# DNS Traffic Monitoring

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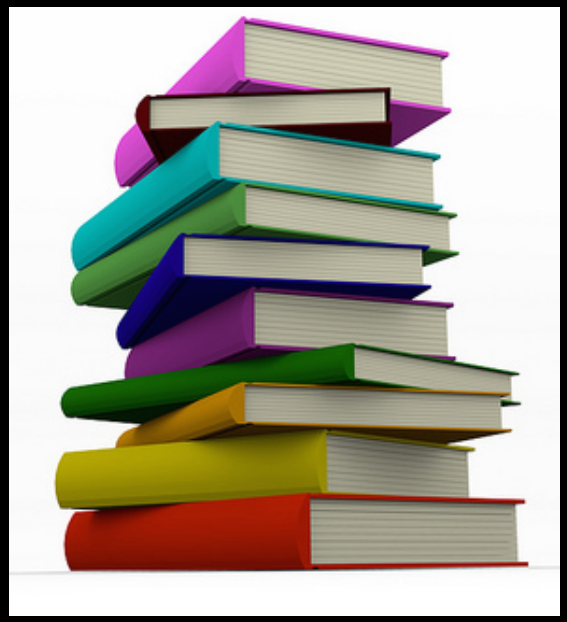
# Domain Names



*ICANN coordinates the administration of global identifier systems*

Domain names provide user friendly identification of hosts

- Latin script (A-Z, 0-9, hyphen) e.g., www.google.it
- *Internationalized Domain Names* accommodate non-Latin languages or scripts e.g., водка.рф

# What can I do with a domain name?

An engineer's answer

- Assign user friendly names to a computer (server) that hosts *Internet applications:*
- Web, blog, file server, email, IP telephony

A businessman's answer

- Create a merchant or other commercial online presence
- Join a commodities market: buy, sell, auction domain names
- Run a commercial service

A government official's answer

- Provide services for public interest

A criminal's answer

- Misuse, exploit or disrupt public or business services

# Criminal or Malicious Domain Registrations


## Domains registered by criminals for

- Counterfeit goods
- Data exfiltration
- Exploit attacks
- Illegal pharma
- Infrastructure (ecrime name resolution)
- Malware C&C
- Malware distribution (drive-by pages)
- Phishing
- Scams (419, reshipping, stranded traveler…)

# Criminal Abuse of Legitimate Domains


Domains compromised or hijacked by criminals or state-sponsored actors

- Host criminal DNS infrastructure
- Domain, NS, or MX Hijacking
- Hacktivism (e.g., defacement)
- Tunneling (covert communications)
- Attack obfuscation
- Host file modification (infected devices)
- Changing default resolvers (DNSChanger)
- Poisoning (resolver/ISP)
- Man in the Middle attacks (insertion, capture)

# Modern malware use domain names and DNS

## Maliciously registered domains are common in spam, phishing URLs

Major cure discovered in world of medicine  Spam x

**Sammy rep@sparscured.com** via corecom.com  5:11 PM (19 hours ago)
to dave

**Why is this message in Spam?** It's similar to messages that were detected by our spam filters. Learn more

**Major Medical Breakthrough That Impacts You**

Finally - Treatment that doesn't just protect us but actually keeps us immune to epidemic diseases.

The discovery was exposed by a 102 year old doctor and can be administered from home against life-limiting diseases such as cancer, heart attack and diabetes.

**See The Video Big Pharma Does Not Want You To See**

hxxp://grill.s[redacted]sc[redacted]ed.com/cure17213154296cr-t2123501true612246174

# Malware also abuse legitimate domain names

Compromised web sites often redirect to criminal domains

Google "no prescription" site:edu

Web Shopping Images News Videos More Search tools

About 92,900 results (0.36 seconds)

Sildenafil **No Prescription** - Baker University
www.bakeru.edu/sildenafil-**no-prescription**/ Baker University
Sildenafil **No Prescription**. Online Pill Store, Big Discounts. Pharmacy Guaranteed - Quality Protects. Natural and healthy products!

**No Prescription** Tadalafil - Environmental Programs
envp.tamu.edu › Environmental Studies Texas A&M University
**No Prescription** Tadalafil. Pill Shop, Best Prices. FedEx. Online support 24 hours!

Generic Tadalafil **No Prescription** - Environmental Programs
vp.tamu.edu/generic-tadalafil-**no-prescription**/ Texas A&M University
neric Tadalafil **No Prescription**. Online Drug Shop, Big Discounts. Safe & Secure. dications are certificated!

ldenafil Online **No Prescription**
w.geography.wisc.edu/sildenafil-o... University of Wisconsin-Madison
denafil Online **No Prescription**. Online Drug Store, Guaranteed Shipping. HOT weekly specials. Natural and healthy products!

Cheap Sildenafil **No Prescription**
medclinic.bli.uci.edu/cheap-sildenafil-**no-prescription**/
Cheap Sildenafil **No Prescription**. Online Drug Store, Cheap Prices. Refund Policy. Cheapest prices ever!

Compromised Wordpress Site at wisc.edu.

Redirects to www.rx-elife.com/

www.rx-elife.com/erectile_dysfunction/viag ic/1-1.htm

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# Advanced uses of Domains and DNS

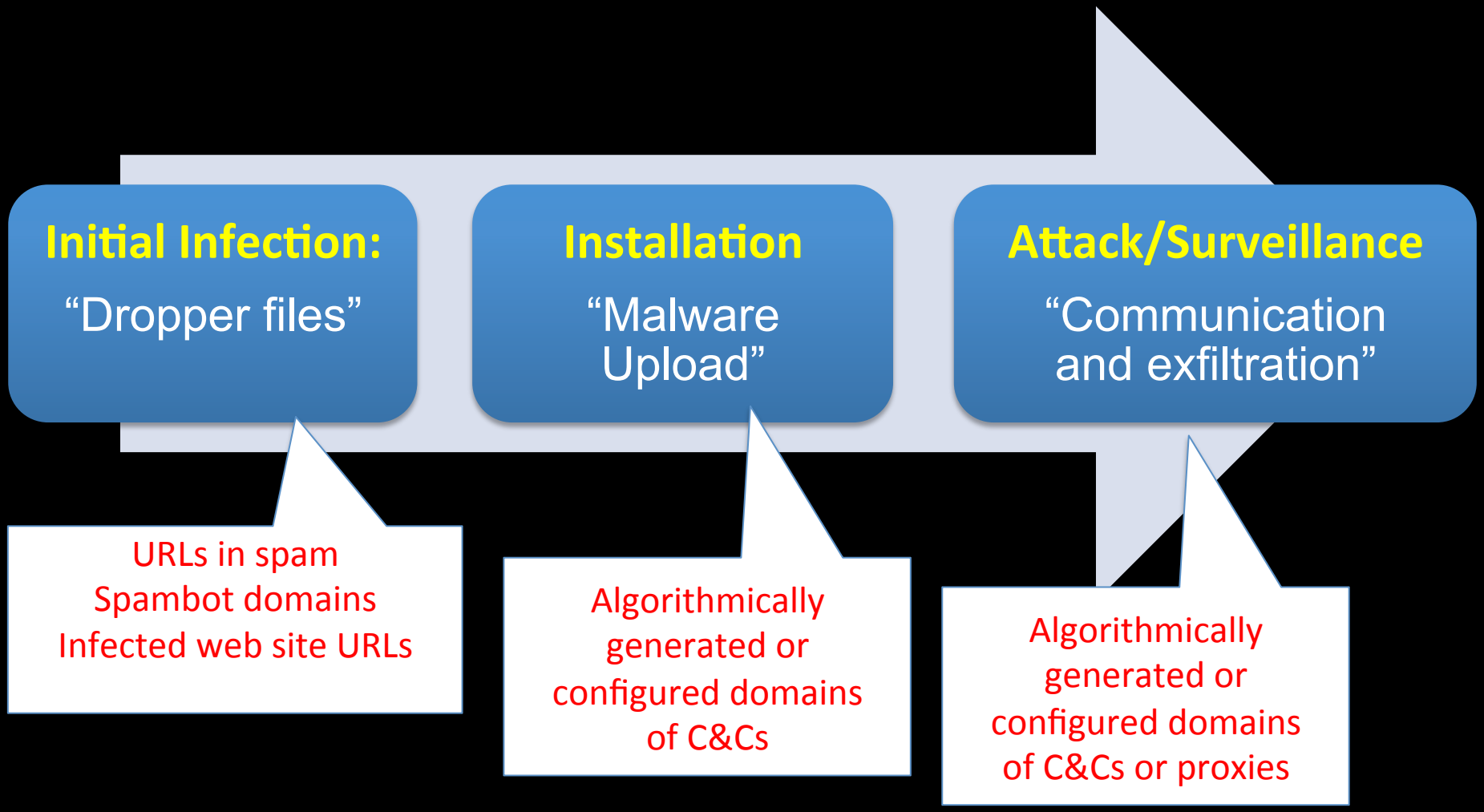
Criminals register domains to identify

- botnet command and control hosts
- proxies for fast flux or MITM hosts
- name servers of malicious domains

Over the course of the malware's life cycle…

Tens, hundreds, sometimes, thousands *per day…*

# DNS is used by malware at different times for different purposes



# But…DNS is a public directory service

Fundamental characteristics of DNS information

- You cannot copyright it: it's meant to be copied
- If you keep it confidential no one can find you
- DNS data are mostly temporal
  - Names are registered not owned
  - Addresses are registered or allocated not owned
  - DNS data and even some addresses have *lifetimes*
- You can't prevent others from collecting it
- Criminals can't stop us from monitoring the DNS

# What are you looking for? Why?

| DNS QUERY TRAFFIC | SYMPTOM OF |
|---|---|
| Spoofed source addresses<br>Unauthorized source addresses<br>Queries that use TCP<br>High query volume | DDOS |
| Malformed queries or queries with suspicious composition | Vulnerability Exploitation Attack or incorrectly operating device |
| Queries to suspicious or unauthorized resolvers | C&C communications/exfiltration |

# What are you looking for? Why?

| DNS RESPONSE TRAFFIC | SYMPTOM OF |
|---|---|
| Suspicious length, especially in association with high volume | DDOS Amplification |
| Suspicious composition | Cache poisoning,<br>Covert channel |
| Incorrect responses for your domains | Domain account hijacking,<br>DNS response modification |
| Short TTLs | Possible fast flux indicator |
| High Name Error volume | Infected hosts cannot reach C&Cs |
| DNS on non-standard, unauthorized ports | C&C communications, exfiltration |

# DNS misuse leaves a trail

- Certain malware change host configurations or resolver data
  - DNSchanger malware
  - Compromised broadband routers/modems
  - Cache poisoners
- You can track others by examining network traffic

https://www.flickr.com/photos/reway2007/

# Where to look

- Host (device) or resolver configuration
- DNS query and response traffic on networks
- Resolver and authority logs
- Event logs
  - Hosts, Security Systems, Network elements
  - Applications (clients or servers)
- Passive DNS replication (sensor networks)

# How to Look (Packet Capture)

- Traffic analyzers
  - Create/borrow DNS filters for PCAP files generated using Wireshark or other packet capture software
    http://ask.wireshark.org/questions/7914/how-to-identify-any-rogue-dns-requests-using-wireshark
- Intrusion Detection Systems
  - DNS rules for snort, suricata, Bro
    http://blog.kaffenews.com/2010/03/04/detecting-malware-infections-with-snort-dns-monitoring/
    http://www.bro.org/search.html?q=dns

# How to Look (Firewalls)

Create Internet firewall rules for

- Antispoofing
- Egress traffic filtering
- Allow DNS to authorized resolvers, deny all other

Enable logging, event notifications

| | | Source | Destination | Service | Interface | Direction | Action | Time | Options |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | linux-static<br>net-192.168.1.0 | Any | Any | eth0 | Inbound | Deny | Any | |

www.fwbuilder.org/4.0/docs/users_guide5/anti-spoofing-rules.shtml

## Firewall Best Practices - Egress Traffic Filtering

Too many network administrators think only to protect private network resources from external attacks when assessing security threats. Today's landscape is littered with threats that emanate from malware-infected endpoints. Attackers can use these to collect and forward sensitive information from your network, to attack or spam other networks. Companies large and small are better served when network administrators are equally concerned with threats that are associated with outbound connections. In this column, I discuss ways organizations can improve their risk profile and be better 'netizens by implementing *egress traffic filtering*.

**Filter Egress Traffic to Protect Yourself**

If you don't restrict the services that hosts in your internal networks can access, malware that will inevitably find its way onto some of your hosts may exfiltrate data to a location that an attacker controls. Data exfiltration could be unintentional, i.e., an insider might incorrectly attach sensitive information an email message to upload it to a document sharing service. Exfiltration can result from configuration error: NetBIOS, DNS, or other service traffic that leaks from your trusted networks may be captured or exploited by external parties. Exfiltration can also be malicious, the result of hosts having been infected with an advanced persistent threat (APT).

Irrespective of the cause, data exfiltration is a threat you can't mitigate without egress traffic enforcement, and one you can't readily detect if you don't log and monitor traffic behavior associated with permitted and prohibited services.

**Filter Egress Traffic to Do No Harm to Others**

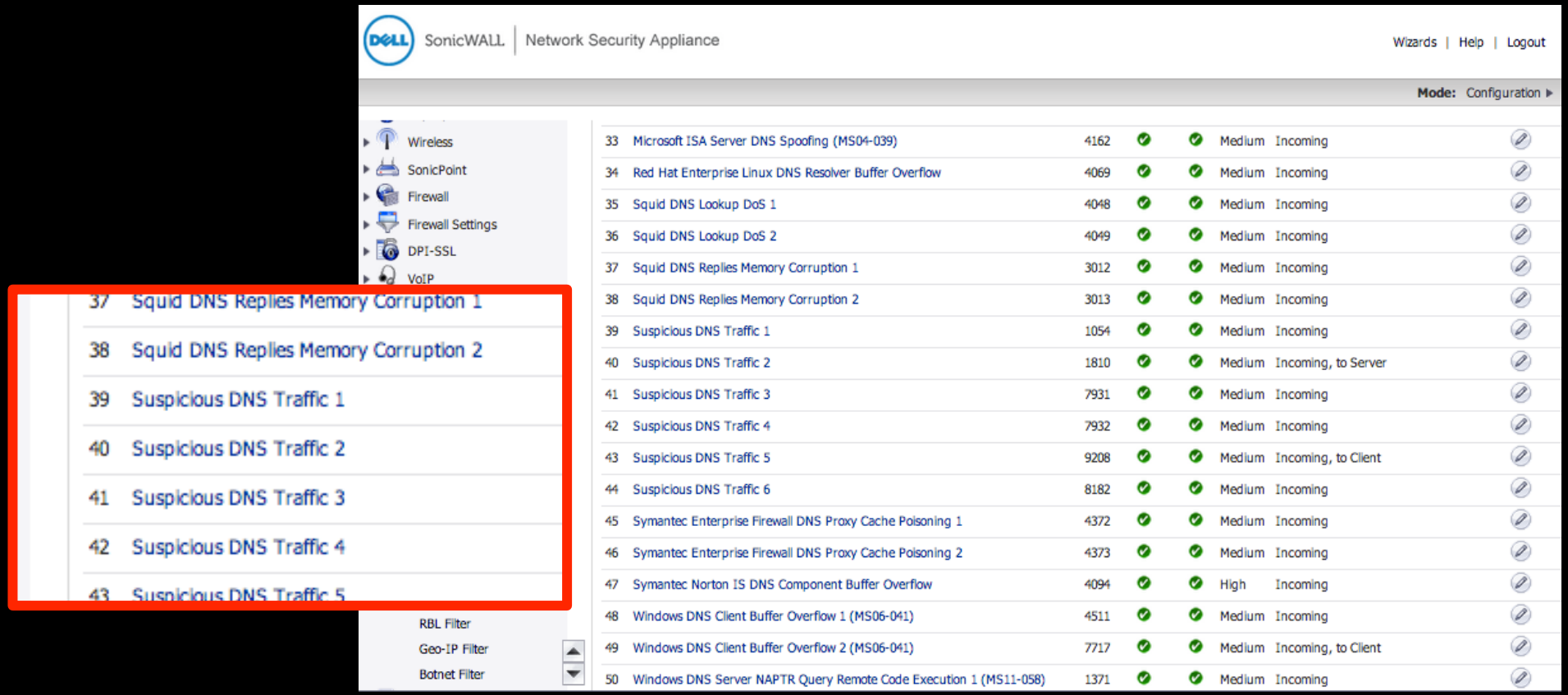
In the most lax of configurations - and sadly, in many default configurations - a firewall or router may treat as valid and forward traffic it receives from any source address. Fred Avolio calls this "The Nefarious Any". Such configurations are green fields for attacks that leverage forged source IP addresses (IP spoofing). Compromised or unauthorized hosts that gain access to your local networks often use IP spoofing to attack (DDoS) other networks, to store child abuse or other illegal material, or to conduct spam or phishing campaigns. This is problem enough in NAT environments: in poorly implemented router configurations, especially where you have multiple access points to the Internet, your organization can inadvertently behave as a transit network for forged, malicious traffic emanating from other organizations.

securityskeptic.com/the-security-skeptic/firewall-best-practices-egress-traffic-filtering.html

# How to Look (IPS)

## NextGen firewall/IPS features

- Sonicwall, Palo Alto,Checkpoint, cisco, others



# How to look (name service)

- DNS log analysis
  - Analyze log data from your resolvers, authoritatives
    http://www.irongeek.com/i.php?page=videos/derbycon3/s114-another-log-to-analyze-utilizing-dns-to-discover-malware-in-your-network-nathan-magniez
- Add Response Policy Zones to your resolver
  - Add zone file with known malicious domains to BIND
    https://sites.google.com/site/thingsoflittleconsequence/home/using-domain-name-service-response-policy-zones-dns-rpz-with-shallalists
- Passive DNS
  - Inter-server DNS traffic captured at sensors, forwarded to collector, then analyzed
    http://www.bfk.de/bfk_dnslogger.html
    https://www.dnsdb.info/

# How to Look (Commercial Grade)

- DNS Monitoring plugins for SIEM, IT infrastructure
  - vFabric Hyperic 4.6, Nagios, ManageEngine (lots of variations among these services)
- DNS Monitoring services
  - Threat intelligence + DNS (Application) Firewall Infoblox, Internet Identity, A10 Networks, others…
- Threat intelligence platforms
  - Cybertoolbelt, Maltego, ThreatConnect, others…

# Final Comments

- DNS is essential to users
  - and to criminals as well
- Observing DNS traffic is a good way to monitor network activities
  - There are lots of ways to do this for small budgets or large
- It's also a great way to identify malicious, or criminal activity

… So why are you still reading and listening?

# further reading

- Monitor your DNS and you may just find a RAT
  http://www.darkreading.com/attacks-breaches/monitor-dns-traffic-and-you-just-might-catch-a-rat/a/d-id/1269593
- 5 Ways to Monitor DNS Traffic
  http://www.darkreading.com/analytics/threat-intelligence/5-ways-to-monitor-dns-traffic-for-security-threats/a/d-id/1315868
- The Security Skeptic
  http://securityskeptic.com