9d0/limesdr-2_jpg_project-body.jpg
- ubertooth - https://cdn.sparkfun.com//assets/parts/5/2/0/6/10573-01.jpg
- Chip whisperer - http://3i2kbu3p64zdryox2qp5q43na.wpengine.netdna-cdn.com/wp-content/uploads/2015/07/chipwhisperer-lite-VB5A0319a.jpg
- minicom - http://spritesmods.com/autobaud/minicom.png
- android tamer - http://www.toolswatch.org/wp-content/uploads/2016/06/logo_android_tamer.png
- Burp suite - https://portswigger.net/sc/InstallingandConfiguring_LaunchingBurp_7.png
- nmap - https://nmap.org/movies/matrix/trinity-nmapscreen-hd-cropscale-418x250.jpg
- sqlmap - http://www.smt-center.com/images/sqlmap.png
- sqlite3 - https://dab1nmslvvntp.cloudfront.net/wp-content/uploads/2015/02/1423063979createTable.png
- medusa - http://www.hackingtools.in/wp-content/uploads/2015/12/medusa.png

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Thanks | Q&A

- You can reach me at aseem@payatu.com
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- Currently working on Contributor License agreement
- Use, Test, Suggest improvements