

Boomer the Bangle Boarding



SANS @ Night

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<https://github.com/itriskltd/>

Information-Security-and-Risk-Public-Presentations

SANS @ Night

Emerging Cyber Ranges
Competition to Compliance

Wednesday, 27 June 2018
7:15pm - 8:15pm

Matthew J. Harmon

GSEC, GCIH, GCIA, CISSP

 @mjharmon

Matthew J. Harmon

- IT Risk Limited, Principal Consultant
 - GRC, Technology Risk Assessments, Remediation, Interim CISO
- SANS Community & Mentor, 10 year anniversary!
 - SEC 401 Security Essentials
 - SEC 504 Hacker Tools, Techniques, Exploits & Incident Handling
 - SEC 464 Hacker Guard, IT Operations Baselining
- St. Paul College, CompSci Course Author & Instructor:
 - 2461 70 & 71 Computer Networking 3 - Linux
 - 2480 40 Network Security & Penetration Prevention
 - 2482 40 Security Incident Handling, Response and Disaster Recovery
 - 2484 40 Ethical Hacking & Countermeasures

Matthew J. Harmon

- Almost two year anniversary of two spinal operations
 - Re-learning how to walk and operate changes you
 - Learned cool new super powers through daily cross-training; incl. dancing, martial arts, jogging
- Cyber Security Summit (Oct 22-24, 2018)
 - Cyber Range Committee Member
 - Building team competition and hack-a-thon held before the summit
- NorSec Foundation
 - Cyber Range research and development
 - Malware analysis

What are we going to cover tonight?

- Cyber Ranges, what are they and why do we need more of them?
 - Offensive and defensive practice
 - Design and product validation proving grounds
 - Once interconnected, they can become more than the sum of their parts.
- Examples of some current large scale cyber ranges
- Considerations of Cyber Range design
- How to safely build your own Cyber Range.

Quick Terminology

- What is a Cyber Range in this presentation context?
- Any environment, that is representative of a realistic enterprise network that exclusively used for detonating malware, testing new Metasploit modules, or some random code you found on a pastebin or got uploaded to your not-a-honeypot-backup-dns-server.

Is my dev environment a Cyber Range?

- No, but...
- We'll talk about shortly about how a Cyber Range can help your dev team.

Cyber Ranges

- NATO War Games with JYVSECTEC
- SANS NetWars Series
- Capture the Flag events
- Follow the Maze style challenges (SANS Holiday Special)
- Scenario Simulation, Execution, and Observation. MITRE's CALDERA, Uber's Metta and...
- Defensive Exercises such as the CCDC
- Offensive Exercises such as the OSCP Lab

SANS NetWars: CyberCity

- 1:87 scale physical city.



<https://www.sans.org/netwars/cybercity>

NetWars: DFIR Tournament

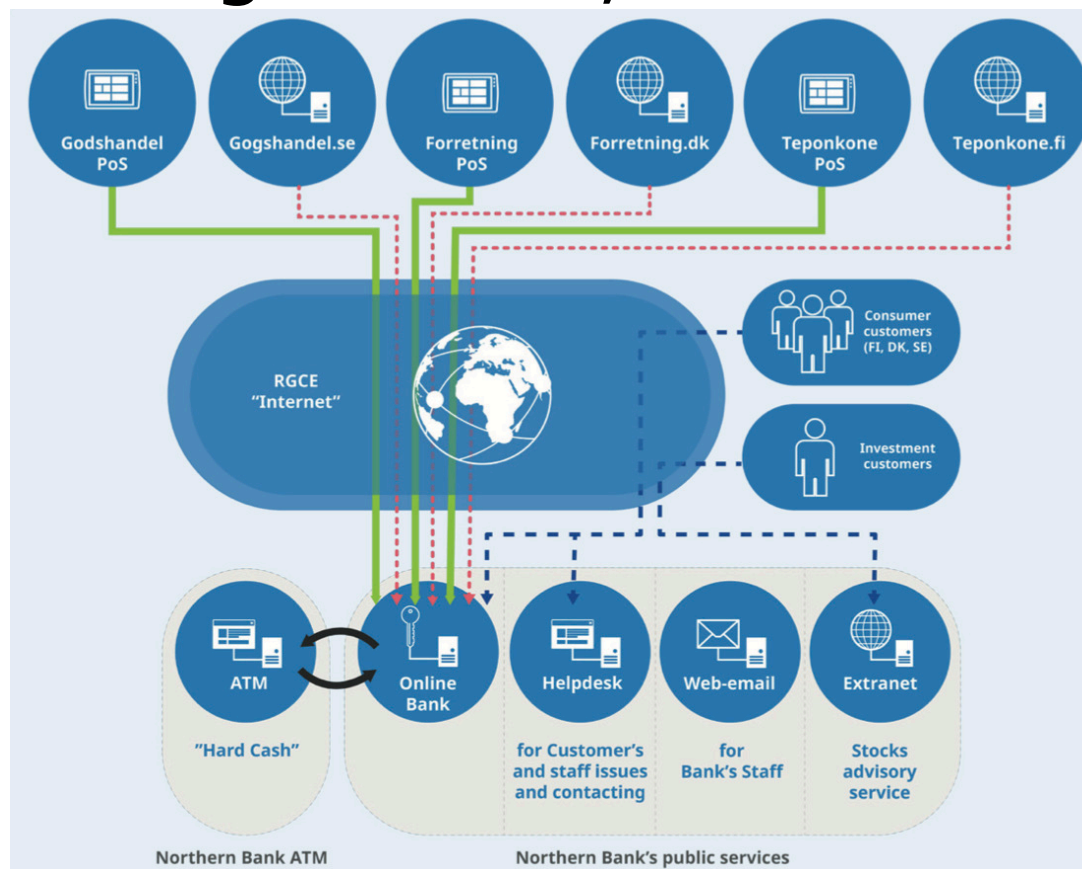
- Digital Forensics, Incident Response and Threat Hunting Scenarios



<https://www.sans.org/netwars/dfir-tournament>

JYVSECTEC

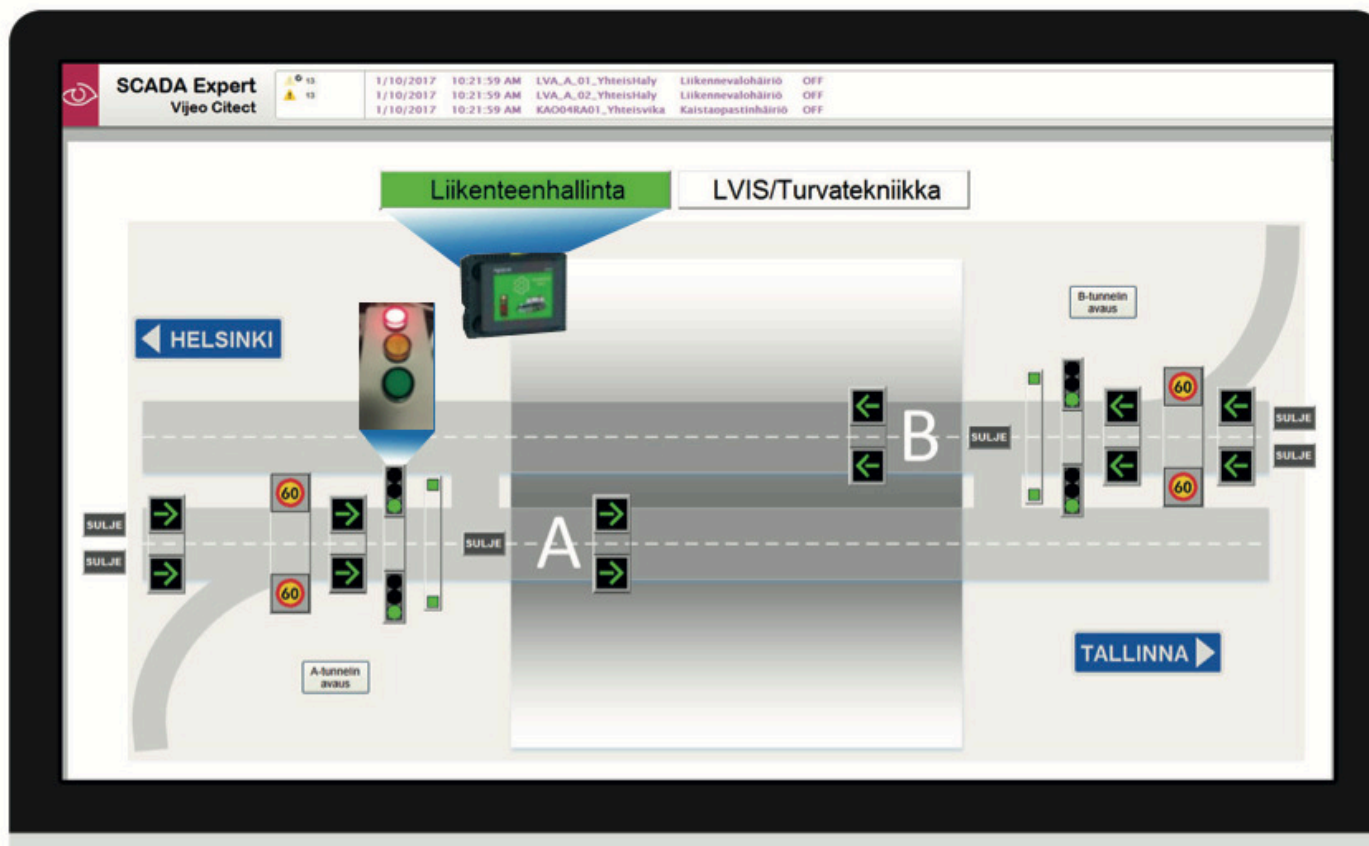
- Financial organization, NorthernBank



<https://jyvsectec.fi/wp-content/uploads/2017/02/JYVSECTEC-cyber-range.pdf>

JYVSECTEC

- Road tunnel provider, Funnel



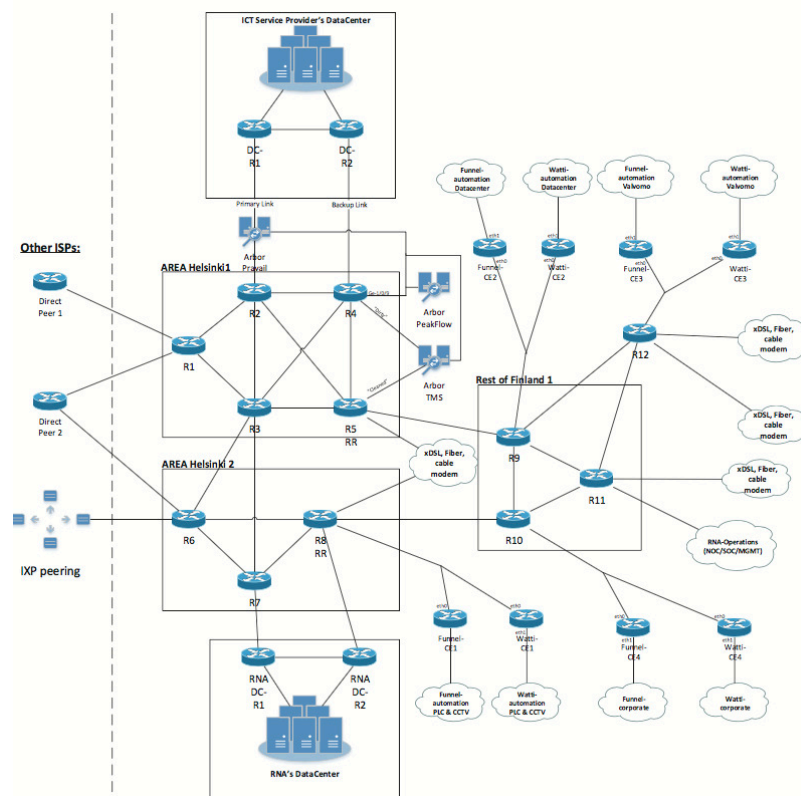
<https://jyvsectec.fi/wp-content/uploads/2017/02/JYVSECTEC-cyber-range.pdf>

- Electricity Company, Watt



JYVSECTEC

- Internet Service Provider, RNA



<https://jyvsectec.fi/wp-content/uploads/2017/02/JYVSECTEC-cyber-range.pdf>

MERIT

- MERIT's Cyber Range started in 2012
- YouTube Channel
 - <https://www.youtube.com/user/michigancyberrange/videos>
- "Powered by Merit Network, the nation's longest-running research and education network, the Michigan Cyber Range is the nation's largest unclassified, network accessible cybersecurity training platform."
<https://www.merit.edu/cyberrange/>

merit

NETWORK. SECURITY. COMMUNITY.

MERIT's Alphaville



<https://www.youtube.com/watch?v=9E08xSGviRI>



National Cyber Range



- DARPA project 2009-2012
- DoD Test Resources Management Center
 - “..providing mission tailored, **hi-fidelity cyber environments** that enable independent and objective testing and evaluation of advanced cyberspace capabilities”
 - <https://www.acq.osd.mil/dte-trmc/ncr.html>

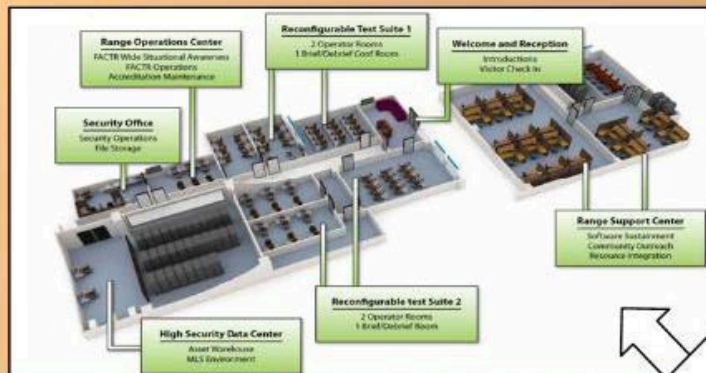
https://www.acq.osd.mil/dte-trmc/docs/20150224_NCR%20Overview_DistA.pdf

Distribution Statement A – Cleared for Open Publication by OSD on February 24, 2015 SB Case Number 15-S-0994

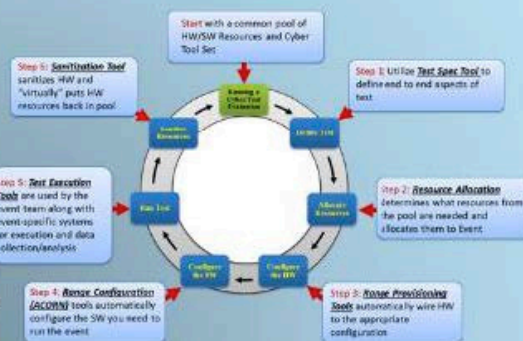


National Cyber Range

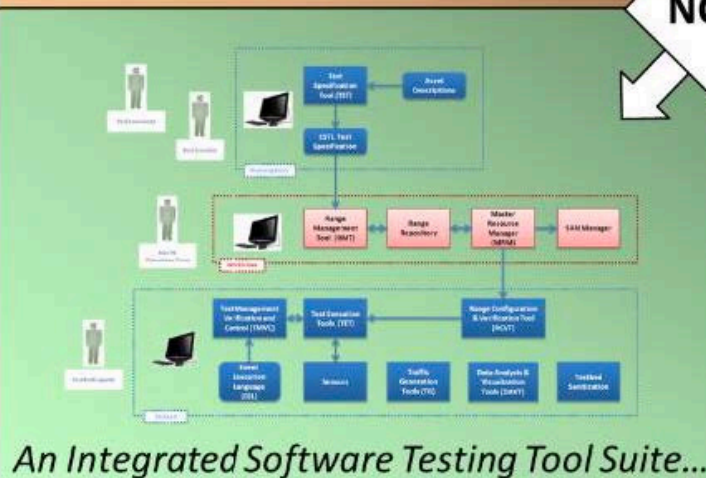
A Range Facility...



A Network Encapsulation Architecture & Operational Procedures...



NCR is:



Services Include, But Are Not Limited To:

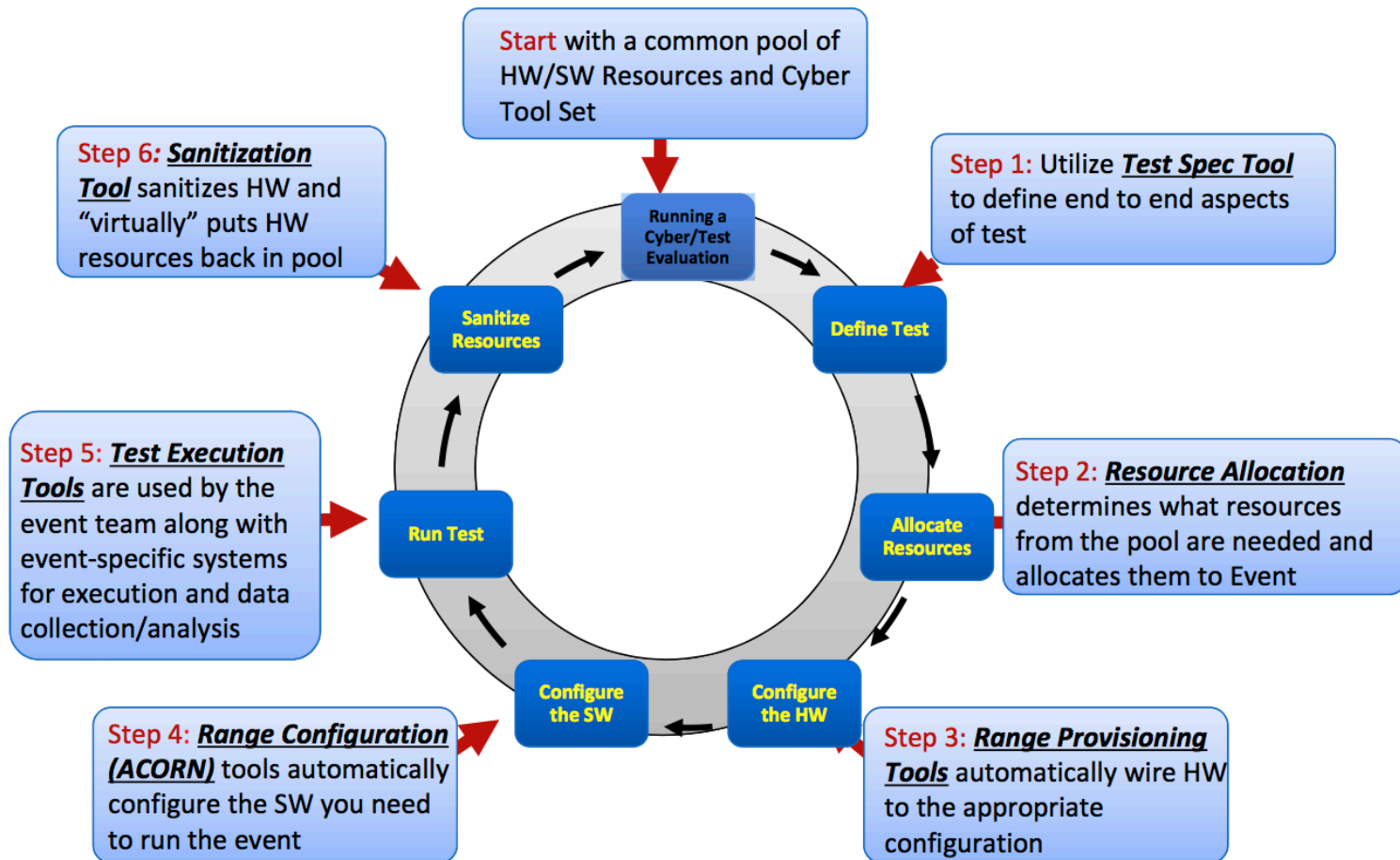
- End-to-End Test Support
- Test Bed Design Support
- Cyber and Testing Expertise
- Threat Vector Development
- Custom Traffic Generation
- Custom Sensor and Visualization Support
- Custom Data Analysis
- Integration of Custom Assets
 - Software
 - Hardware
 - Wired and Wireless
 - Remote Red/Blue Team Support

And An Expert Range Support Team...

<https://www.acq.osd.mil/dte-trmc/ncr.html>



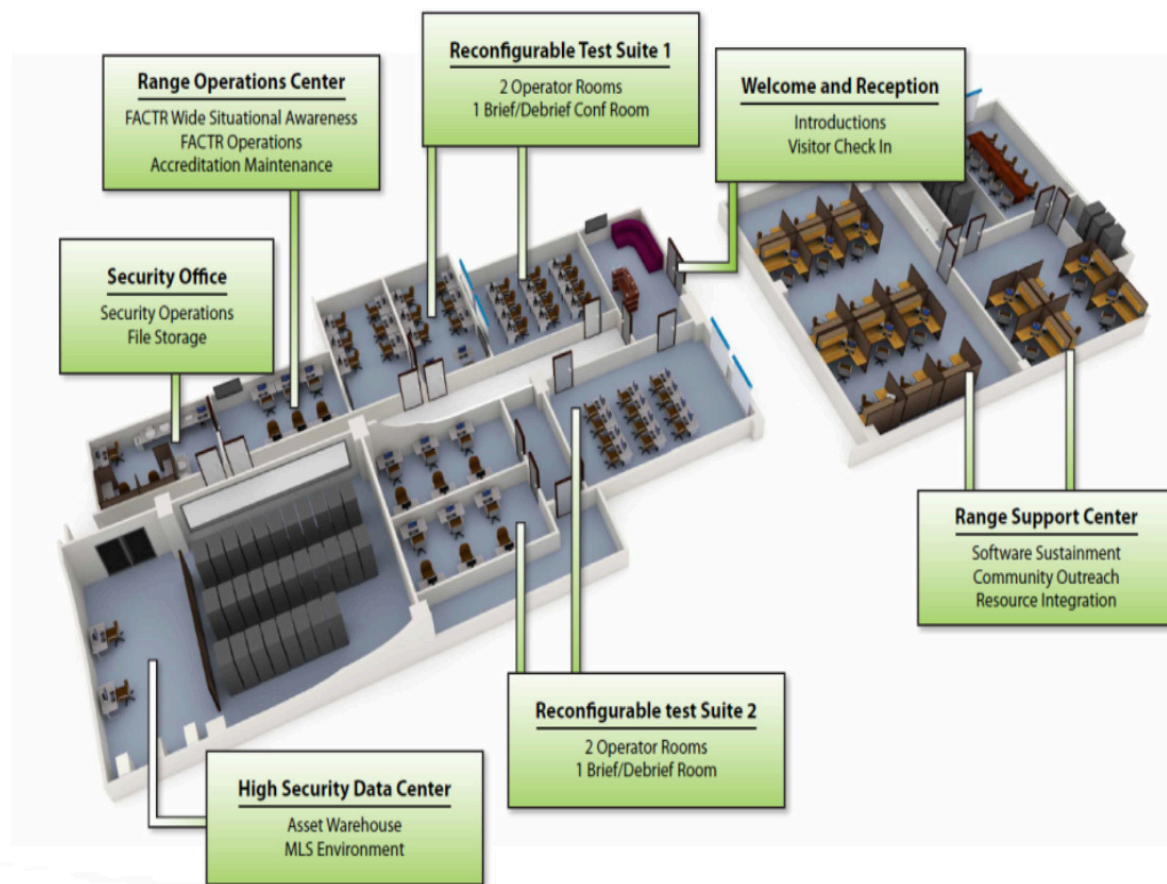
National Cyber Range



<https://www.acq.osd.mil/dte-trmc/ncr.html>



National Cyber Range

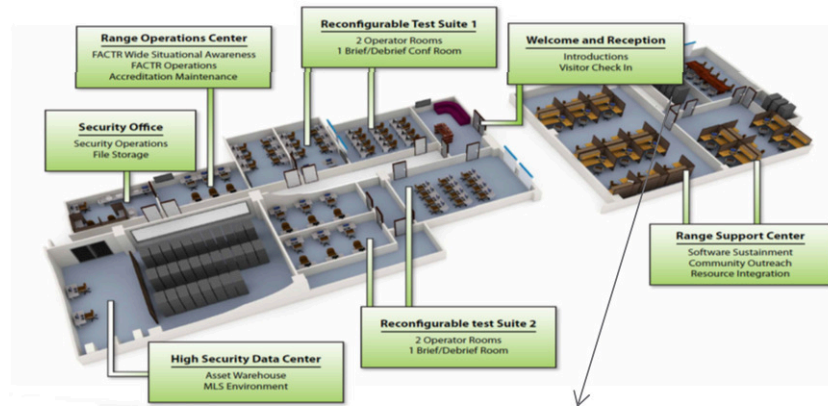


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National Cyber Range

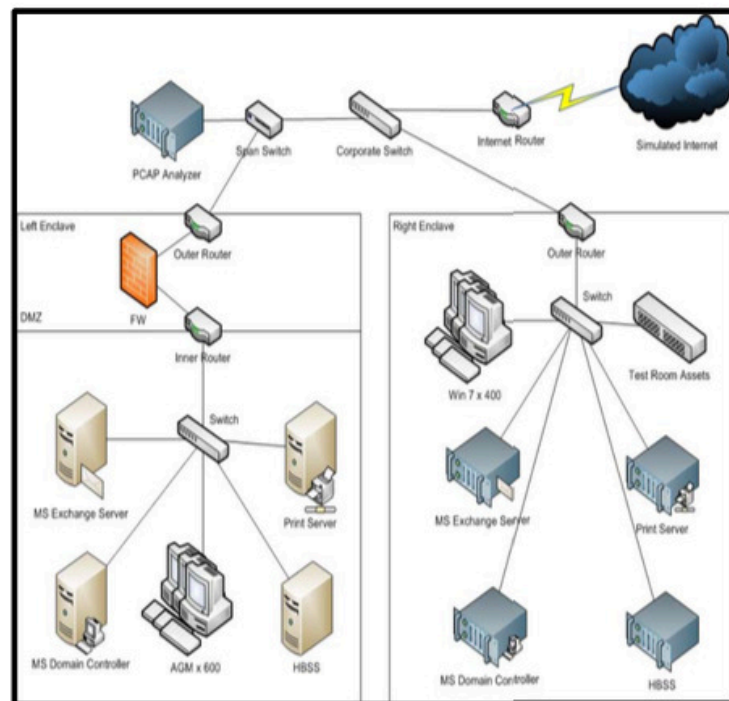


Question: Does Product “A” close a requirements gap?

- Does it mitigate a particular set of threats within my operational system?
- How well?
- What is my residual risk?

What you get:

- Empirical evidence showing how the technology or product closes the requirements gap in your operational environment

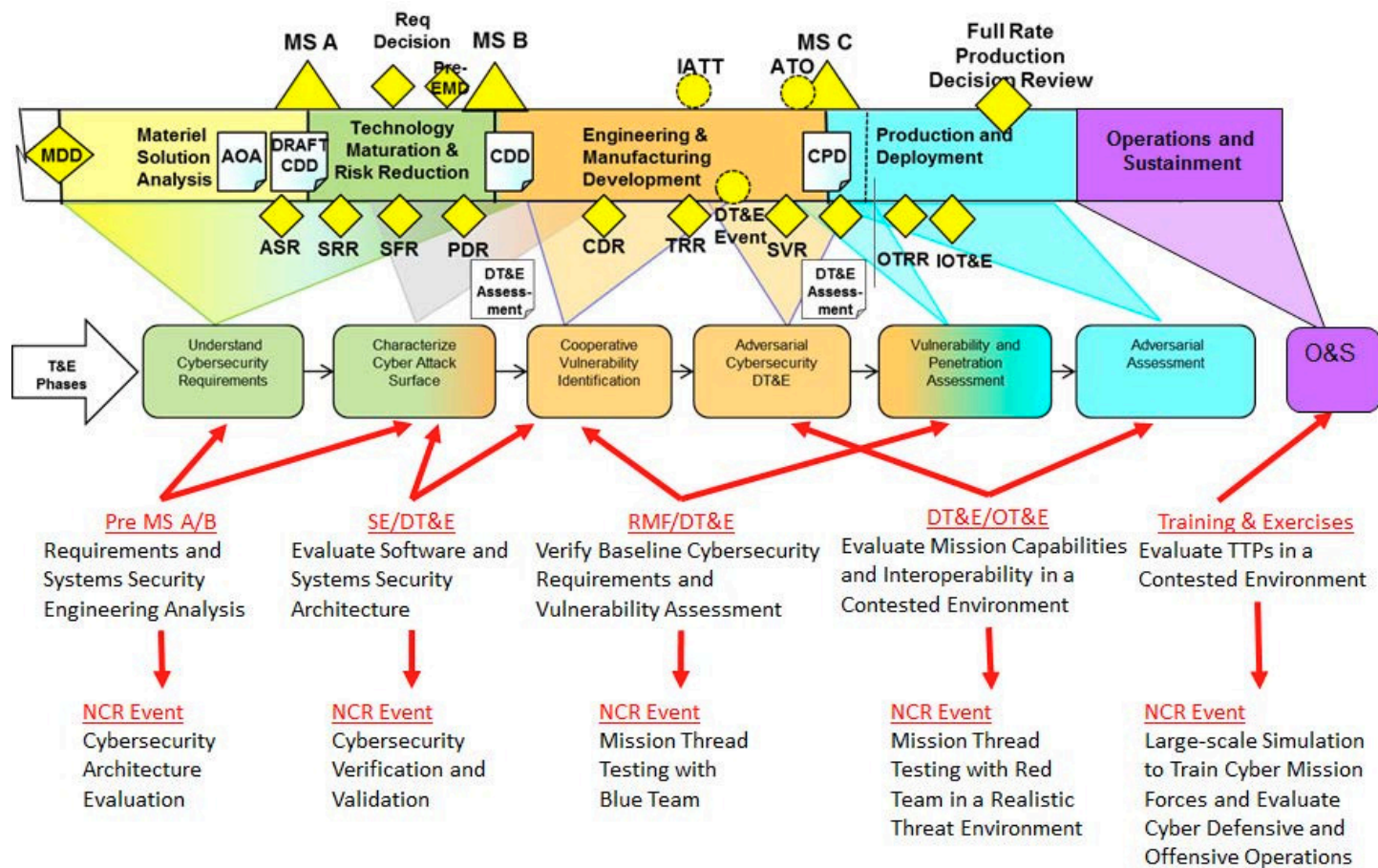


How does adding a technology to my existing environment reduce my threat surface?

https://www.acq.osd.mil/dte-trmc/docs/20150224_NCR%20overview_DistA.pdf
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Integrating Compliance



https://www.acq.osd.mil/dte-trmc/docs/20150224_NCR%20overview_DistA.pdf
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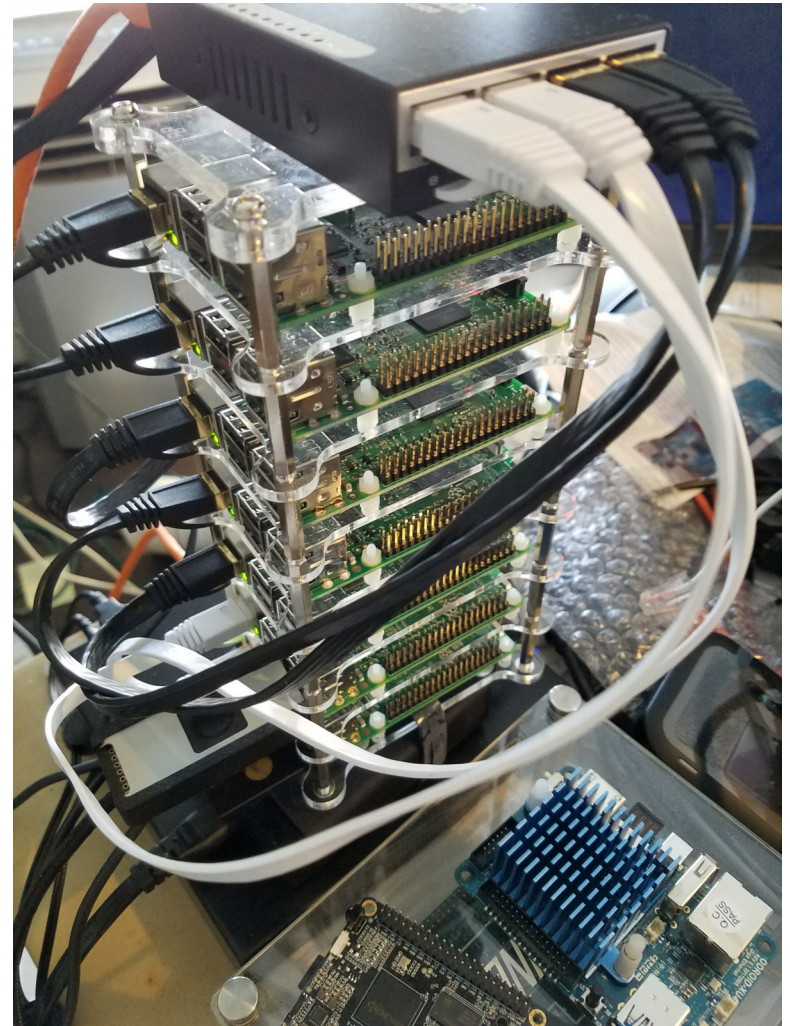


Cyber Range Principles

- Contained
- Auto Scaling
- Routing between separate networks
- Encrypted, routed, peer tunnels
- Explicit and Validated Authorization
- Rapid Restoration
- Portable

Proof of Concept

- Raspberry Pi Cluster
- apu2c4
- USB Armory
- YubiKey
- Modeled after dn42



Cyber Range Components

- BIRD & FRR
- tinc(GRE/BGP) & WireGuard(GRE/OSPF)
- iPXE, netboot.xyz
- QEMU (architecture emulation and shim)
- YubiKey

CrowdSupply Circumference



<https://www.crowdsupply.com/ground-electronics/circumference/>

Hostile Authentication Terminal

- init ram disk ++
- Assume everything is compromised
- dump & analyze ram, pull BIOS/EFI
- Validate known firmware
- Once state is known, begin bootstrap:
 - via iPXE over HTTPS (experimental¹)
 - via rsync'ed encrypted ZFS snapshot

[1] Experimental work by P. Danek, netbook.xyz, et al.

Multi Tier Authentication System

- init ram disk ++
- YubiKey Based, GPG, x509 Certificate
- fwknop with GPG
- credential and routing package.enc
- Unlock routing package via GPG
- Connect to bootstrap server
- Key to open ZFS snapshot
- Peer Configuration
- Peer Public Keys

YubiKey

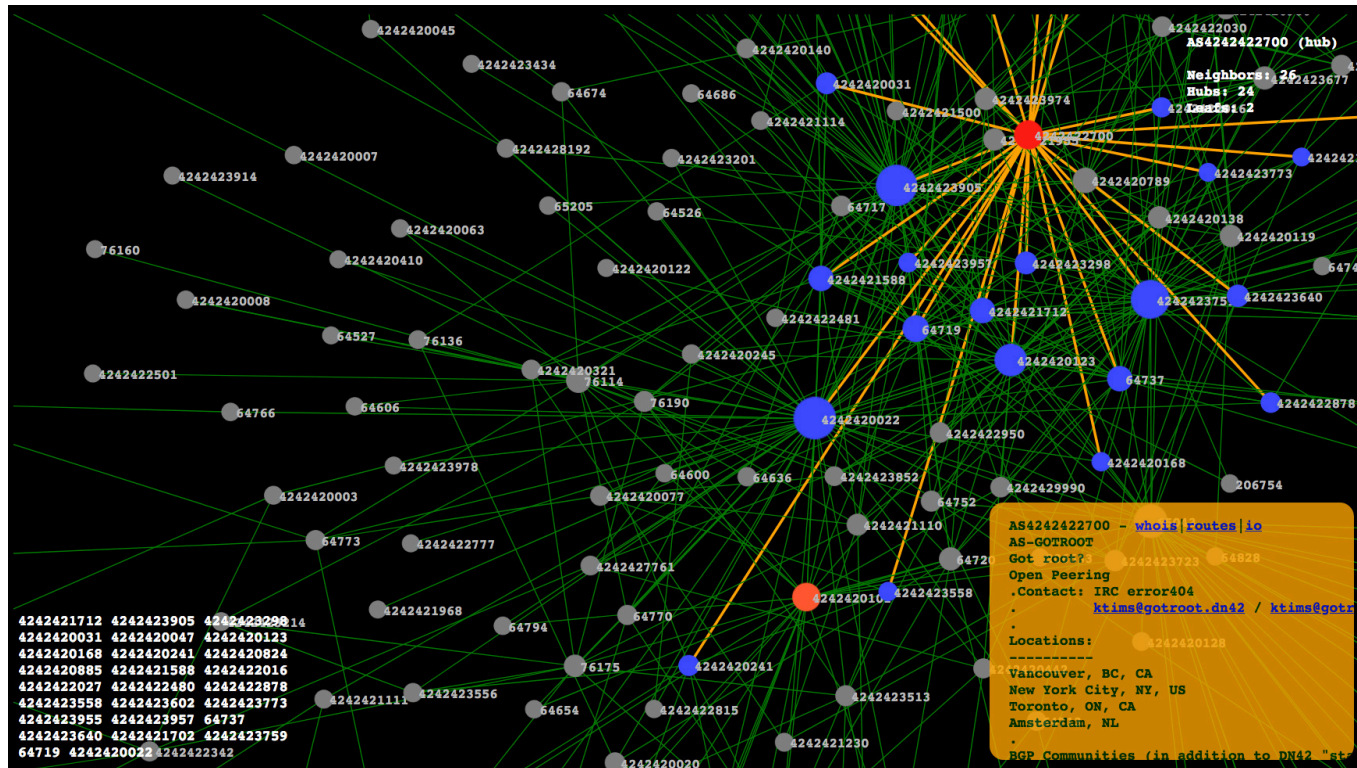
- HSM Key Storage
 - Set OTP + CCID + GPG mode
 - Require Touch before Authentication
 - libu2f-host
 - `echo -e '\x06\x00\x00\x00' | u2f-host -d -a sendrecv -c c0`

Adversary Simulation

- MITRE ATT&CK
 - CALDERA (Windows)
 - <https://github.com/mitre/caldera>
- Uber Metta (Windows, MacOS, Linux)
 - <https://github.com/uber-common/metta>
- Netflix
 - Simian Army: <https://github.com/Netflix/>
- Dumpster Fire
 - <https://github.com/TryCatchHCF/DumpsterFire>
- Malware Detonation

dn42

- Security Research Network



<https://nixnodes.net/dn42/graph/>

NOTE: I have no relation to dn42, only great admiration for their work.

Routing

- BGP through tinc, FRR
 - tinc chose due to solid history and peer recommendations, sends frequent PING / PONG packets discovering new routes. Perfect for the network edge to discover and add new BGP peers.
- OSPF through WireGuard, BIRD
 - Used as internal protocol as it is quiet and doesn't send any data when idle. WireGuard formally verified.

Calming the Route Chaos

```
(64511, 1) :: latency \in (0, 2.7ms]
(64511, 2) :: latency \in (2.7ms, 7.3ms]
(64511, 3) :: latency \in (7.3ms, 20ms]
(64511, 4) :: latency \in (20ms, 55ms]
(64511, 5) :: latency \in (55ms, 148ms]
(64511, 6) :: latency \in (148ms, 403ms]
(64511, 7) :: latency \in (403ms, 1097ms]
(64511, 8) :: latency \in (1097ms, 2981ms]
(64511, 9) :: latency > 2981ms
(64511, x) :: latency \in [exp(x-1), exp(x)] ms (for x < 10)

(64511, 21) :: bw >= 0.1mbit
(64511, 22) :: bw >= 1mbit
(64511, 23) :: bw >= 10mbit
(64511, 24) :: bw >= 100mbit
(64511, 25) :: bw >= 1000mbit
(64511, 2x) :: bw >= 10^(x-2) mbit
bw = min(up,down) for asymmetric connections

(64511, 31) :: not encrypted
(64511, 32) :: encrypted with unsafe vpn solution
(64511, 33) :: encrypted with safe vpn solution (but no PFS – the usual OpenVPN p2p
configuration falls in this category)
(64511, 34) :: encrypted with safe vpn solution with PFS (Perfect Forward Secrecy)
```

<https://dn42.net/howto/Bird-communities>

Certification & Accreditation

- Doesn't have to be boring
- Device Testing through Crowdsourced Penetration Tests over the Cyber Range network
- On-going Bug Bounties with explicit permission built in
- Hack-a-thons anywhere via an interconnected range

Cyber Range (Why not?)

- Proper Security Research
- Cyber eSport Competitions
- Corp-to-Corp War Games
- Device Testing & Claim Validation
 - Medical, ICS,
 - Toy Bears, Smart TVs
- Students Writing Malware
- Connect your range to your peers
 - Long distance LAN parties

Shoot for the stars.



Thank you!



matthew@itriskltd.com



Presentation Repository
<https://bit.ly/ITRiskPres>

**Technology and Business Risk Management,
(Pre-)Audit, Security Testing, Governance,
Interim CISO Services**

Sources, References & Credits

1. Colonel Stephanie Horvath US Army MN National Guard
2. JYVSECTEC
3. US Dept of Defense
4. SANS NetWars: <https://www.sans.org/netwars/cybercity>
5. dn42
 1. BIRD Communities: <https://dn42.net/howto/Bird-communities>
 2. BIRD Community Latency Script, <https://github.com/Mic92/bird-dn42/blob/master/bgp-community.rb>
6. SpaceX Night Launch, Original Videographer Unknown
7. CrowdSupply, Circumference Raspberry Pi Cluster Project:
 1. <https://www.crowdsupply.com/ground-electronics/circumference/>
8. YubiKey Configuration
 1. <https://github.com/drduh/YubiKey-Guide#4.7-requiring-touch-to-authenticate>
 2. <https://github.com/Yubico/libu2f-host>
 3. https://developers.yubico.com/libu2f-host/Mode_switch_YubiKey.html
9. Lou Ann Jensen
10. David La Belle

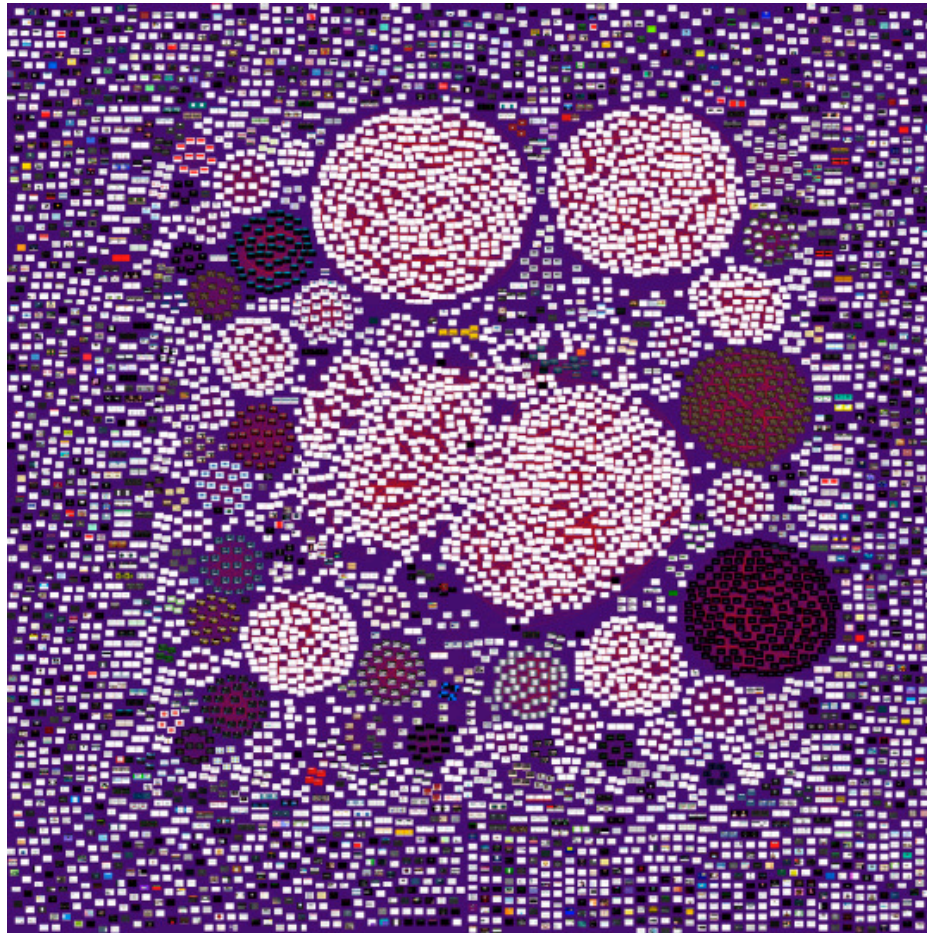
Sources, References & Credits

- Minneapolis Starry Night
- Uber metta
 - <https://github.com/uber-common/metta>
- MITRE CALDERA
 - <https://github.com/mitre/caldera>
- https://bsdrp.net/documentation/examples/bgp_route_reflector_and_confederation_using_quagga_and_bird
- <https://github.com/Mic92/bird-dn42/blob/master/bgp-community.rb>
- @HyperionGray Dark Web Map
 - <https://blog.hyperiongray.com/dark-web-map-introduction/>

Sources, References & Credits

- If you're a network engineer, the previous slide made you think about routing loops and other insanity.
- Introducing BIRD BGP community and automatic calculations.
 - https://bsdrrp.net/documentation/examples/bgp_route_reflector_and_confederation_using_quagga_and_bird
 - <https://github.com/Mic92/bird-dn42/blob/master/bgp-community.rb>

The Dark Web Map by @HyperionGray



<https://blog.hyperiongray.com/dark-web-map-introduction/>