Getting Close to the Adversary

Forward-based Defense with QFIRE

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Abstract

- (TS//SI//REL) The goal of forward-based defense is to detect and mitigate malicious threats in real-time, *as close to the source as possible*. It is part of a layered defense strategy with four concentric zones: endpoint-, perimeter-, aggregation-, and forward-based defenses. The QUANTUMTHEORY mission leverages NSA's vast system of distributed passive sensors to detect target traffic and tip a centralized command/control node. This node assesses the tip and injects a response towards the target using active TAO assets.
- (TS//SI//REL) Extremely powerful CNE/CND/CNA network effects are enabled by integrating our passive and active systems:
  - ***resetting connections***
  - ***redirecting targets for exploitation***
  - ***taking control of IRC bots***
  - ***corrupting file uploads/downloads***
  - ***More***!
- (TS//SI//REL) The success rate of these effects is largely determined by the latency from tip-to-target. **QFIRE** is a consolidated QUANTUMTHEORY platform under development that reduces latencies by co-locating (1) existing passive sensors with (2) local decision resolution, and (3) the ability to locally inject traffic to achieve the desired network effect.

Topics

- Layered Defense Model
- NSA TURBULENCE Architecture
  - TURMOIL passive SIGINT sensors
  - TURBINE active SIGINT command/control
- QUANTUMTHEORY
  - Integrating passive/active systems for CNE/CND/CNA
- QFIRE
  - Consolidated low-latency QUANTUMTHEORY capability under development for forward-based defense

Forward-based Defense
NSA TURBULENCE Architecture

Distributed Sensors: Passive Collection

Accesses

- TURMOIL
- TUTELAGE

TURMOIL (S//SI//REL) High-speed passive collection systems intercept foreign target satellite, microwave, and cable communications as they transit the globe.

TURBINE: Active Mission Management

Accesses

- TURMOIL
- TUTELAGE
- Implants (TAO)

(TS//SI//REL) TURBINE provides centralized automated command/control of a large network of active implants

QUANTUMTHEORY

- (TS//SI//REL) Extremely powerful CNE/CND/CNA network effects are enabled by integrating our passive and active systems:
  - *Resetting connections (QUANTUMSKY)*
  - *Redirecting targets for exploitation (QUANTUMINSERT)*
  - *Taking control of IRC bots (QUANTUMBOT)*
  - *Corrupting file uploads/downloads (QUANTUMCOPPER)*

- (TS//SI//REL) QUANTUMTHEORY dynamically injects packets into a target's network session to achieve CNE/CND/CNA network effects.
  - **Detect**: TURMOIL passive sensors detect target traffic & tip TURBINE command/control.
  - **Decide**: TURBINE mission logic constructs response & forwards to TAO node.
  - **Inject**: TAO node injects response onto Internet towards target.

- (TS//SI//REL) The propagation delay from tip-to-target determines the success rate of the network effect. ***Less Latency = More Success!***

QFIRE: Consolidate for Low Latency

- (TS//SI//REL) Eliminate trans-Atlantic/Pacific latency
  - QUANTUMTHEORY Path: ***site*** ° ***NSAW-TURBINE*** ° ***target***

- (TS//SI//REL) QFIRE collocates at site: sensor, decision logic, and local/regional injection capability to achieve low latency.
  - Use existing SIGINT sensors for alerting
  - Local decision resolution (local TURBINE)
  - Local/regional injection capability
  - QFIRE Path: ***site*** ° ***target***

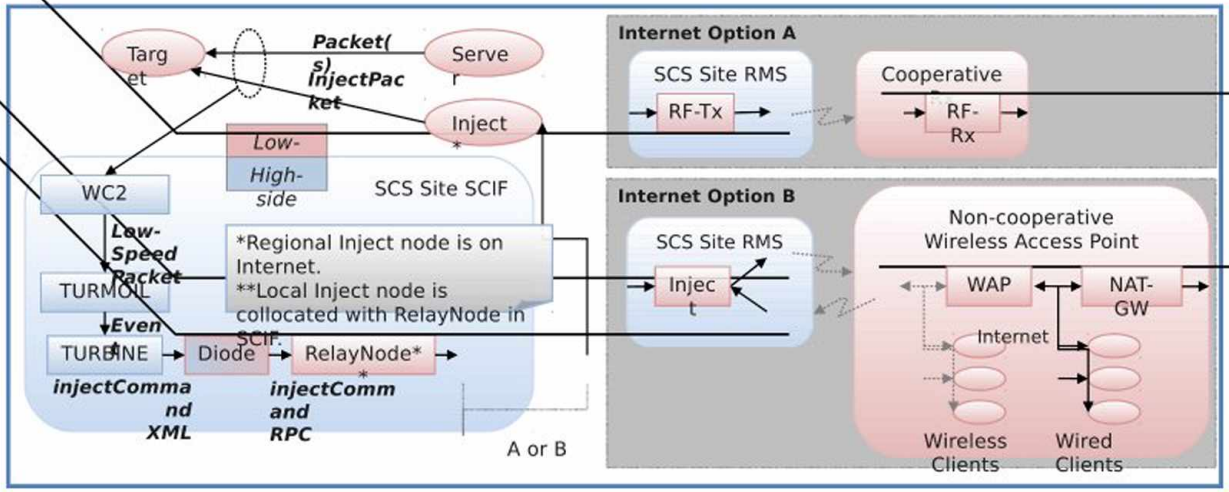
- (TS//SI//REL) A low latency capability substantially increases the variety of achievable CNE/CND/CNA network effects and improves their overall effectiveness.

QFIRE/Forward-Based Defense: Development/Dependencies

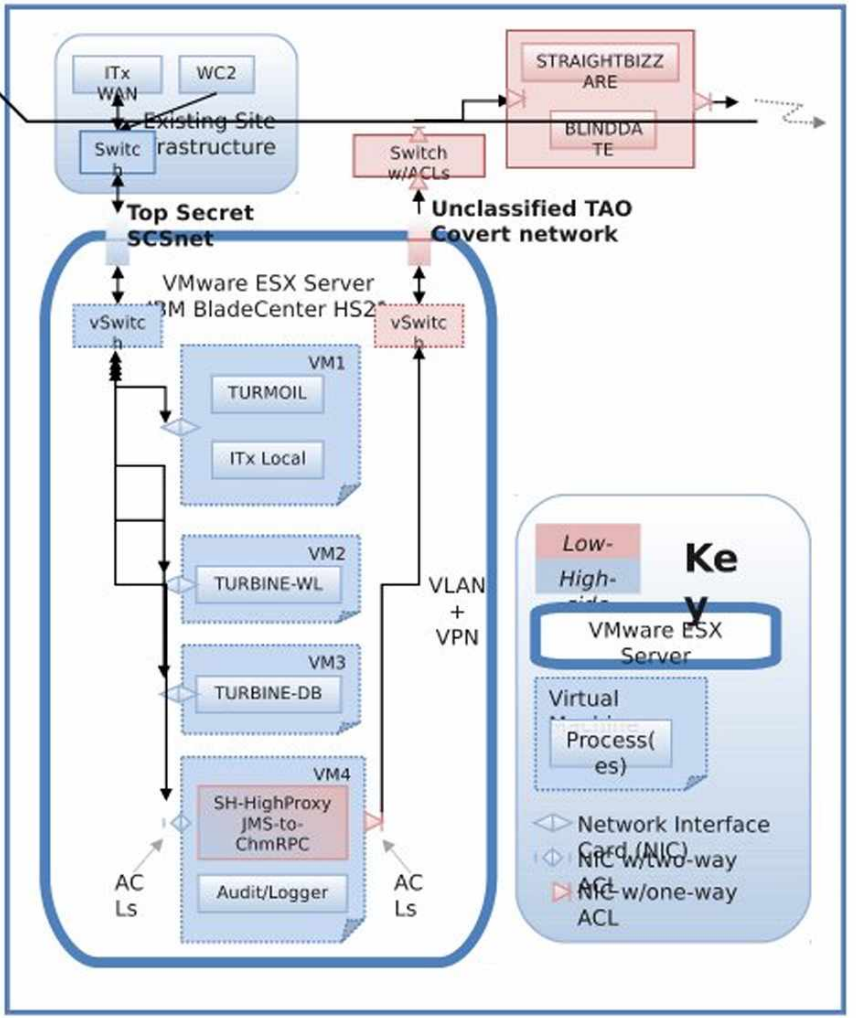
- QFIRE
  - Develop/deploy QFIRE prototype for SCS site(s)
  - Conduct time trials & evaluate operational effectiveness
  - Develop/deploy QFIRE for high-speed SSO cable site(s)

- Dependencies
  - Grow regional shooter infrastructure (more Points-of-Presence)
  - Develop local/regional insertion capability at SSO cable accesses
  - Enhance cloud analytics and QUANTUM missions
  - Botnet mitigation pilot effort

QFIRE Components @ SCS



QFIRE @ SCS: Physical/Virtual Network Architecture



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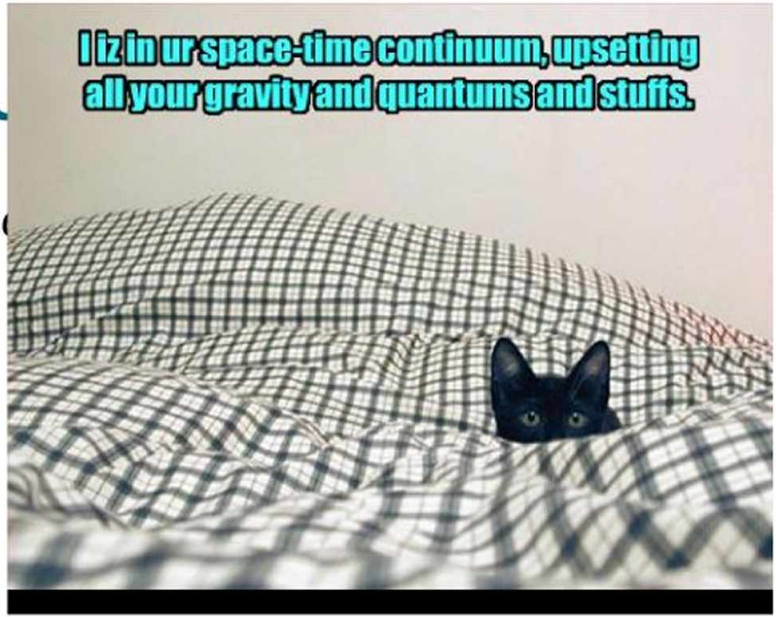


HTTP Web Client/Server

- Client initiates request, then server replies
- TCP socket:
  - Client: TCP SYN
  - Server: TCP SYN/ACK
- HTTP 1.1 Persistent C0nnection
  - Client: HTTP GET1
  - Server: HTTP Response1
  - Client: HTTP GET2
  - Server: HTTP Response2

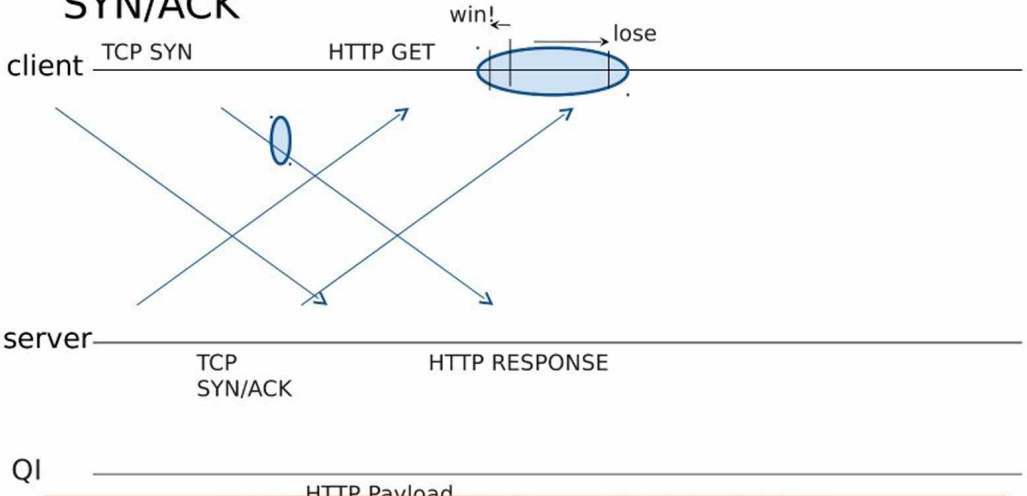
QUANTUM INSERT: racing the server

- The Game:
  - **Wait** for client to initiate new connection
  - Observe server-to-client TCP SYN/ACK
  - Shoot! (HTTP Payload)
  - **Hope** to beat server-to-client HTTP Response

- The Challenge:
  - Can only win the race on some links/targets
  - For many links/targets: too slow to win the race!

QUANTUM INSERT: racing the server

- QI detects/shoots on server-to-client TCP SYN/ACK



QUANTUMTHEORY Latency*

Node	QUANTUMTHEORY Function	Minimum Latency to Reach Next Node (ms)	Total Latency (ms)
SAS	Site Access System: Front end & Layer 0/1	?	?
Stage0	TUMULT: Demux & Layer 2	?	?
Sensor	TURMOIL: Layer 3+Passive Sensor/Event Detection	10	10
ITx	ISLANDTRANSPORT: Enterprise Message Service	120	130
C&C	TURBINE: Command/Control Decision Logic	20	150
Diode	SURPLUSHANGAR: High-to-Low Diode	20	170
CoviNet	TAO Covert Network (MIDDLEMAN)	70	240
Inject	TAO injection implant	75	315
Target	Destination for CNE/CND/CNA network effect	--	686

*Timing Measurements, QUANTUMTHEORY Workshop, October 2010