July 26, 2017

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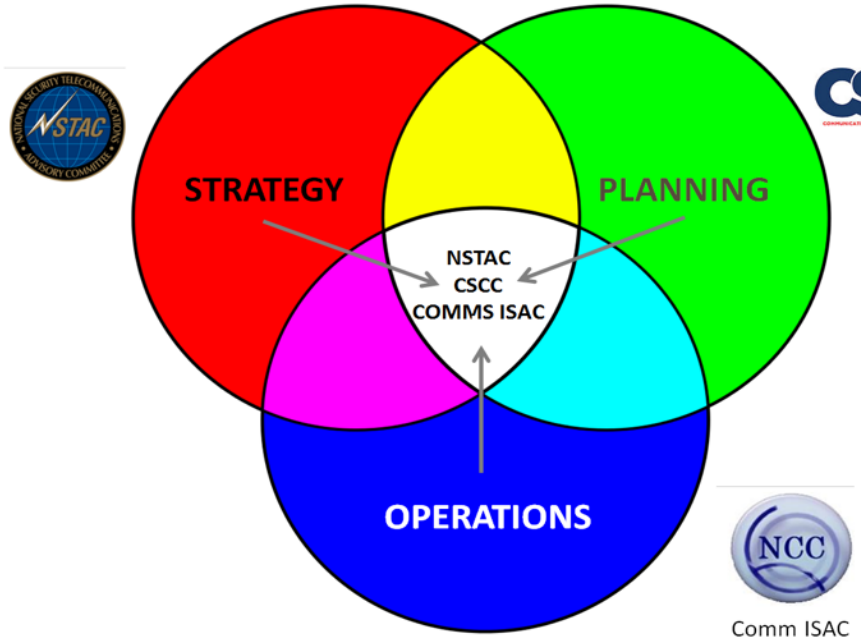
Vice President Broadband Technology, NCTA – The Internet & Television Association
& Co-Chair for the CSCC Cybersecurity Committee

Communications Sector Coordinating Council



- Help coordinate initiatives to improve the physical security and cybersecurity of sector assets
- Help to ease the flow of information within the sector, across sectors, and with designated Federal agencies; and
- Help to address issues related to response and recovery following an incident or event

BROADCASTING

There are more than 14,000 radio and 1,700 television broadcasting facilities in the United States, sending broadcasts through the air to a frequency network of transmitters.

CABLE

The cable industry is composed of approximately 7,791 cable systems that offer analog and digital video programming services, digital telephone service, and high-speed Internet access service.

WIRELESS

Wireless technology consists of cellular phone, paging, personal communications services, high-frequency radio, unlicensed wireless and other commercial and private radio services.

WIRELINE

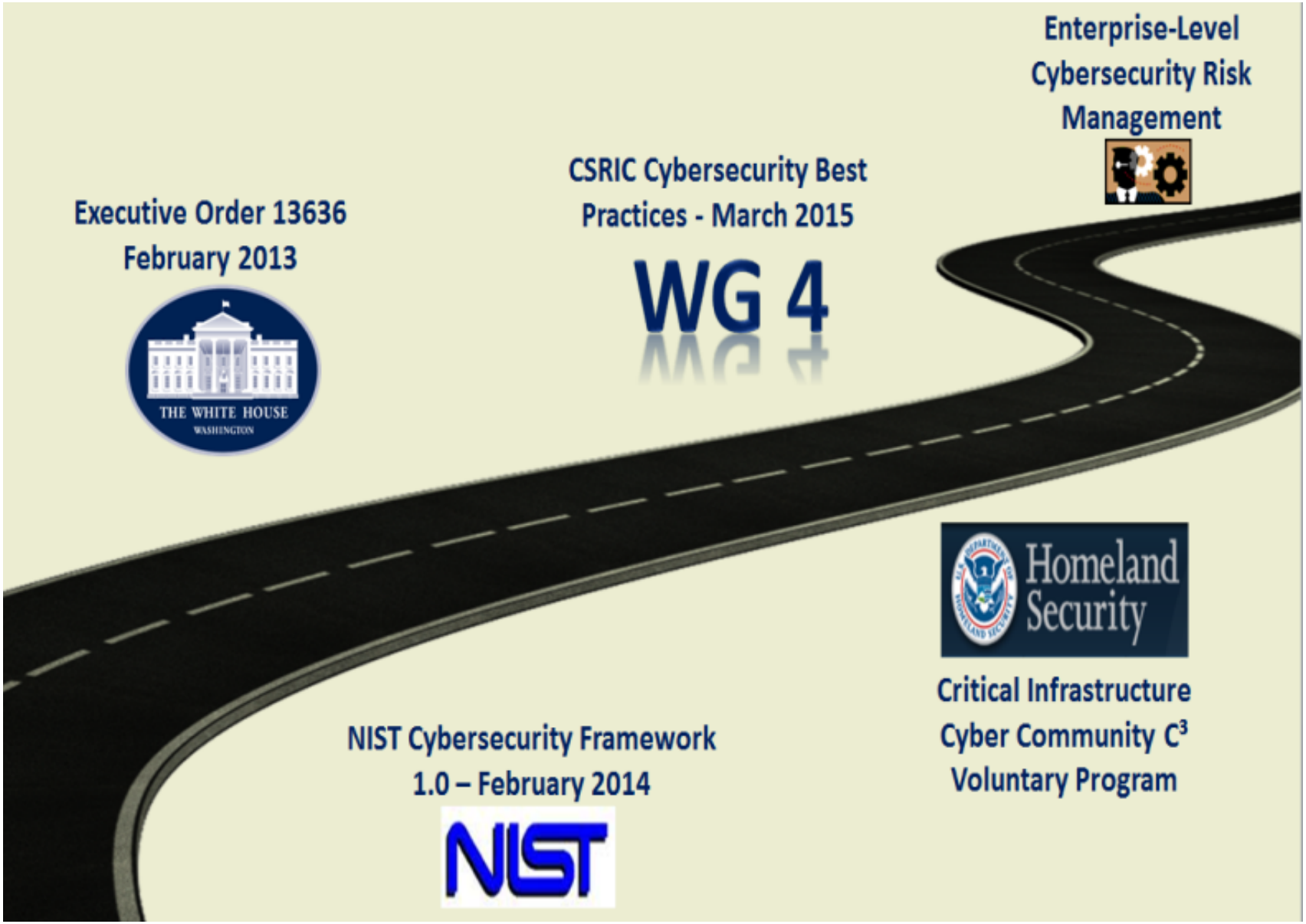
Over 1,000 companies offer wireline, facilities-based communications services in the United States. Wireline companies serve as the backbone of the Internet.

SATELLITE

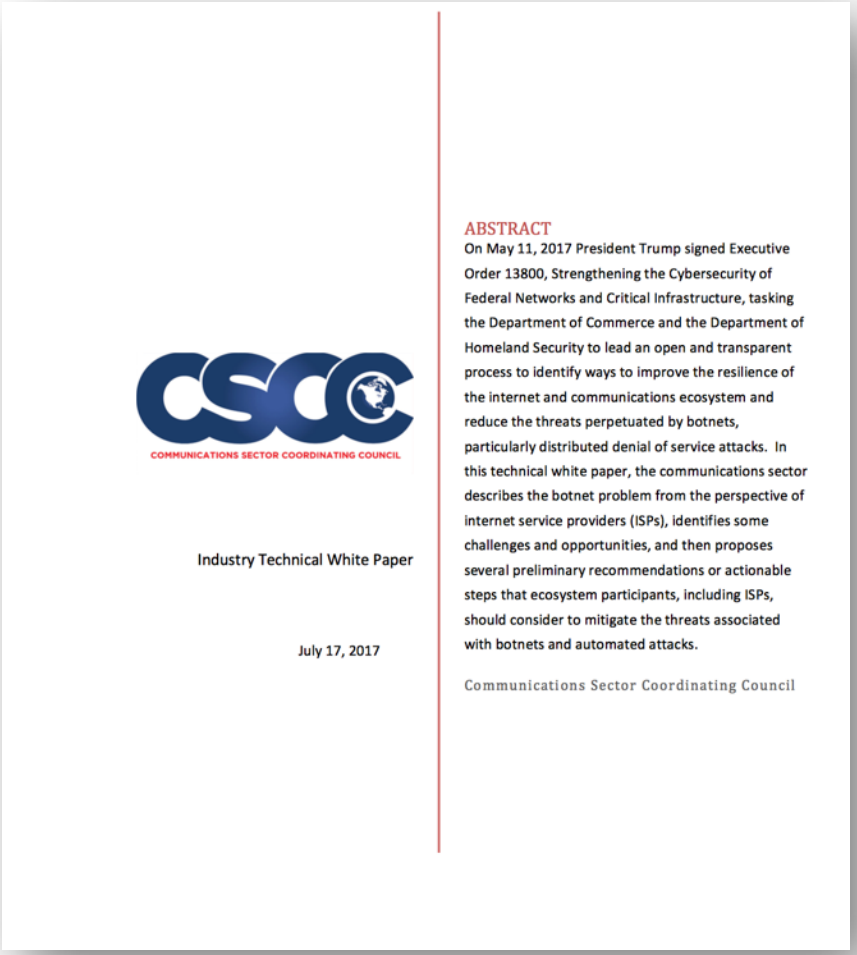
Satellite communications systems deliver advanced data, voice, and video communications, transmitting data from one point on the Earth to another.

CSCC Industry Partners

CSCC COMMUNICATIONS SECTOR COORDINATING COUNCIL


Enterprise-Level
Cybersecurity Risk
Management
CSRIC Cybersecurity Best
Practices - March 2015
WG 4
Executive Order 13636
February 2013
THE WHITE HOUSE
WASHINGTON
Homeland
Security
Critical Infrastructure
Cyber Community C³
Voluntary Program
NIST Cybersecurity Framework
1.0 – February 2014
NIST

CSCC Technical White Paper


COMMUNICATIONS SECTOR COORDINATING COUNCIL

Industry Technical White Paper

July 17, 2017

ABSTRACT

On May 11, 2017 President Trump signed Executive Order 13800, Strengthening the Cybersecurity of Federal Networks and Critical Infrastructure, tasking the Department of Commerce and the Department of Homeland Security to lead an open and transparent process to identify ways to improve the resilience of the internet and communications ecosystem and reduce the threats perpetuated by botnets, particularly distributed denial of service attacks. In this technical white paper, the communications sector describes the botnet problem from the perspective of internet service providers (ISPs), identifies some challenges and opportunities, and then proposes several preliminary recommendations or actionable steps that ecosystem participants, including ISPs, should consider to mitigate the threats associated with botnets and automated attacks.

Communications Sector Coordinating Council

- Discusses botnets through the lens of ISPs
- Discusses what ISPs do today and some emerging solutions
- Makes nine preliminary recommendations for the internet ecosystem to help reduce the threats

https://www.comms-scc.org/botnets

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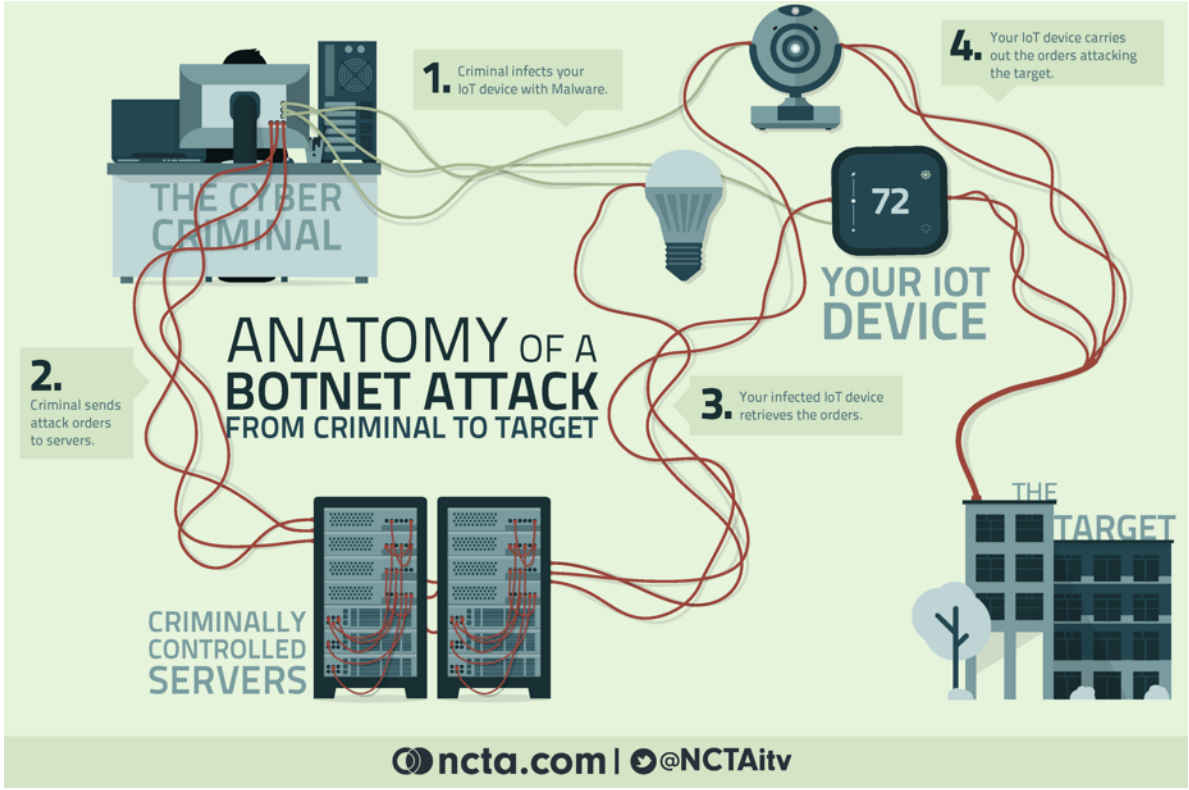
Bots and Botnets



*Bot – a program that is installed on a system in order to enable that system to automatically (or semi-automatically) perform a task or set of tasks typically under the command and control of a remote administrator (aka bot master or bot herder).**

*Botnet – a network of internet-connected end-user computing devices infected with bot malware and are remotely controlled by third parties for nefarious purposes.**

* Both definitions are from Federal Communications Commission (FCC), Communications Security Reliability and Interoperability Council (CSRIC) III, *U.S. Anti-Bot Code of Conduct (ABCs) for Internet Service Providers*, (Mar. 2012)

Threats from Botnets

DDoS Attacks

Data Theft

Illegal Content Distribution

Unauthorized Network Gateways

Processing Theft

Click Fraud

Email spam

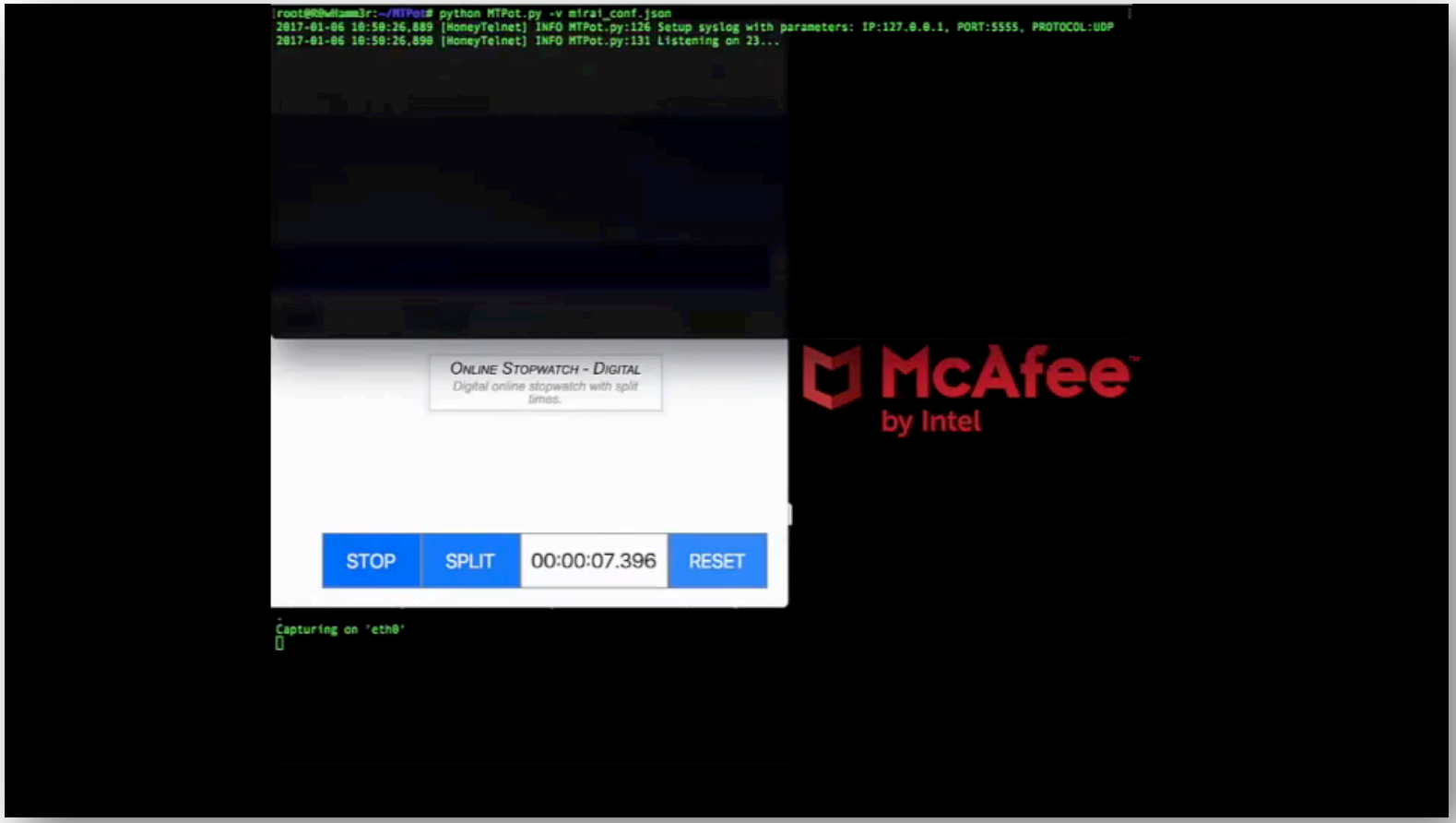
Mirai Botnet

- Level 3 Threat Research Labs observed >1M IoT devices participating in attacks
- Majority of infected devices were located in Taiwan, Brazil, and Columbia

A good case study to illustrate botnets through the lens of an ISP

Source: McAfee, https://www.mcafee.com/us/resources/misc/infographic-threats-report-mar-2017.pdf

Demonstration of Mirai Botnet Scanning



Source: McAfee on Youtube - https://youtu.be/vnitAXYGmI0

- Within 30 seconds attacks start hitting the honeypot
- Within 60 seconds Mirai hits the honeypot

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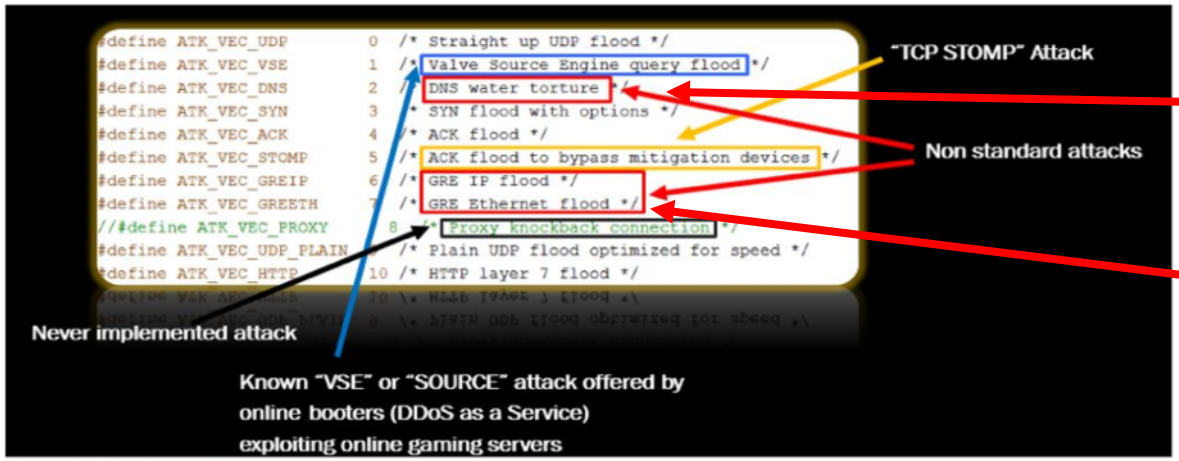
Mirai Botnet Attacks



Attack against Dyn

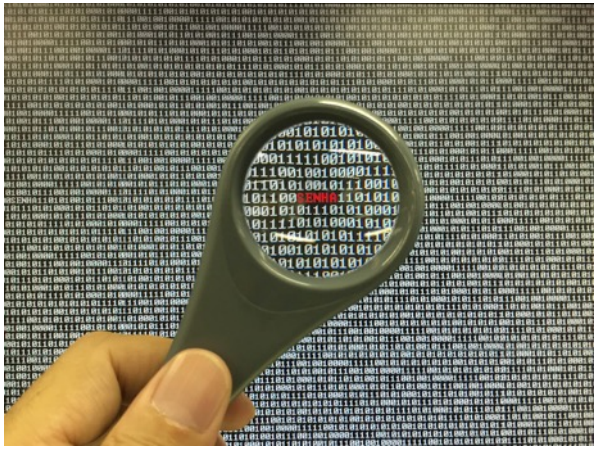
Attack against KrebsOnSecurity.com

Figure 1: DDoS Attack Methods Source: F5 Labs - https://f5.com/labs/articles/threat-intelligence/ddos/mirai-the-iot-bot-that-took-down-krebs-and-launched-a-tbps-attack-on-ovh-22422

Primary Sources

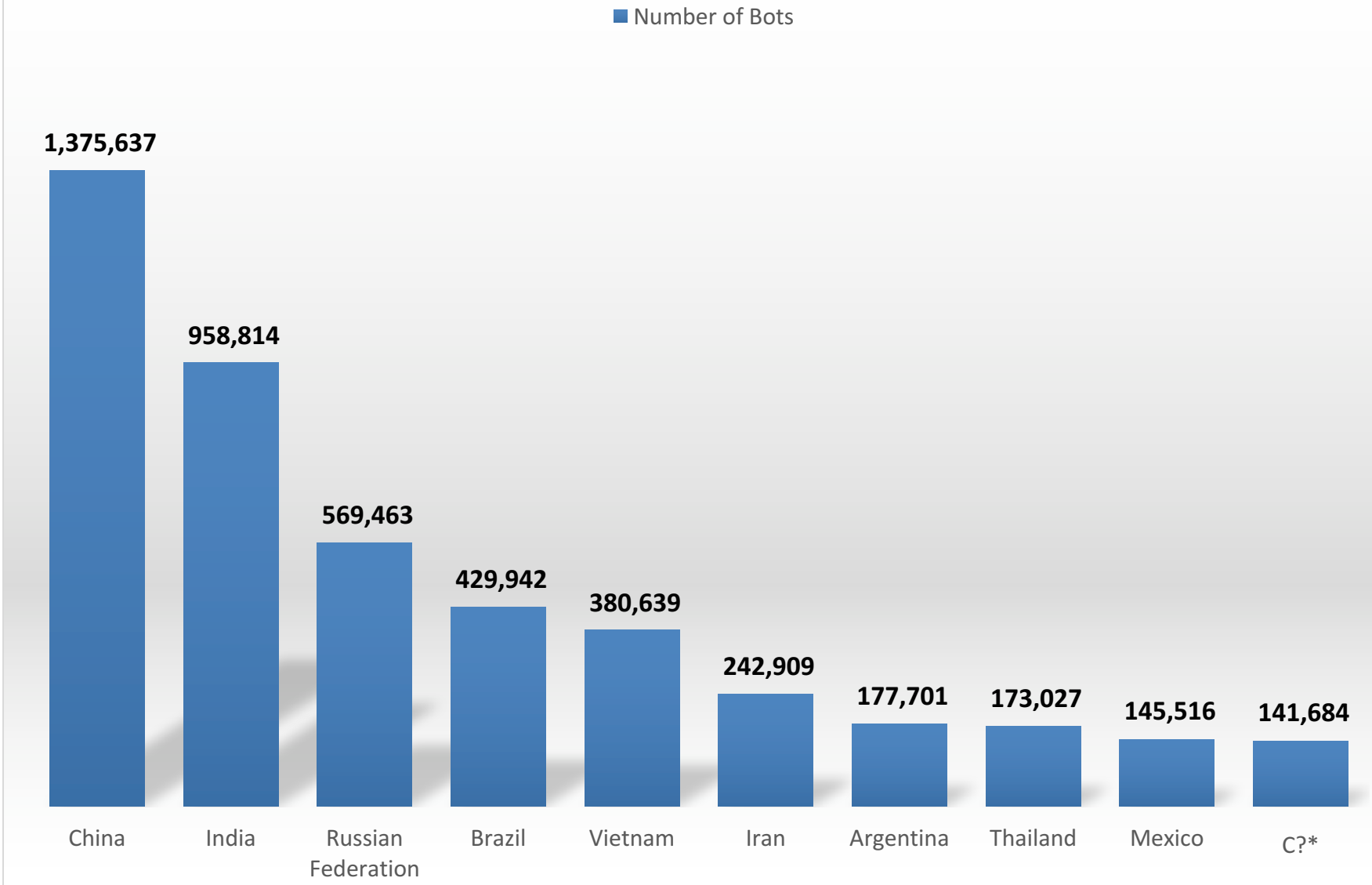
- IoT devices – IP security cameras and their DVRs
- Majority of traffic originated from outside the U.S.

Botnet Attack Traffic



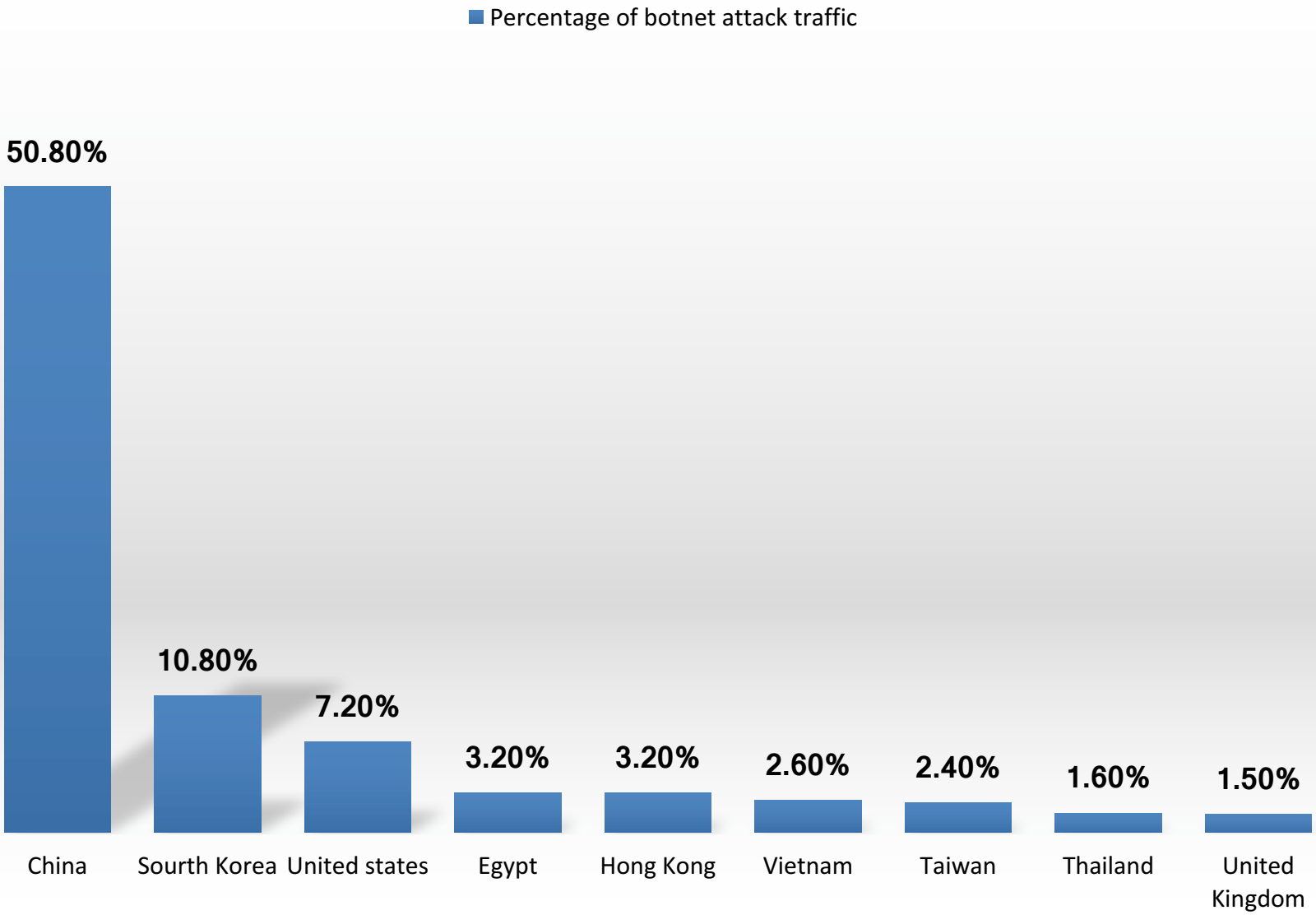
- Abuses UDP-based protocols
  - DNS/DNSSec, NTP, chargen, QOTD,SSDP
- Not limited to UDP protocols
  - Brobot used HTTP/HTTPS
  - IPv6 header extensions
- Growing trend to encrypt C&C traffic
- Vast majority of traffic originates from outside the U.S.

Top 10 Worst Botnet Countries



Source: Spamhaus as of June 29, 2017. https://www.spamhaus.org/statistics/botnet-cc/

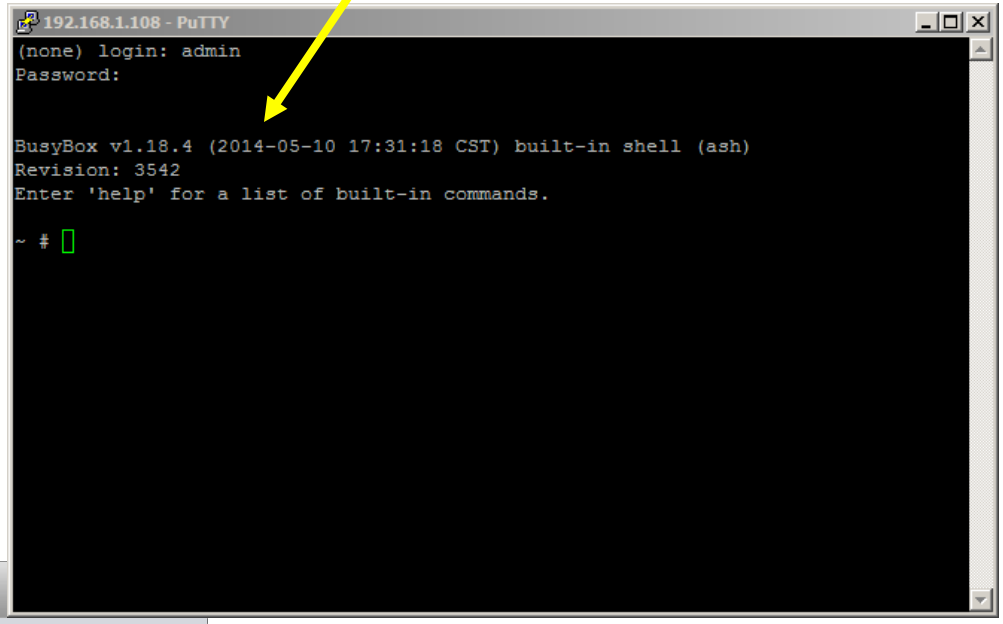
Top 10 Botnet Traffic Attacking Countries

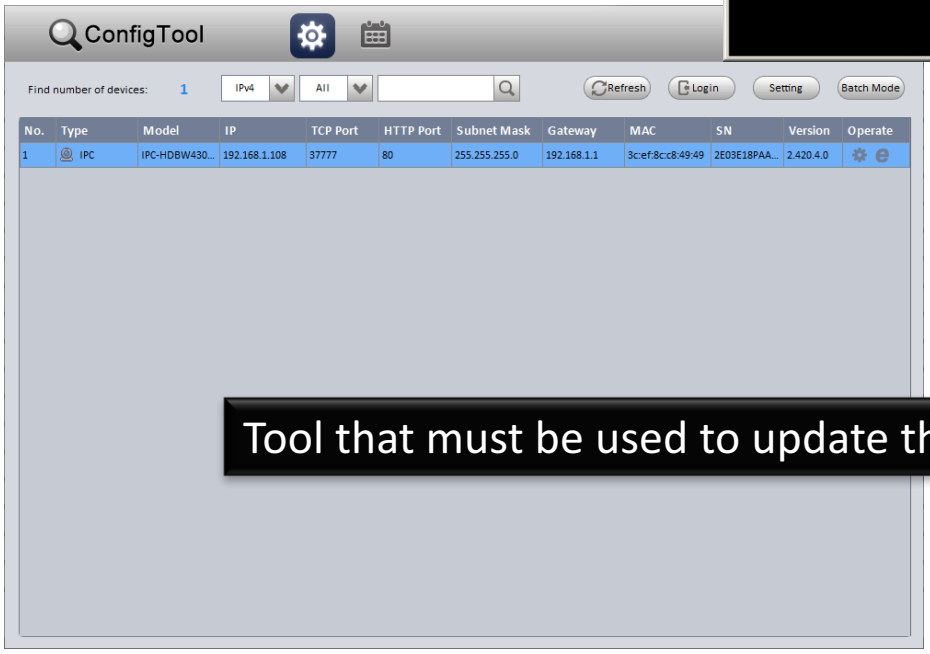


Source: Incapsula Global DDoS Threat Landscape Q1 2017. https://www.incapsula.com/ddos-report/ddos-report-q1-2017.html

Purchased via Amazon in late 2016

Out of date software - 2014!!

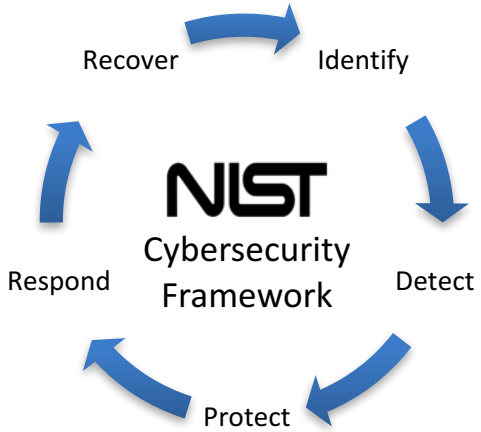




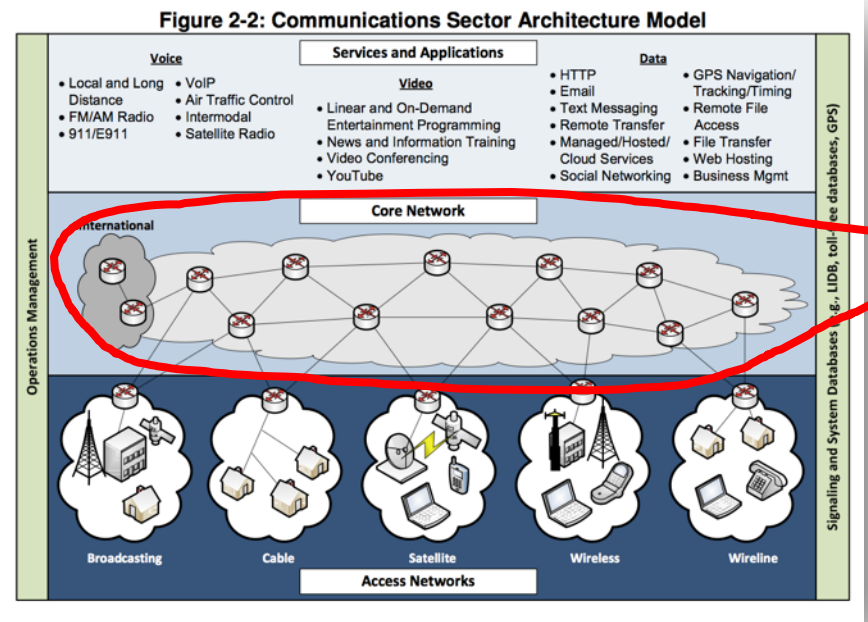
Tool that must be used to update the software

Tools & Techniques Used By ISPs

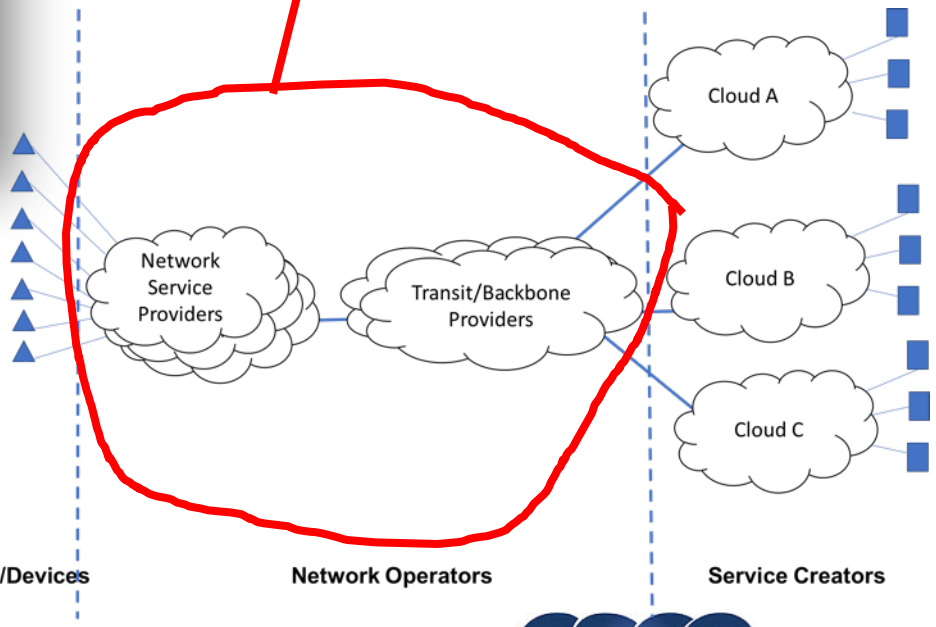
Identify	Identification of critical assets, Information Sharing
Detect	Packet Sampling, Signature Analysis, Heuristic/behavioral Analysis
Protect	ACLs, policing, black/sink holes, DDoS ”scrubbers”, BGP Flowspec, CDNs/anycast, end-user AV software, managed security service offerings to customers
Respond & Recover	Mitigate attack traffic, work with upstream provider(s) to filter; notify customers per ABC for ISPs



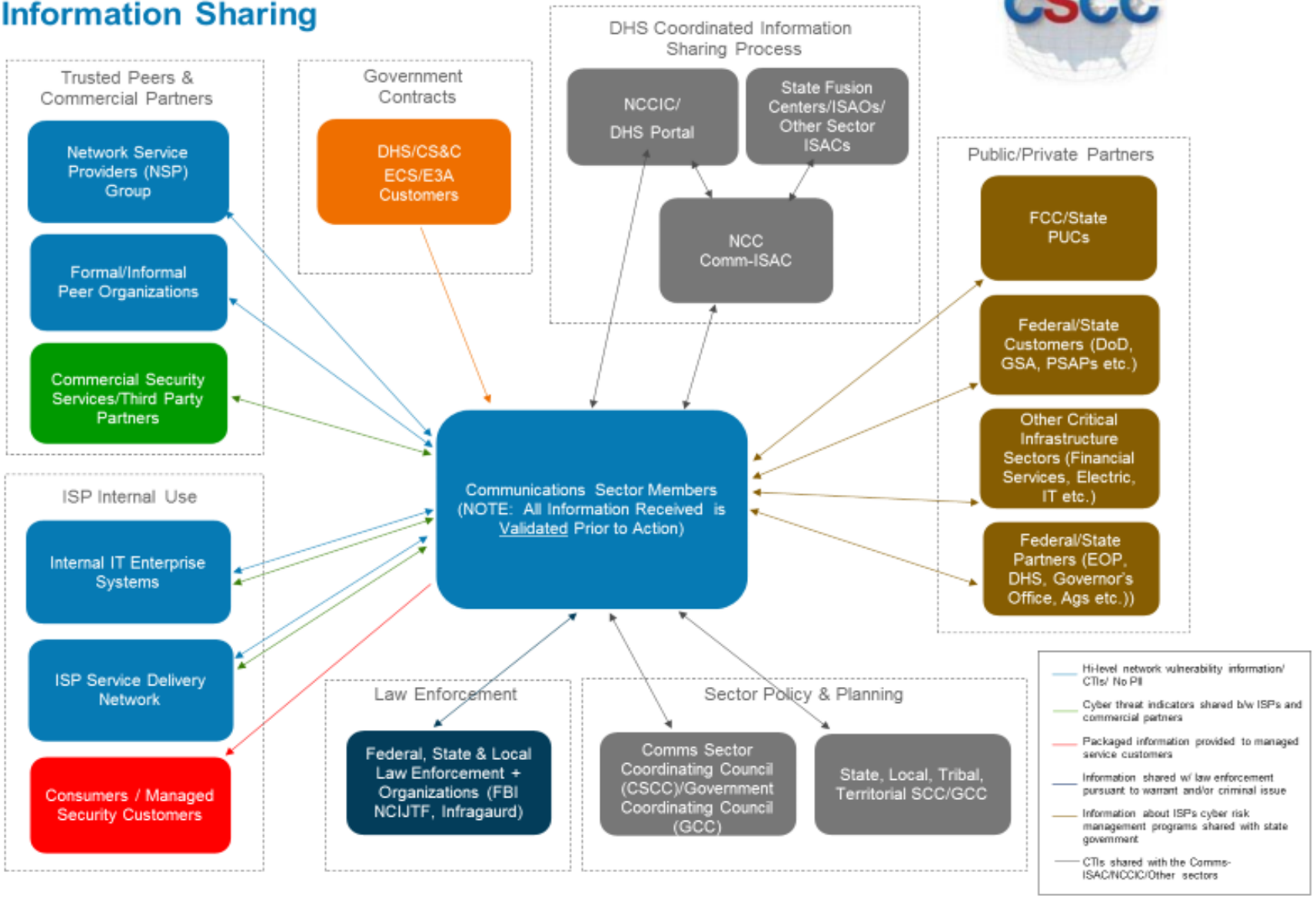
Identify: Critical Assets



Protect the core network to ensure the delivery of services



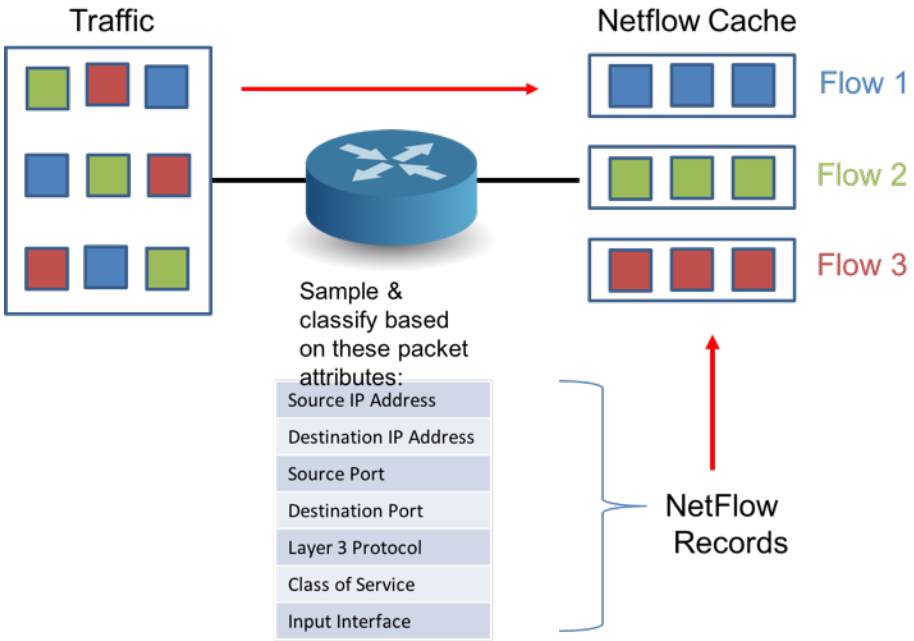
Notional Diagram Communications Sector Information Sharing



Identify - Information Sharing

Detect

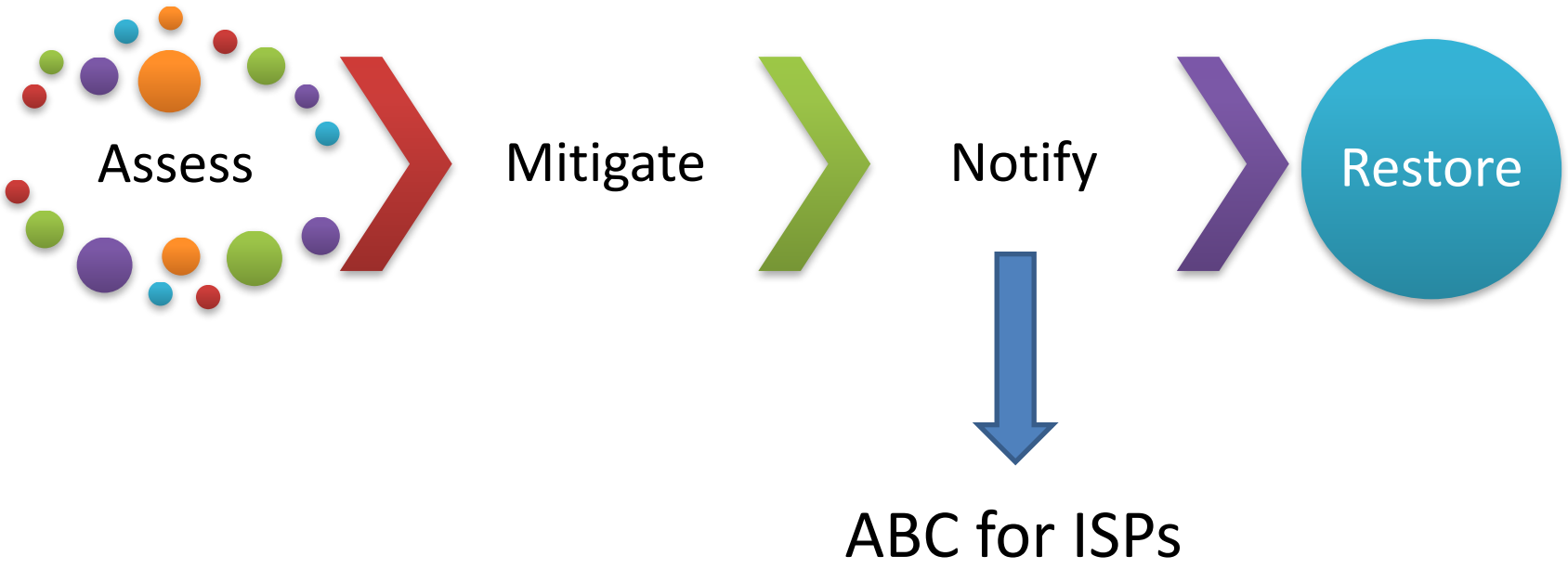
- Packet Sampling
- Signature & Behavioral Analysis



Protect

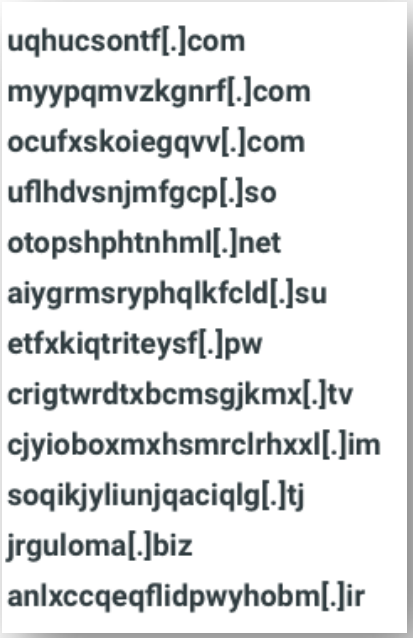
Techniques	Description
Access Control Lists (ACLs)	Typically in a router/switch and is applied to the IP address and/or port, can be applied to domain names
Traffic Policing	Slowing down of malicious traffic
Black Holes	Silently drop packets from a source or to a destination, often done at the router
Sinkholes (DNS, sinkhole routing)	Used to redirect attacks to a server to capture attack traffic for analysis
BGP Flow Spec	Block traffic on the router that matches five-tuple
DDoS Scrubbers	Diverting victims traffic through a system that looks for traffic that matches malicious traffic patterns, and drops it
Content Delivery Networks/Anycast	Geographically distributing the content across multiple hosts
End-user Anti-virus Software	Desktop software that looks for malware
Managed Security Service Offerings	Network based firewalls, secure VPN, web/email security

Respond & Recover



Emerging Solutions - Technical

- Application of Machine Learning for Detection
  - Example – Applying AI to detect bots using domain generation algorithm
- Fingerprinting of encrypted C&C traffic
- Creating tarpits from dark IP address blocks
- Software Defined Networks (SDNs)



Emerging Solutions - Collaborative

- IETF DDoS Open Threat Signaling (DOTS)
  - Protocol for the real-time exchange of telemetry between DDoS mitigation platforms
  - Supports requests for DDoS mitigation and status updates network-to-network
- M3AAWG DDoS API
  - Application Program Interface to share identified sources (source IP addresses) of DDoS attack traffic
  - Allows network operators to share the source IP address for inbound IP flows in anonymous fashion with the network from which the flow emanates

Challenges & Opportunities

	Challenge	Opportunity
Botnet Takedowns	Requires lots of resources & coordination	More law enforcement & streamlining of international processes
Actionable Threat Information	Stale information in particular IP addresses	DHS AIS, IETF DOTs, M3AAWG DDoS API
Network Address Translation (NAT)	Identifying devices behind NAT routers	Reduce the need for NAT in home routers with IPv6
Off-Net Traffic	Overwhelming majority of botnet traffic originates from outside the U.S.	Inclusion in peering/transit agreements for availability and scrubbing to filter malicious traffic
End-User Notifications	Reaching the accountable party and notifying. IoT makes this worse	Following best practices and standards that include methods for device identification

Challenges & Opportunities

	Challenge	Opportunity
Fast Flux DNS	Botnets rapidly changing the IP addresses associated with the domain names for C&C servers	Broader use of the SSAC recommendations; Use of machine learning
Insecure IoT Devices	IoT devices shipping with known vulnerabilities	• Applying principles of least privilege into the design of IoT devices • Use of network isolation/filtering by IoT devices to keep IoT traffic from doing harm to others
Amplification Attacks	Source address spoofing	Broader implementation of source address validation techniques (i.e. BCP 38/84, MANRS)
Network-to-Network Coordinated Network Management	Sources of ground truth for botnets; heterogeneous network architectures; C&C servers operating with shared services	More close, trusted collaboration and communications between stakeholders

Preliminary Recommendations

Attack Mitigation	End-Point Prevention
Encourage continued migration to all IPv6	End-points including IoT devices should follow security best practices and standards
Sharing of actionable cyber threat information	Ensure end-points are running up-to-date software
Pre-negotiated provisions for traffic filtering in transit and peering agreements	IoT devices should use network isolation and/or network-based filtering techniques for any communications to cloud-based services.
Streamline law enforcement process for botnet takedowns	
Adapt & apply machine learning for botnet detection	

Still need to discuss best practices & capabilities for all segments of the internet ecosystem

ADDRESSING BOTNETS IS A SHARED RESPONSIBILITY

Thanks!

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