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# ADVANCED ATTACK SURFACE DISCOVERY AND EXPLOITATION

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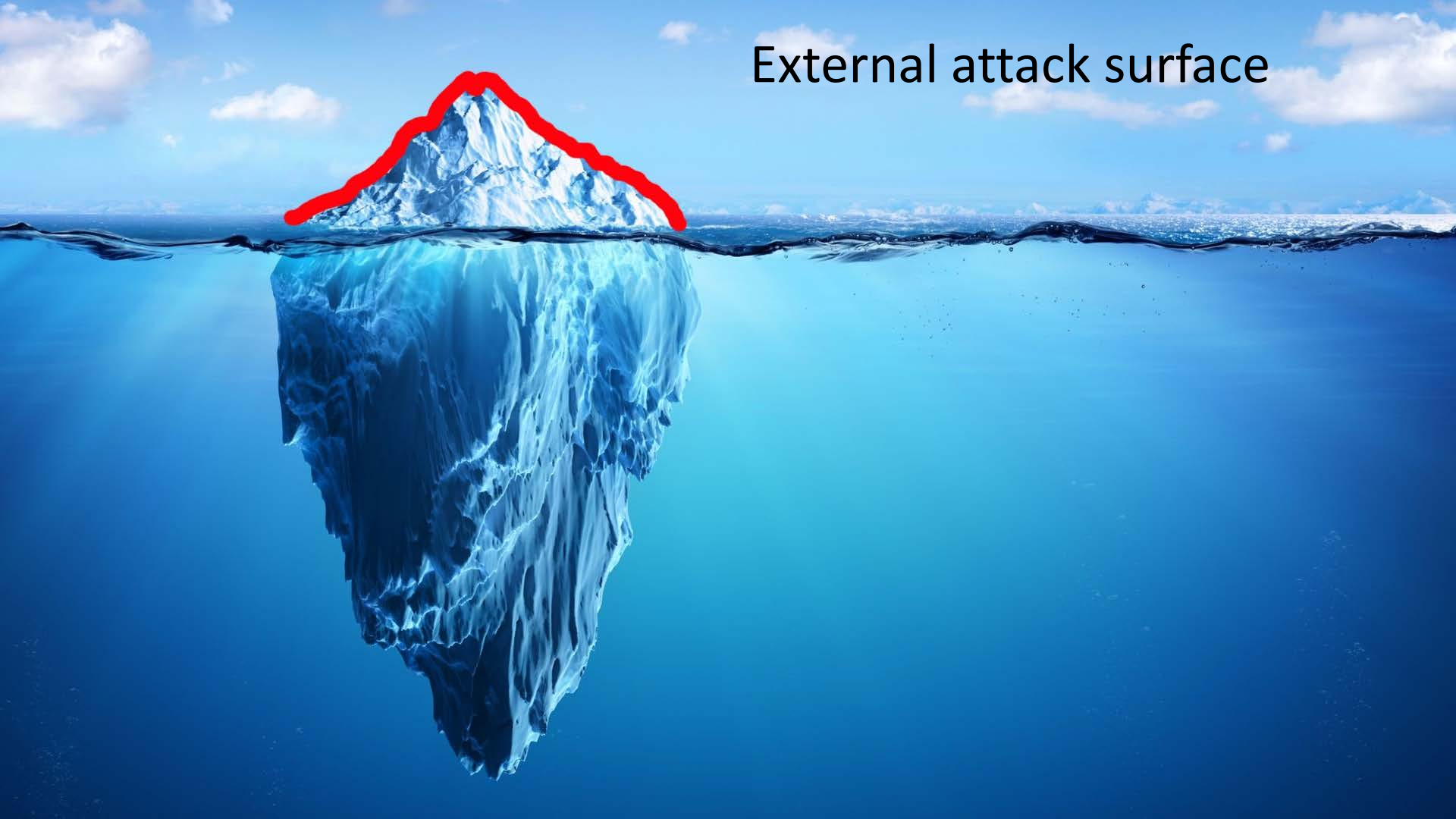
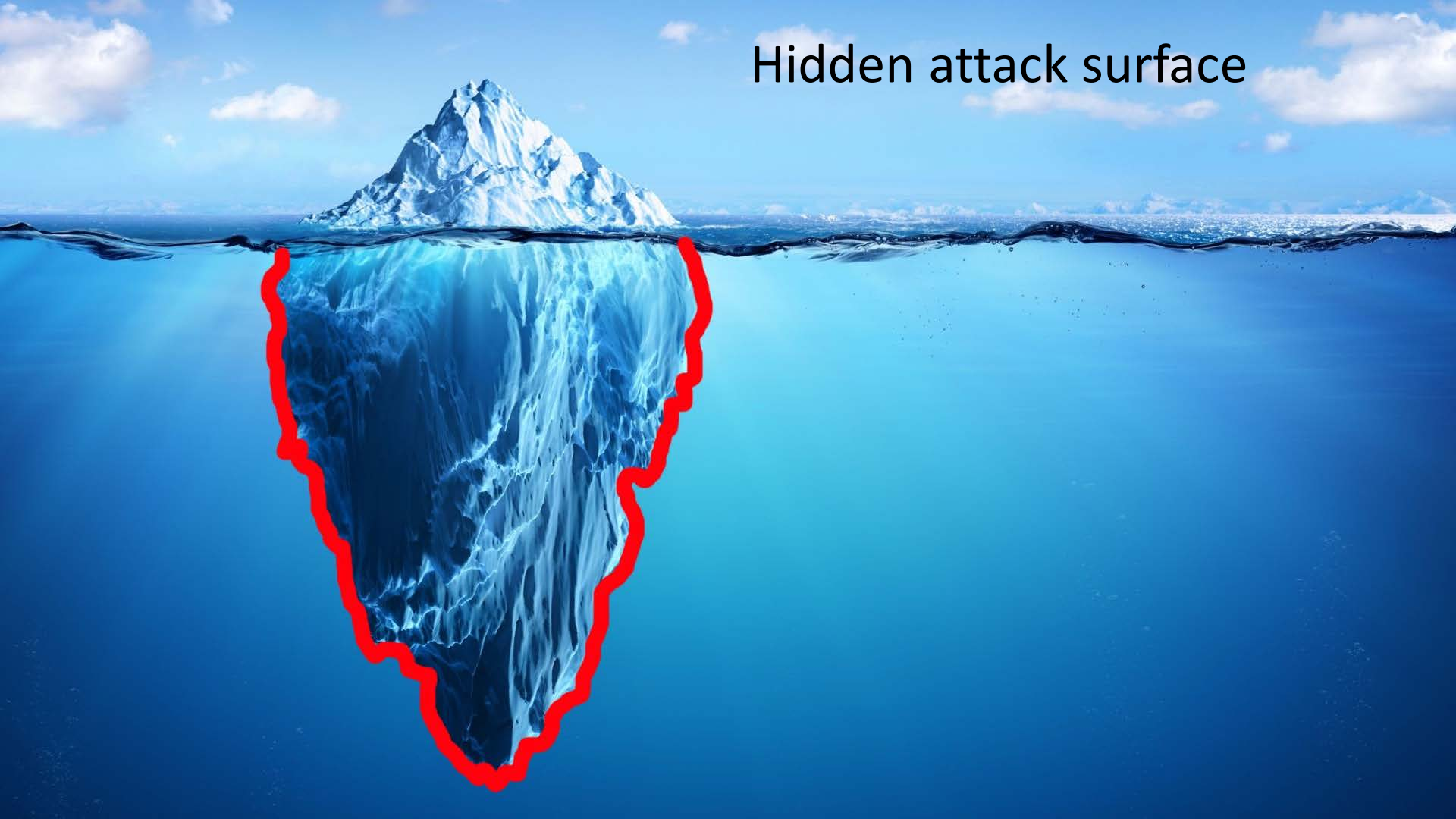
# Obligatory who is this guy?


- Adrian Bednarek
- Security Analyst/Researcher at ISE (Independent Security Evaluators)
- Started in the security field as an ethical blackhat (!?)
- Here to talk about emerging technologies in the battlefield of information security as it pertains to complex software used in many fields including IoT
  - Custom protocols
  - Code obfuscation
  - Self modifying code

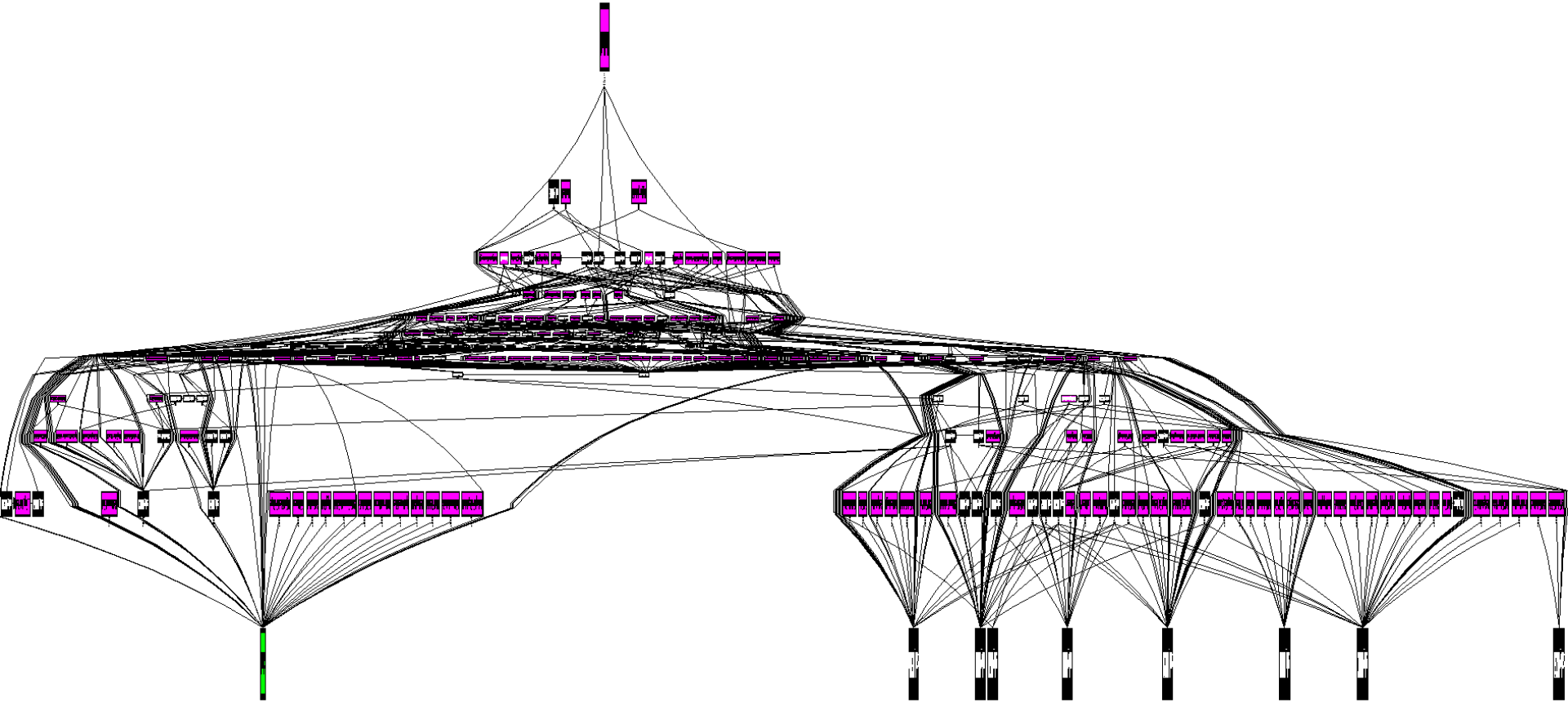

Defining the attack surface


External attack surface

# Hidden attack surface



# A simple application function code flow:

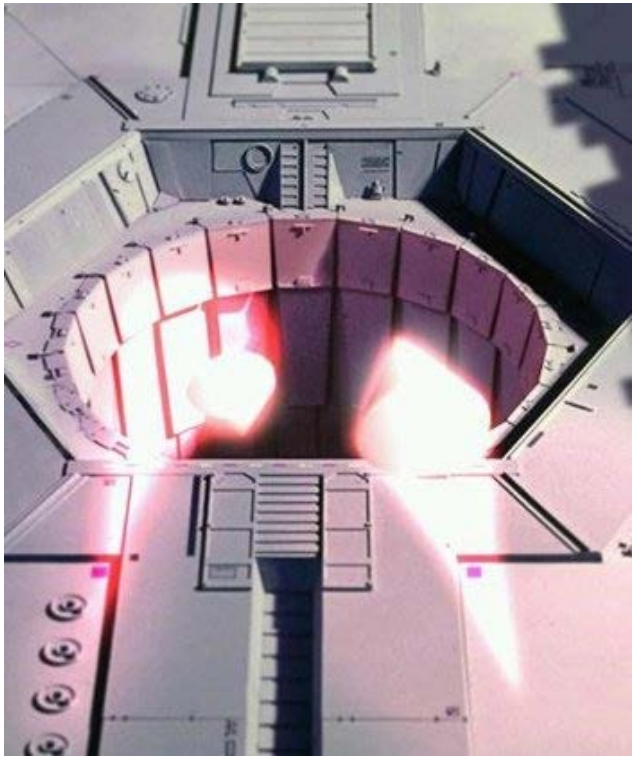



# CODE AUDITS AND SYSTEM HARDENING


This should hold. I’ve looked over the code a dozen times.

# Security Defects

- Various severities
- Configuration
- Code execution
- Business logic
- Authenticated users
- Unauthenticated users

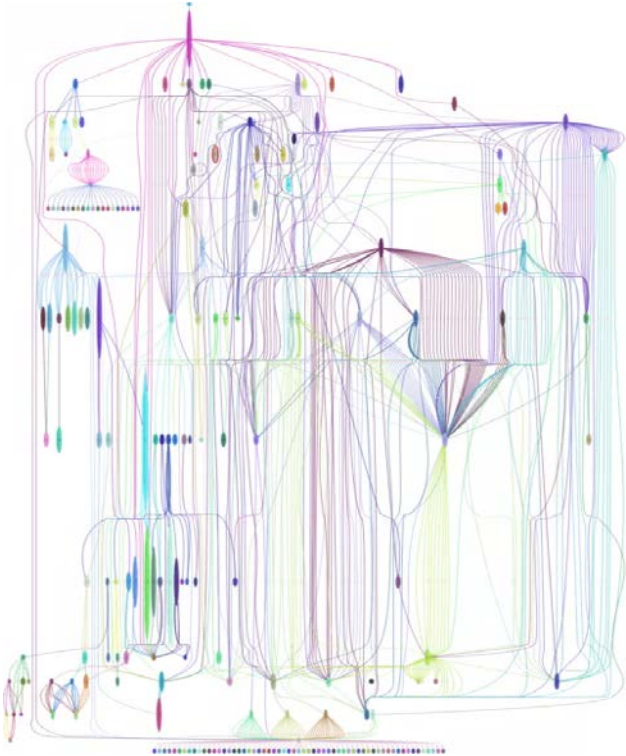


Hate to spoil things, but…

# The Arms Race

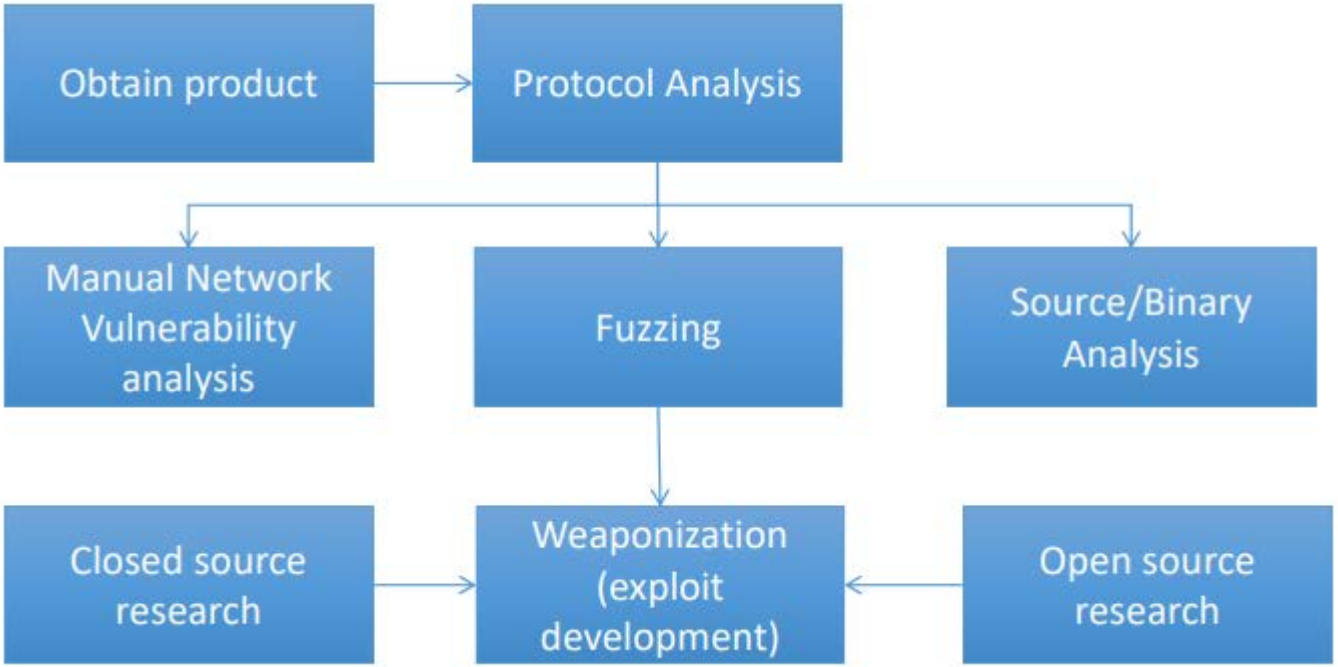


- Attack surfaces are increasing
  - Top layer (User and internet facing services)
  - Deep hidden layer (Business logic)
- Attack surfaces are layered
  - Top (‘script kiddies’, automated scanners)
  - Middle (Hobbyists, for profit individuals or groups)
  - Hidden layer (Highly skilled and motivated attackers using custom tools)



# Typical Attack Flow





# An attackers arsenal



- Threat modeling
  - Inventory all the things that could be exploited
- Manual testing
  - Static code review
  - Network analysis
- Tool assisted testing
  - Dynamic code analysis
    - Debugging/Manual fuzzing
      - Automated fuzzing
  - Network MITM tools for dynamic analysis

# Attack Surface Fuzzing

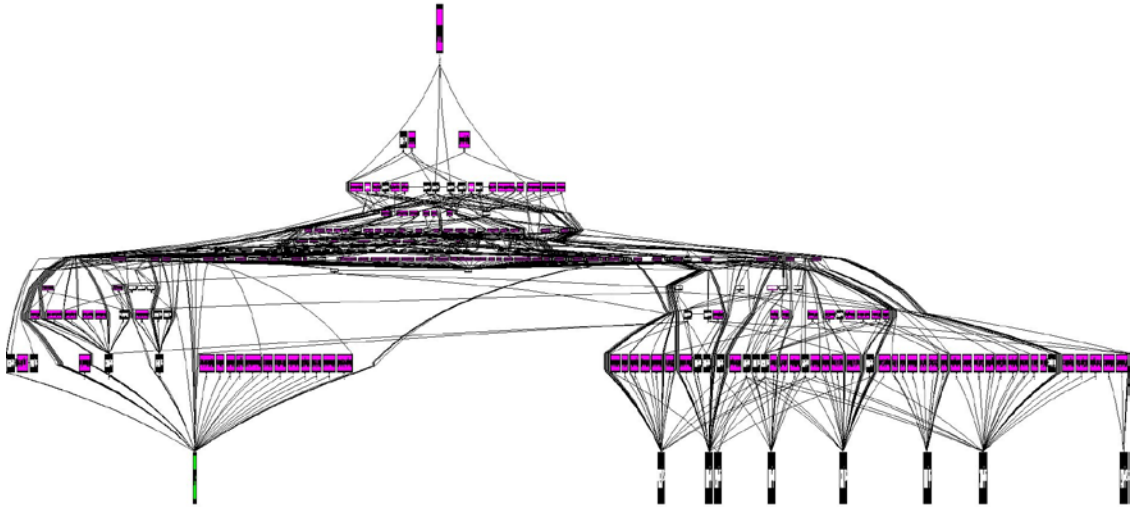


- Manual Fuzzing
  - Time consuming
  - Run tests with best guest inputs to trigger vulnerability discovery
    - Time consuming!
    - Especially when preexisting events must be established (e.g. complex state sessions)
- Automated fuzzing
  - Run many tests quickly and log abnormal results

# Attack Surface Discovery



- Explore what?
  - Everything
  - Specific points of interest
    - Trigger events in hidden layer



# Example Bug Hunting



```
int readData(int fd)
{
    char header[50];
    char body[100];
    size_t size_header = 50;
    size_t size_body = 100;

    read(fd, header, size_body);
    read(fd, body, size_body);

    return 0;
 }
```

# Example Bug Hunting



```
int readData(int fd)
{
    char header[50];
    char body[100];
    size_t size_header = 50;
    size_t size_body = 100;

    read(fd, header, size_body);
    read(fd, body, size_body);

    return 0;
 }
```

# Example Bug Hunting



```
int readData(int fd)
{
    char header[50];
    char body[100];
    size_t size_header = 50;
    size_t size_body = 100;

    read(fd, header, 100); // Classic Buffer Overflow
    read(fd, body, 100);

    return 0;
 }
```

# Deep Dive



- Manual analysis of previous example
  - Would probably be missed
  - Time consuming to find
  - Counter intuitive
- Automated fuzzing
  - Discovered in seconds
    - All permutations will be tested
      - Leading to discovery of other classes of bugs!

# Inputs



- Outwardly facing APIs
  - In comparison to the whole system, a small number
  - Frequently executed
  - Battle tested (hopefully!)
  - May have layers of obfuscation (hopefully)
    - Obfuscated solutions may be hard to audit
      - Low hanging fruit exploits may be out of reach
  - Trigger code deep within program logic

# Advanced Attack Surface Discovery


- Finally!
- Simple services are composed of
  - Millions of lines of assembly
    - Composing thousands of functions
  - Unrealistic to explore and fuzz everything
    - Especially when fuzzing requires stateful permutations
- Automated discovery of code paths that touch data of interest
  - Data that an attacker can input into the system

# Custom tools to discover attack surfaces



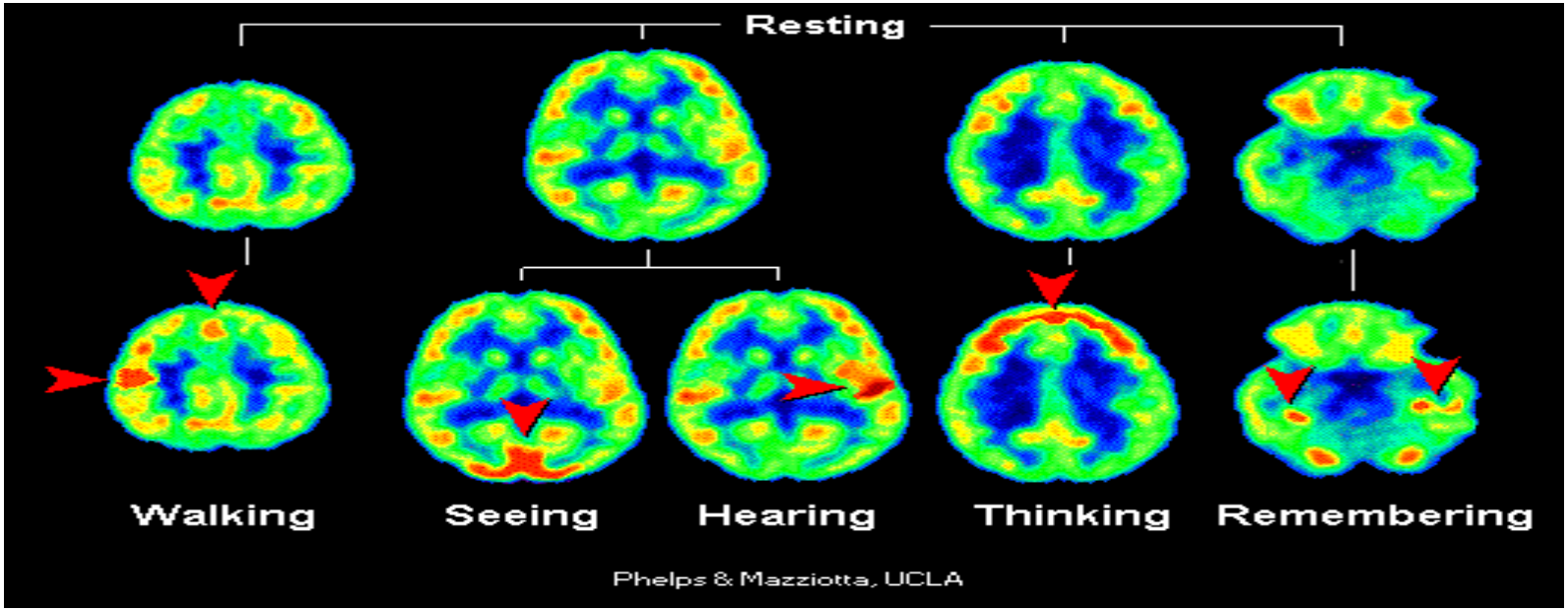
- Custom tools and solutions are used by adversaries
  - In house solutions
  - Black market
- Thread Imager
  - Automatic discovery of code paths an adversary can influence
  - Attack surface discovery
  - Allows lower skilled adversaries to exploit complex and obfuscated systems
    - Encrypted code
    - Obfuscated code
    - Self modifying code

# DEMO

# Summary



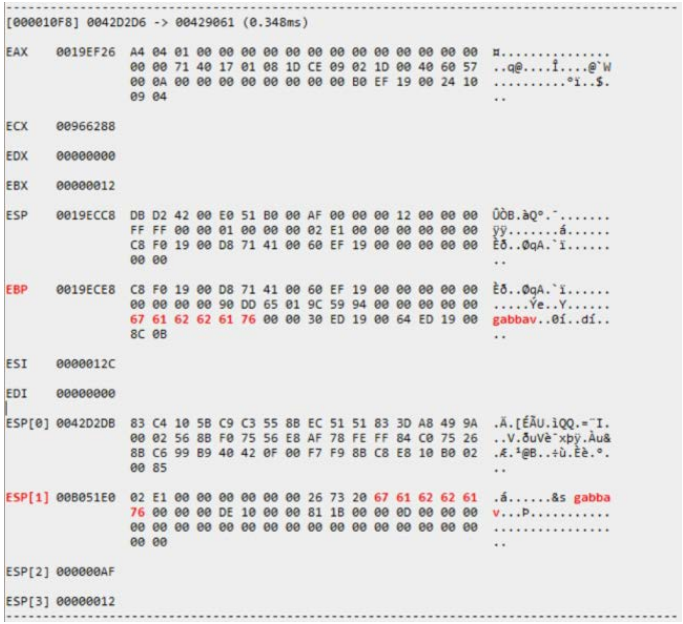
- External APIs and inputs fire off numerous subsystems



# Summary

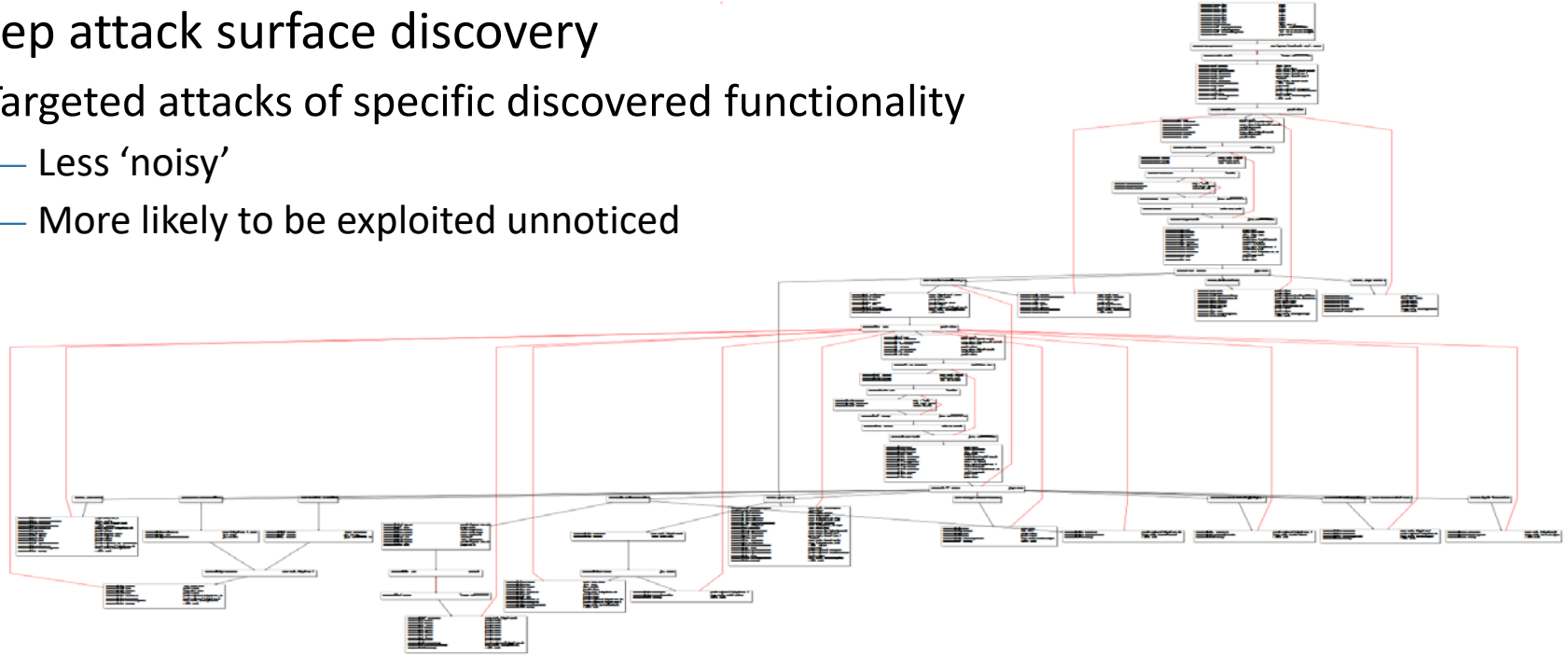


- Attack surfaces are multi faceted and multi layered
- Discovery of code paths that handle user input lead to an increase in attack surface
- Adversaries are capable of learning the inner workings of services at a very fine grained level – sometimes knowing more about the internal mechanics than the developers



# Summary

- Deep attack surface discovery
  - Targeted attacks of specific discovered functionality
    - Less ‘noisy’
    - More likely to be exploited unnoticed




# QUESTIONS?

## About tools/Obfuscation effectiveness?/Anything?

# THANK YOU!

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