Cyber Simulator Showcase

CERT Cybersecurity Workforce Development

Part 4 of 6: vTunnel and WELLE-D

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vTunnel

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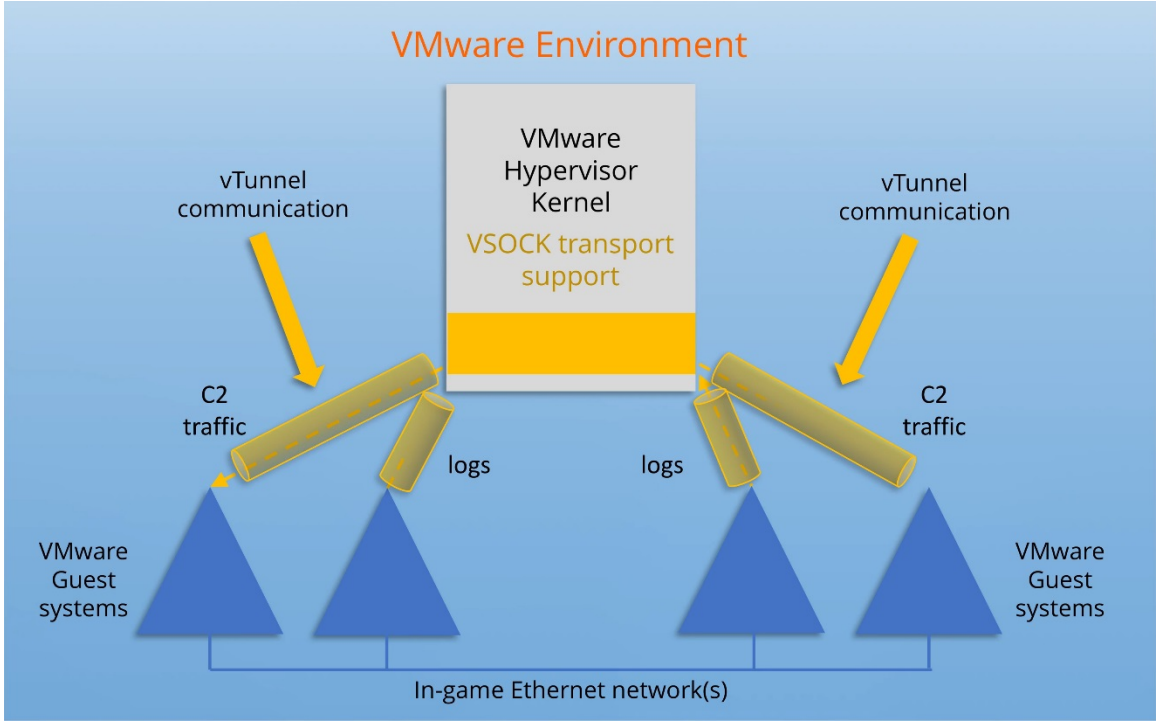
vTunnel

Allows a tunnel to be established one way:

- Guest side to host side
- Host side to guest side



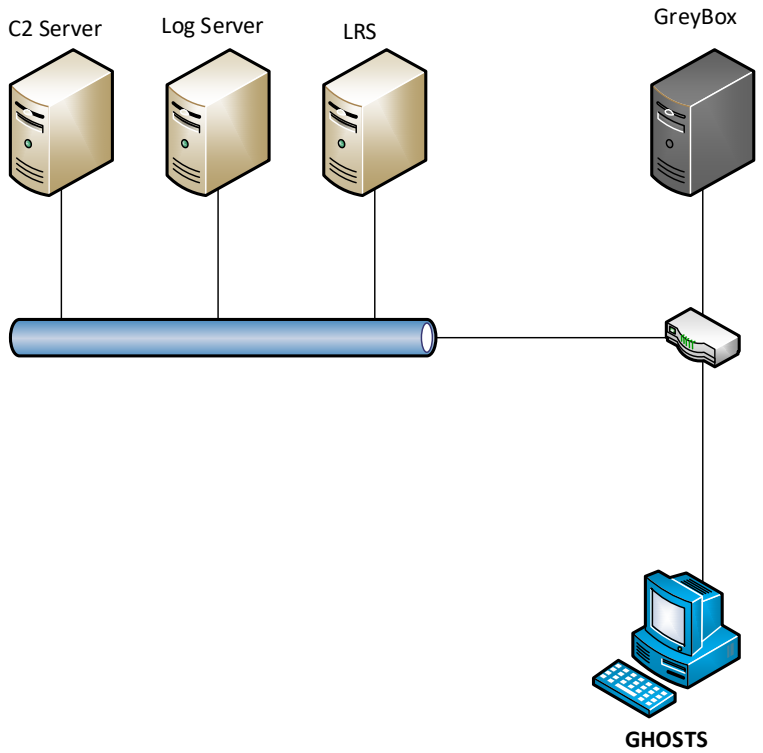
Range Management Traffic

Relies on networked applications

Injects activity into exercise

Logs network and system activity

Scores student actions

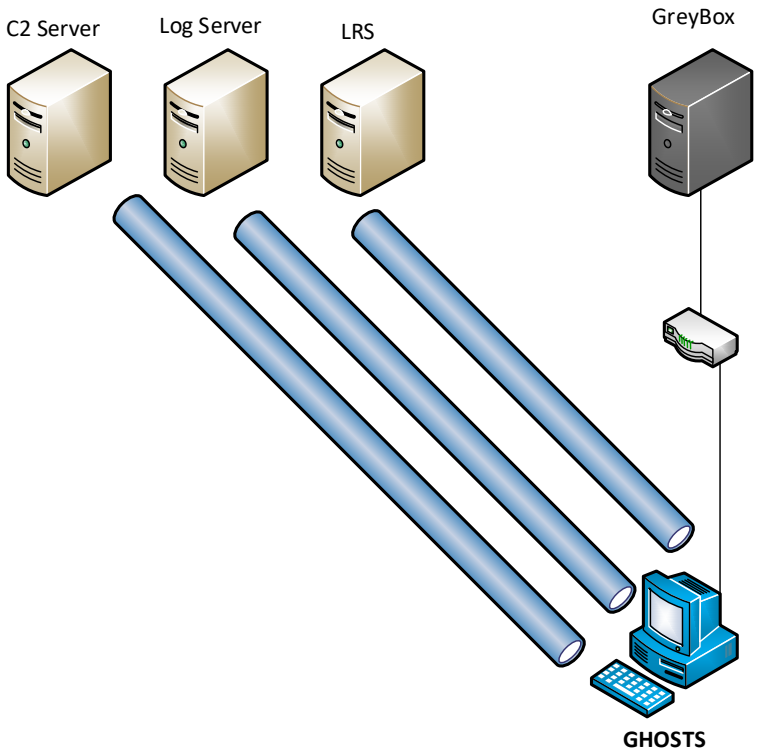


vTunnel

Tunnels IP traffic between guest and host networks

Uses VSOCK to transmit data via hypervisor

Traffic is hidden from participants



vTunnel

Disadvantages of in-game management traffic

- Participants can be tipped off to injects
- Participants can block the traffic
- Participants can manipulate the traffic

Advantages of using vTunnel to hide management traffic

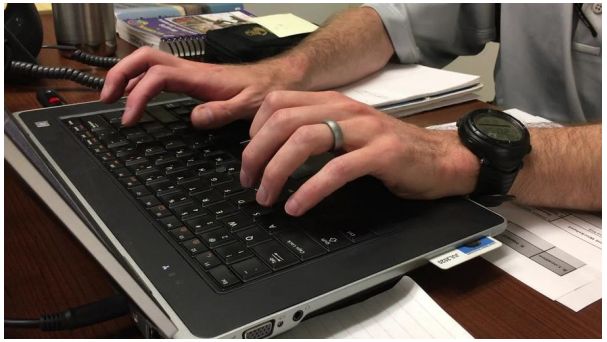
- Traffic in game stays on localhost
- Simplifies client configuration

vTunnel

Command and Control

- GHOSTS tasks
- Ansible configuration
- File copy

Allows system modifications

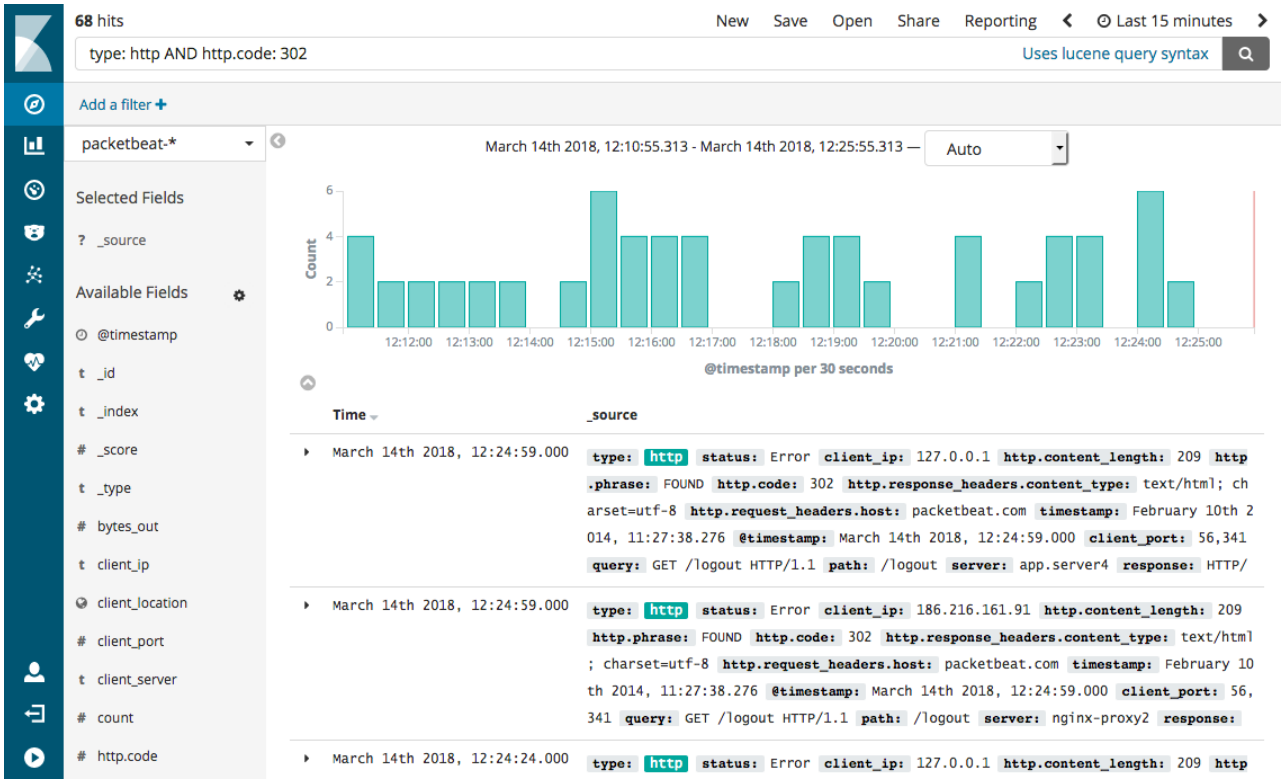


vTunnel

Logs

- Netflow records
- System logs
- GHOSTS results

Allows tracking of exercise performance



vTunnel

Student activity

- xAPI logs to LRS

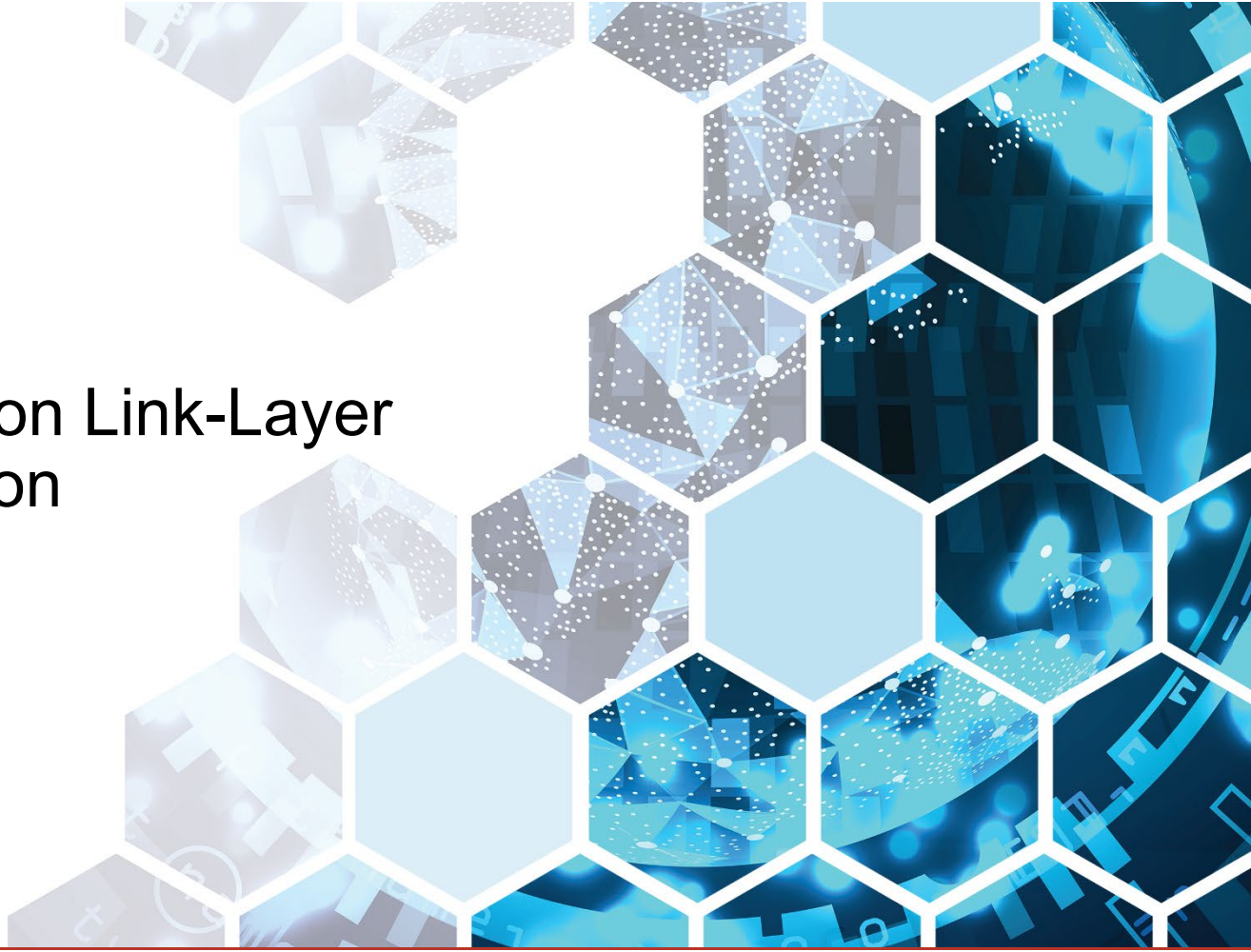
xAPI

- Student activity
- Actor, Verb, Object

Learning Record Store

- Receives xAPI
- Multiple sources


```
{
    "version": "1.0.0",
    "actor": {
        "objectType": "Agent",
        "name": "Example User",
        "account": {
            "homePage": "http://example.com/moodle",
            "name": "1"
        }
    },
    "verb": {
        "id": "http://id.tincanapi.com/verb/viewed",
        "display": {
            "en": "viewed"
        }
    },
    "object": {
        "objectType": "Activity",
        "id": "http://example.com/moodle/course/view.php?id=1",
        "definition": {
            "type": "http://id.tincanapi.com/activitytype/lms/course",
            "name": {
                "en": "CMU Moodle Demo Course"
            }
        }
    },
}
```



WELLE-D
Wireless Emulation Link-Layer Exchange Daemon

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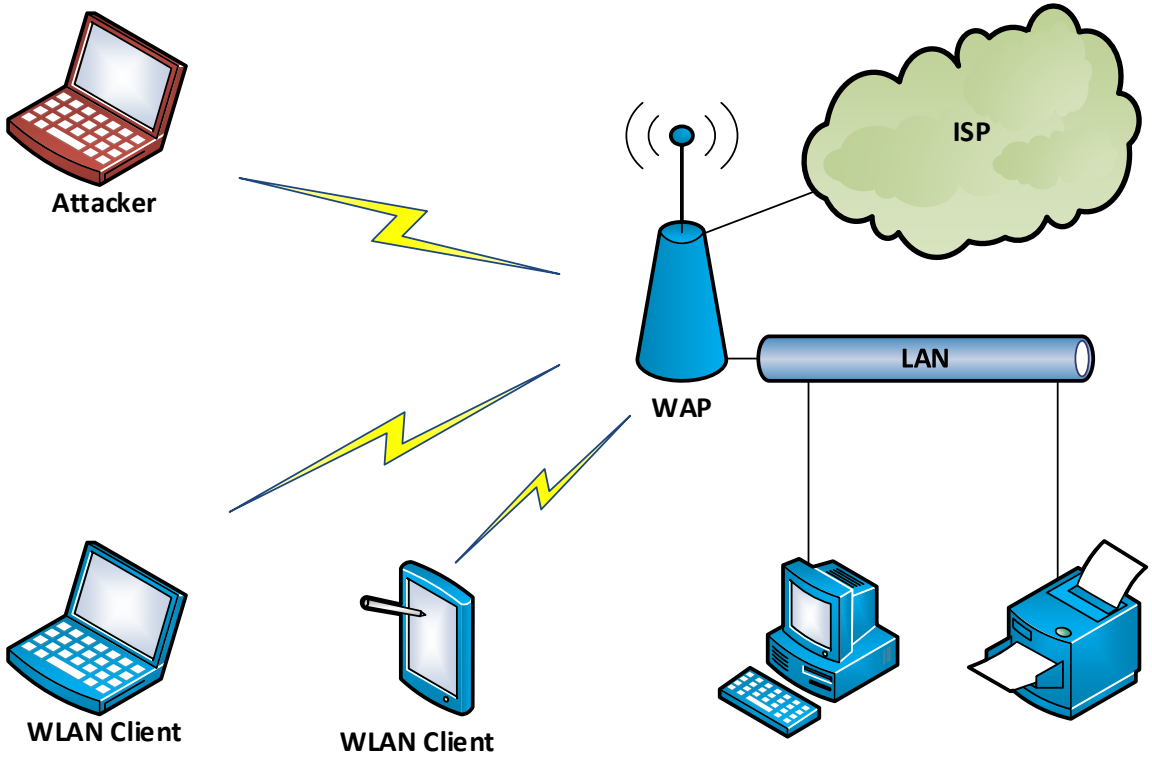
Wireless Security Training

Cyber security training relies heavily on virtualization

But not for wireless training…

No native virtual wireless adapters



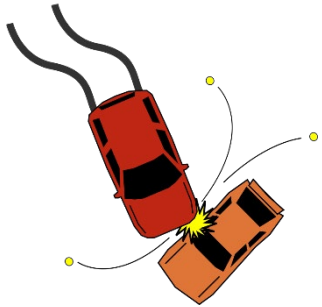
Problems with Physical Devices

Cost

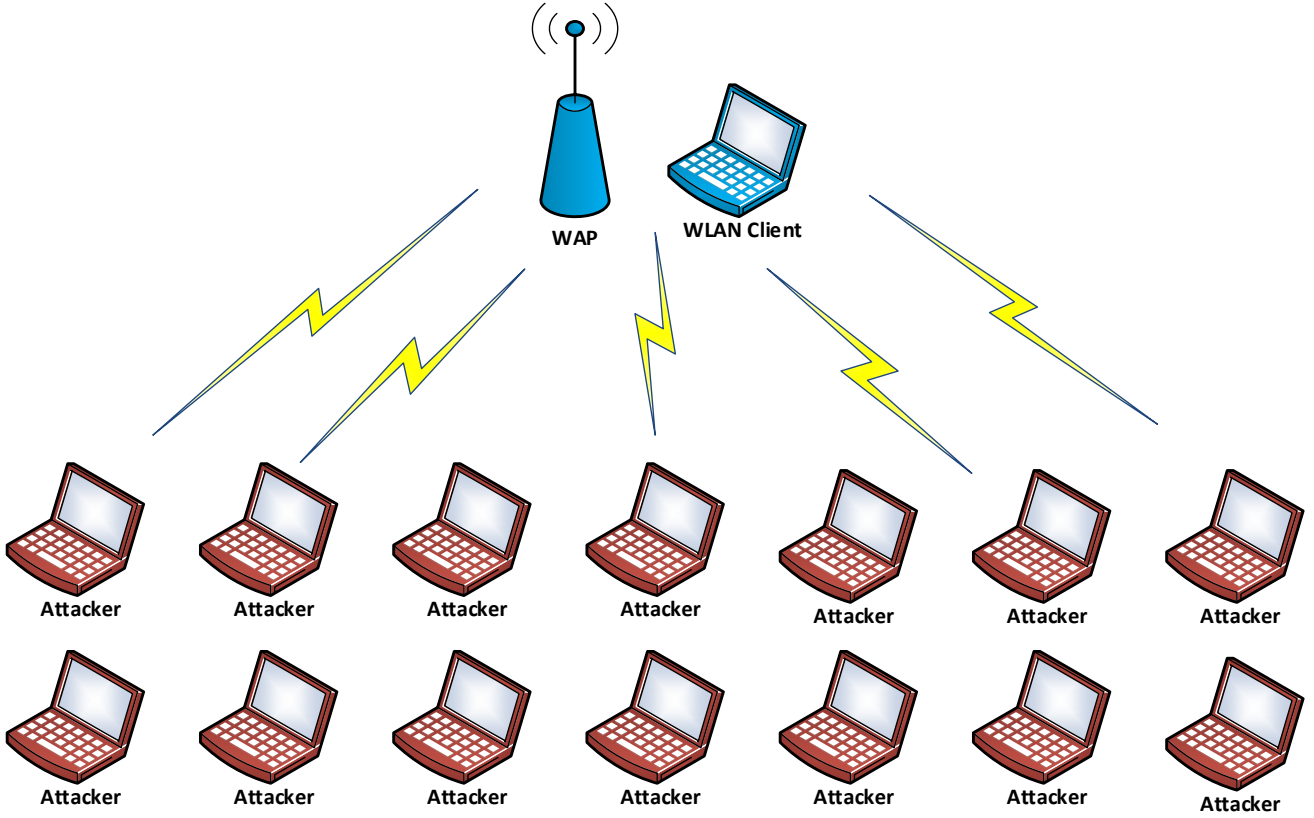
Time

Security Policy

Interference



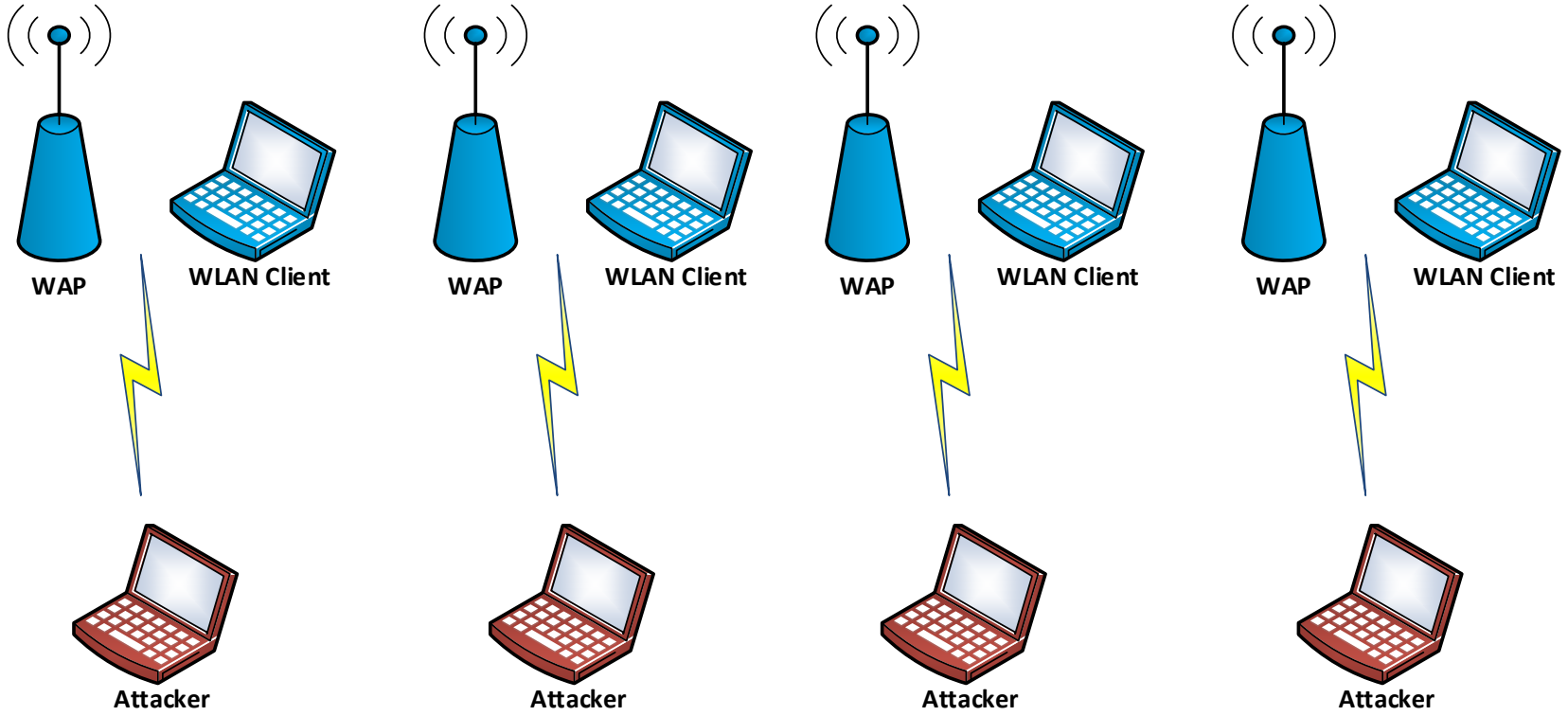
Problems with Physical Devices



Advantages of Virtual Devices

- Cost effective
- Efficient
- Compliant
- Secure
- Scalable
- Repeatable training
- Enables distance education

Advantages of Virtual Devices



WELLE-D

Implementation

WELLE-D
Wireless Emulation Link-Layer Exchange Daemon

Leverages frames from mac80211_hwsim driver

Uses VSOCK to transfer frames

Simulates wireless medium

Provides GPS simulation

Enables high-fidelity use of full-featured operating systems

Open Source: https://github.com/cmu-sei/welled

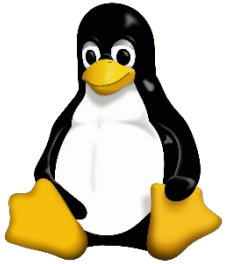
WELLED
Wireless Emulation Link-Layer Exchange Daemon

```
[user@Fedora-WLAN ~]$ iwconfig
lo        no wireless extensions.

virbr0    no wireless extensions.

wlan0     IEEE 802.11  ESSID:"OpenWrt"
          Mode:Managed  Frequency:5.18 GHz  Access Point: 00:0C:41:00:00:00
          Bit Rate=6.5 Mb/s   Tx-Power=20 dBm
          Retry short limit:7   RTS thr:off   Fragment thr:off
          Power Management:on
          Link Quality=47/70  Signal level=-63 dBm
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:23   Missed beacon:0

virbr0-nic  no wireless extensions.
```

WELLE-D
Wireless Emulation Link-Layer Exchange Daemon

Hosts
- Linux
- ESXi
- Windows

Linux Guests
- OpenWrt
- Fedora
- Android
- Ubuntu



WELLE-D

Implementation

Host Configuration

WMASTERD
Wireless Master Daemon

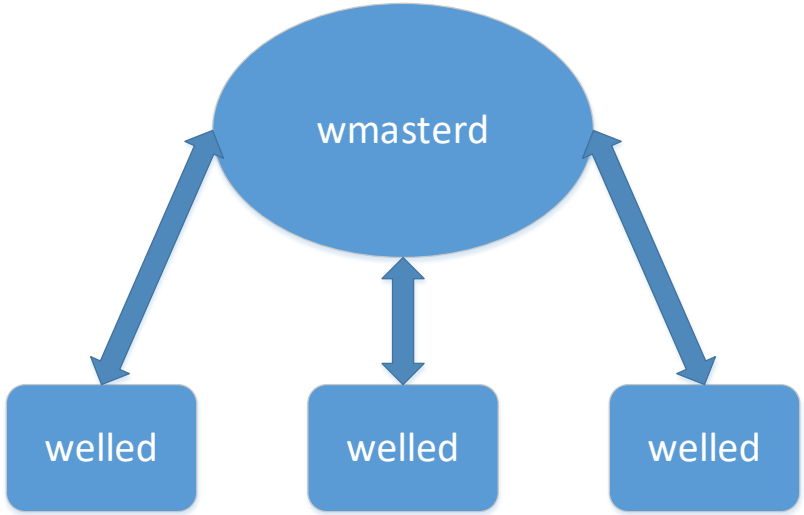
Receives frames from virtual machine nodes

Can calculate distance between nodes

Can produce GPS data as NMEA sentences

Enables simulation across multiple virtual machines

Isolates traffic from different users based on roomid



WELLE-D

Implementation

Guest Configuration

WELLED
Wireless Emulation Link-Layer Exchange Daemon

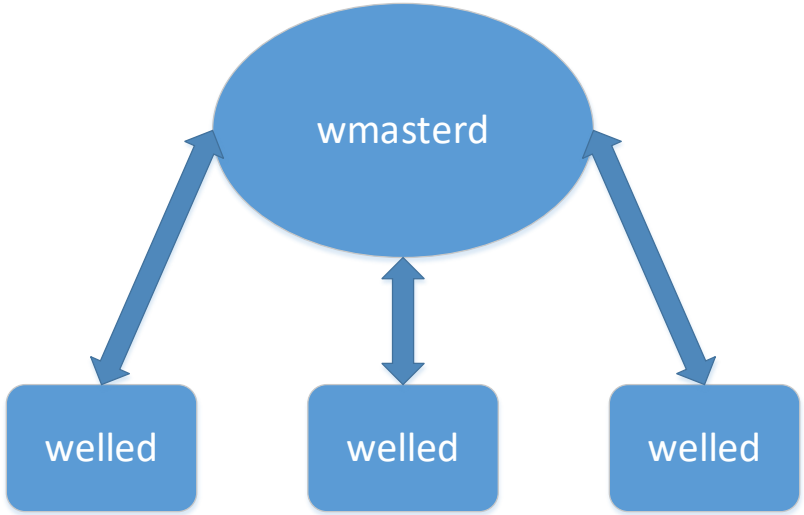
Receives frames from mac80211_hwsim,

transmits frames to wmasterd

Receives frames from wmasterd,

transmits frames to driver

Applies signal variations based on distance



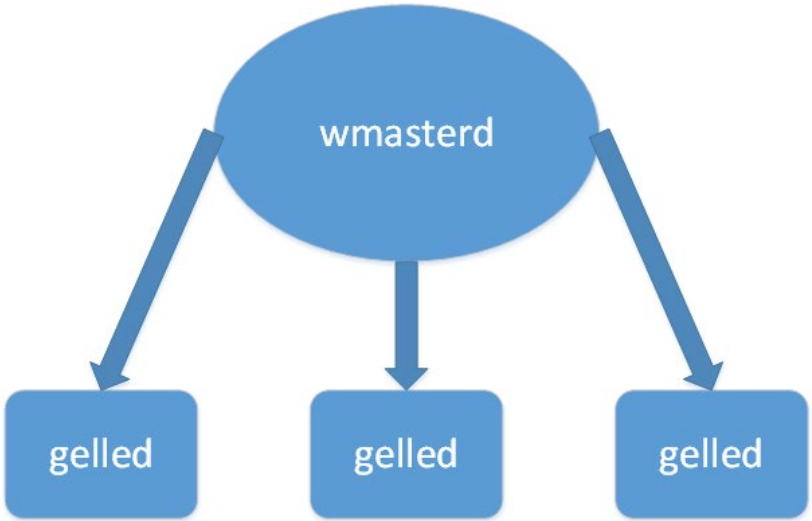
GELLED
GPS Emulation Link-Layer Exchange Daemon

Receives NMEA from wmasterd,

transmits NMEA to serial device

Allows GPSD to track location

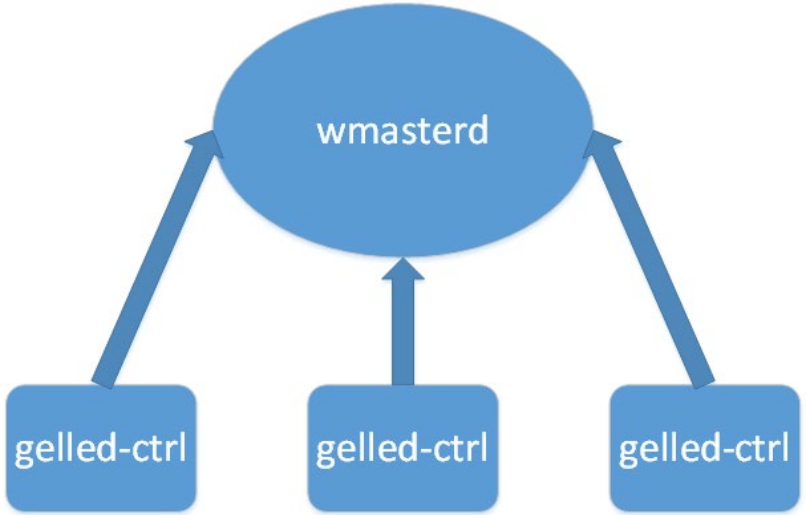
Allows kismet to log network locations



GELLED-CTRL
GPS Emulation Link-Layer Exchange Daemon Control

Manipulates guest's GPS feed

- Speed
- Course
- Climb
- Follow
- Latitude
- Longitude
- Altitude

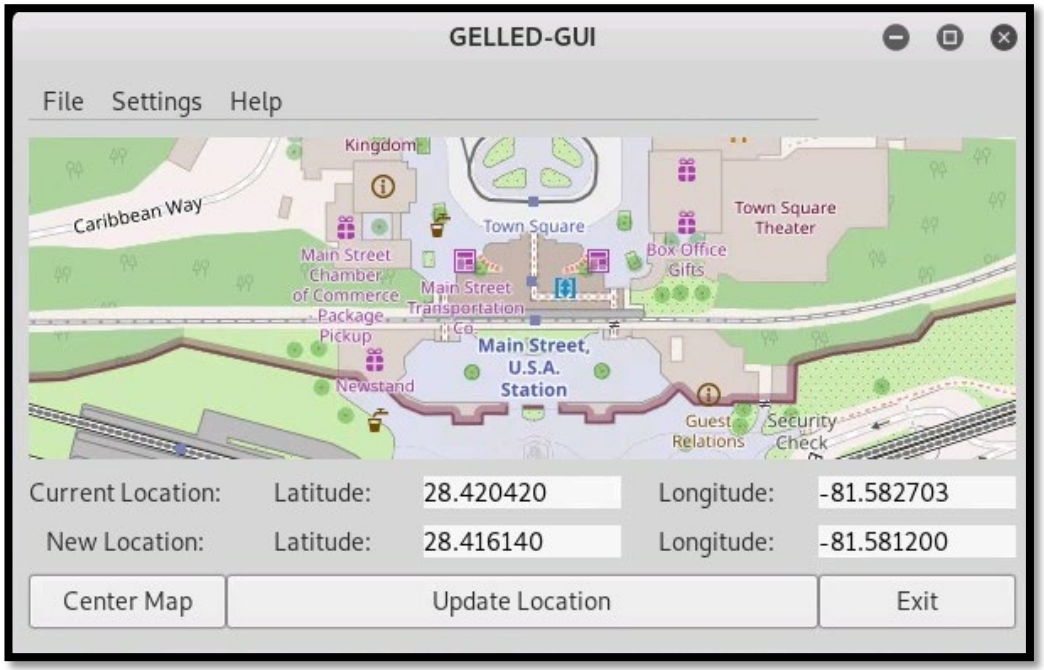


GELLED-GUI
GPS Emulation Link-Layer Exchange Daemon GUI

Changes guest's position

- Uses open street maps
- Executes gelled-ctrl

Enables war driving scenarios



Training Scenarios

Wireless Monitoring with kismet/kismon

Wardrving with kismet/gelled-gui

Eavesdropping

WPS attacks

WPA2 deauthentication

MiTM attacks with evil twin

Rogue APs

Krack attacks

Wireless surveys

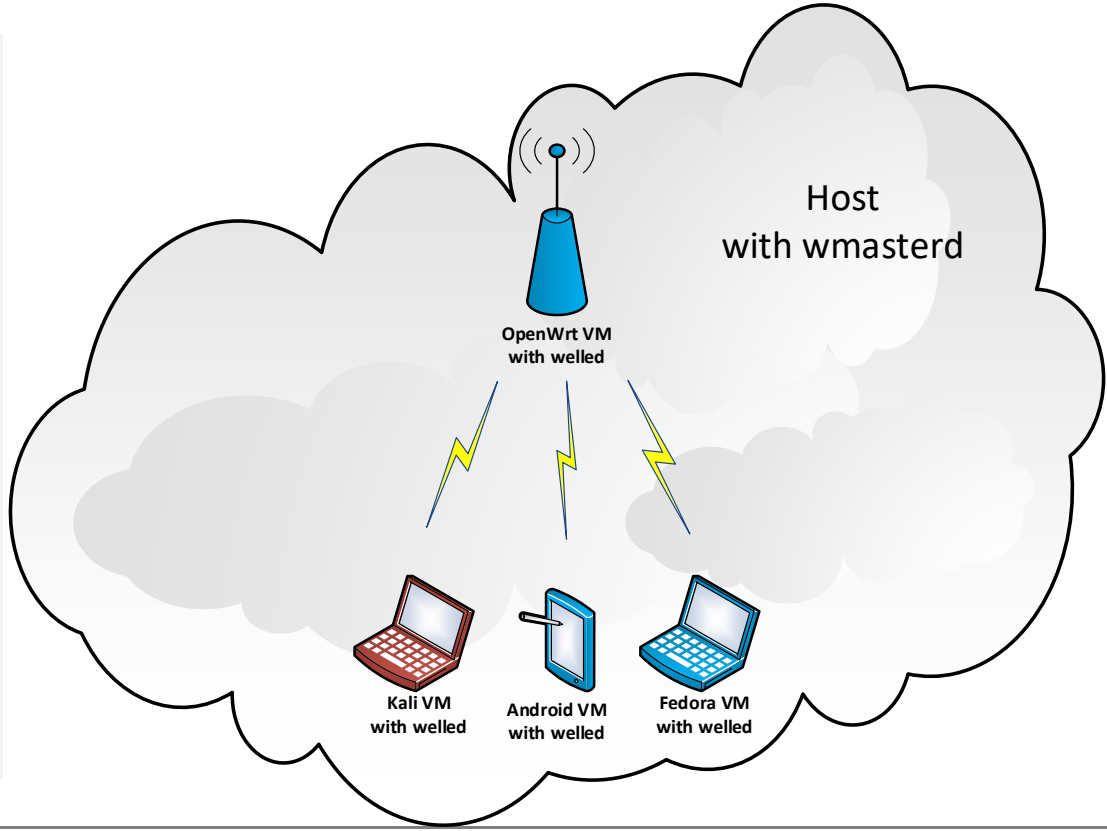
WPA Enterprise

WELLE-D Training Lab Overview

Investigating WELLE-D Configuration
- wmasterd on host
- welled on Linux VMs

Performing a Wireless Attack
- Capture packets
- Perform deauthentication attack
- Perform dictionary attack
- Decrypt traffic

Wardriving Walt Disney World
- Run kismet and kismon
- Move VM using gelled-ctrl



Questions ?