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Digital Active Self Defense

DEFCON 12

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Some references

- *Defending your right to defend: Considerations of an automated strike-back technology*
  - Timothy M. Mullen
- *Launch on Warning: Aggressive Defense of Computer Systems*
  - Curtis E.A. Karnow
- *Enforcer, Automated Worm Mitigation for private networks*
  - BlackHat Seattle, February 2003, Timothy M.Mullen, AnchorIS.com
- *Vigilantes on the net*
  - Barbara Moran, NewScientist, 12 june 2004
- *Symbiot, Adaptive Platform for Network Security*
  - http://www.symbiot.com
- Active Defense research project, Dittrich
  - http://staff.washington.edu/dittrich/ad/

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Summary

- Introduction
- Current threats and limitations
- Active Defense
- Warning
- Legal Issues
- Technical considerations
- Requirements
- Honeypots
- Internal computers
- Internal threats
- Examples
- Technical limitations
- Conclusions

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Introduction

- Current threats
  - Known limitations for defense technologies
    - Many solutions in the information security field
  - Laws fail for certain kind of activities
- Natural temptation
  - Fighting back attackers, counterstrike…
- Not so many solutions that use active countermeasure capabilities
  - Interesting field of research and development ?

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The digital threats

- Though we use more and more security technologies, there are still security problems
  - Confidentiality, Integrity, Availability, Copyright, etc
  - Information Assurance
- External threats
  - Firewall, Proxies, Hardened services…
    - Ethical Hackers, Corporate spies, Cyber terrorists...
- Internal threats : easier/faster access
  - Authentication, In-depth Protection...
    - Trainees, Outsourcing, Employees…

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From hardening to reaction

- A lot of technologies might be used to block evil traffic
  - Routers, Firewalls, proxies, etc
  - Allow the minimum that is needed
- But aggressors still find solutions like :
  - Bouncing in (bad security rules, bugs, etc)
  - Getting an access inside the minimum accepted (target services, target end-users with stupid clients, etc)
- Countermeasure technologies
  - While getting a sign of an attack (IDS…), security resources will respond by trying to stop the attack
  - Could it be an interesting answer to handle some threats ?

Countermeasure problems

- Countermeasure : Detection ➔ Reaction
- The delay between a detection and the associated response is not zero second
  - Some packets may reach the victims
  - IDS see signs of attacks while victims receive the attacks, so that responses (RST, ICMP, firewall ruleset modified…) may arrive too late to stop the attack (which has ever begun)
  - Examples of problems :
    - SQL-Worm : 1 UDP small packet !
    - Multiple source of attackers...

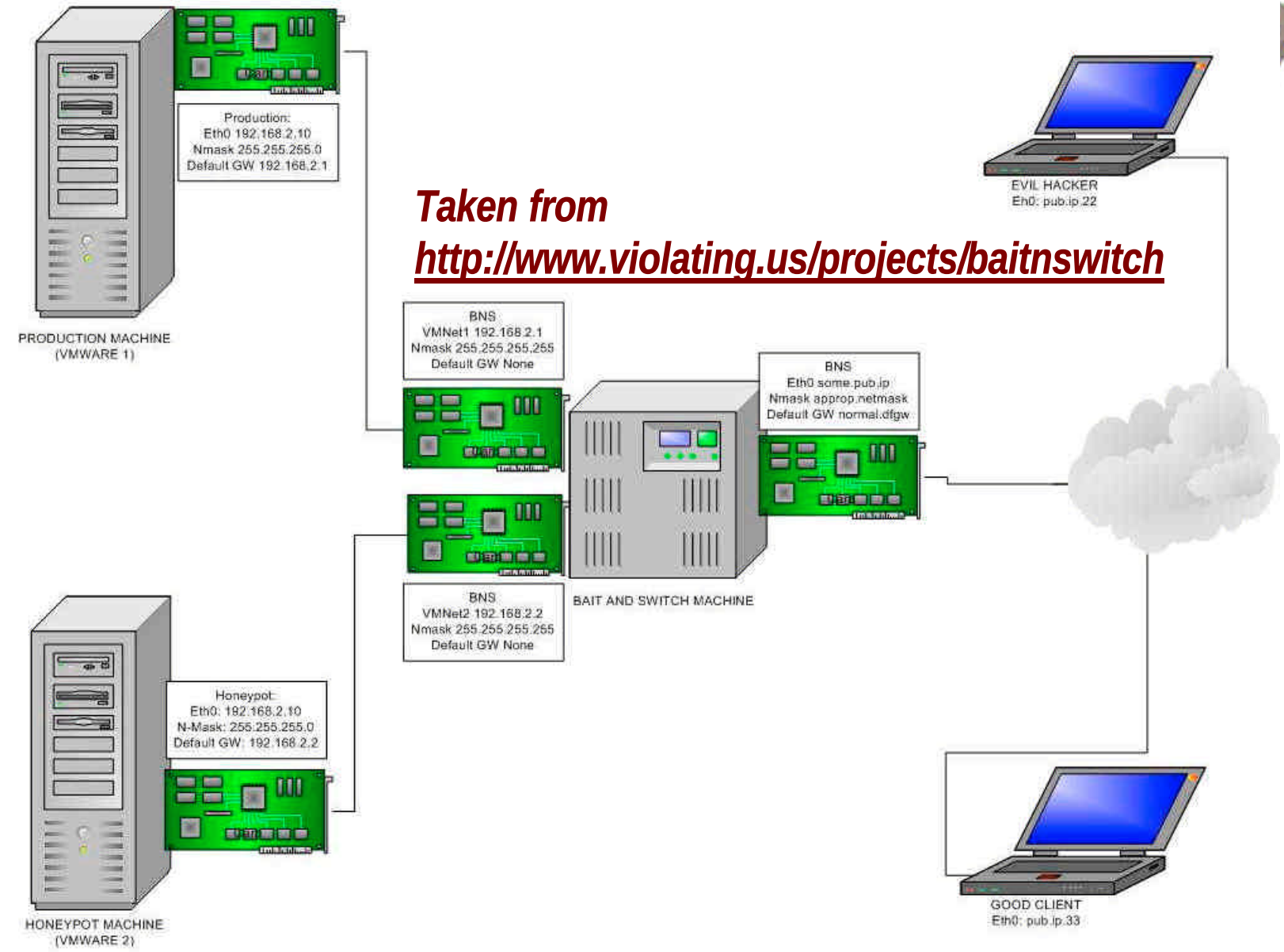
Prevention / Countermeasure

- « Intrusion Detection Systems + Firewall » ?
  - Why couldn't we prevent the attack when we detect the attack, in order to avoid problems ?
  - Easy to say ➔ new concept ?!
    - "*happy super market concept*" ? OR "*real technical concept*" ?
- Intrusion Prevention Systems
  - NIPS : Network IPS
    - Inline IDS
    - Bait and switch honeypots…
  - HIPS ?
    - Sanboxes (systrace…)...

Prevention + Deception

- Diverting evil traffic
- *"Building an Early Warning System in a Service Provider Network"*, BH Europe 2004, Nicolas Fischbach
- Bait and switch, « aggressive honeypot »
  - Easy GPL modification on snort : snort plugin output
  - Netfilter and routing under Linux2.4
  - When evil packets are caught by snort from a given IP source, this one is redirected to a fake network : **prevention** and **deception**
    - An attacker launch an attack to the production network
    - He is caught by the modified snort
    - All his future actions will be transparently redirected to a deception network (dedicated to blackhat people)

Bait & Switch example



Taken from
http://www.violating.us/projects/baitnswitch

Diversion limitations

- Excellent cool concept mixing firewalls, IDS and honeypots in a kind of prevention architecture
- Some limitations :
  - Yet another single point of failure (DOS)
  - Rulesets and evasions against the IDS (snort)
  - Denial of service with IP Spoofing of attacks claiming to come from friendly hosts (white list to maintain)
  - Fingerprinting a B&S network
    - TCP problems after the switching
    - TCP Timestamp changes…
    - Multiple IP Source for the attacks : deception detected

BlackHats versus Prevention

- Denial of service
  - *« IDS are too slow & easy to attack with states tables attacks, packet bombing...»*
  - More problems with IPS : detection AND prevention to do !
- Abusing the rulesets
  - *« easy to bypass ids with evasion, and 0-days exploits can't be caught »*
  - More problems with IPS : 0-prevention !
- Generating a denial of service
  - Spoofing an attack coming from (a) friendly host(s)
  - Solution: white list, but what if a friend is used to bounce to you ?
- What about distributed attacks ?
  - Multiple source of coordinated attackers

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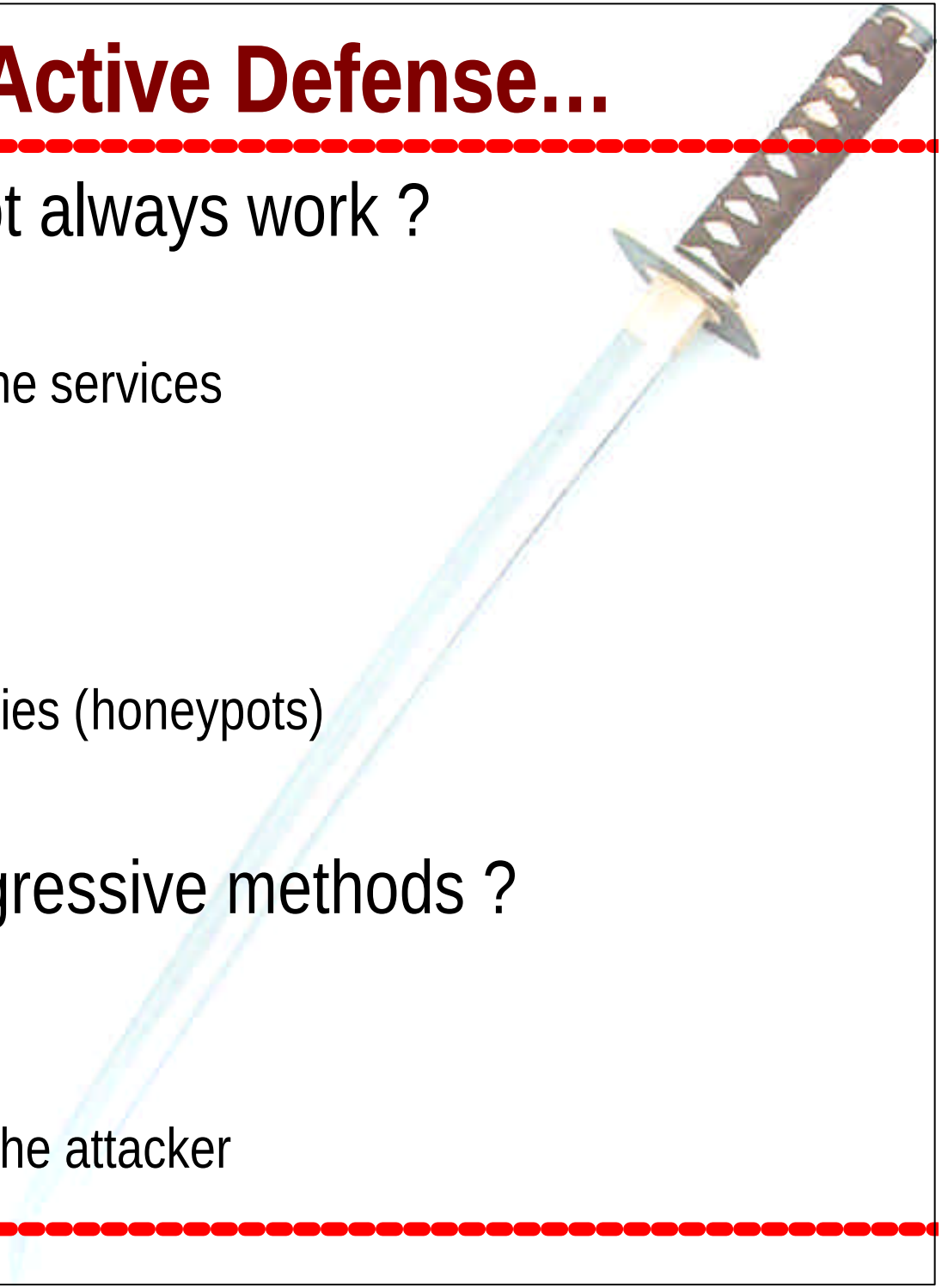
Active Defense...



- Usual methods would not always work ?
  - Block incoming traffic
    - Might be problem for online services
  - Apply rate limitation
    - Bandwidth adjusted
  - Divert the traffic
    - Bait and switch technologies (honeypots)
  - Fake responses (decoy)
- Should we use more aggressive methods ?
  - Self Defense
  - Counterstrike
    - Disable, destroy, control the attacker

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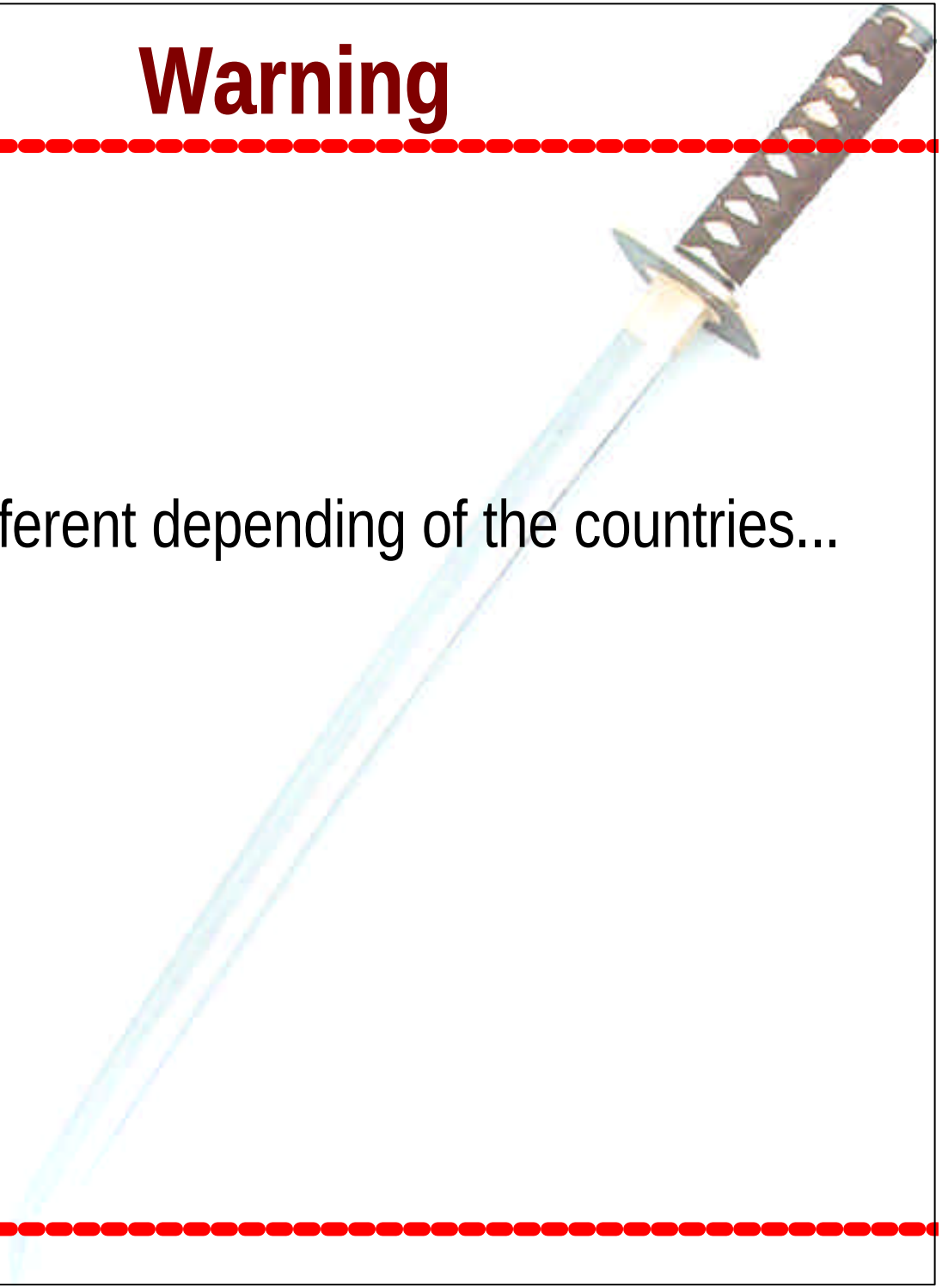
Warning



- Limitations
  - Not a legal expert
  - Legal issues might be different depending of the countries...

Legal Issues

- Toward a concept of *digital* active self defense ?
- Self defense occurs when someone is threatened with imminent bodily harm
  - Might be applied to avoid injury to property
- Requirements
  - Necessity: No choice but using force
    - No adequate alternatives
  - Proportionality: This force is reasonable
    - Proportional response to the harm avoided
  - The threat is unlawful

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Proportional response

- What could mean *proportional* ?
  - subjectivity
- Need to create a classification of attacks to chose the appropriate response
  - Families of attacks and hierarchy
    - DDOS > DOS ?
    - Remote shell > Scan ?
    - …
- Once it is done, you might be able to take a decision

No adequate alternatives

- Proving that you had no other choice ?
- Experts could argue that many other possibilities might be used :
  - First consideration : disconnect the victim(s) to avoid the attack ?
    - Self Defense doctrine does not require the victim to back away
    - Such a disconnection would result in a kind of denial of service on the victim
      - what about an e-business web server ?
  - Other possibilities : perimeter defenses ?

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No adequate alternatives

- How can we explain that the counterstrike tools were able to fight back the attacker and that they could not block the attack ?
  - So many solutions of security to avoid an attack
- Conclusion : might be difficult to prove that you had no other possibility

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Legal Issues and IW

- What about Information Warfare ?
  - Not officially recognized by The Hague and Geneva Conventions
  - No real example of act of war on the cyber battlefield
    - Individuals, groups, governments…
  - No real legal considerations

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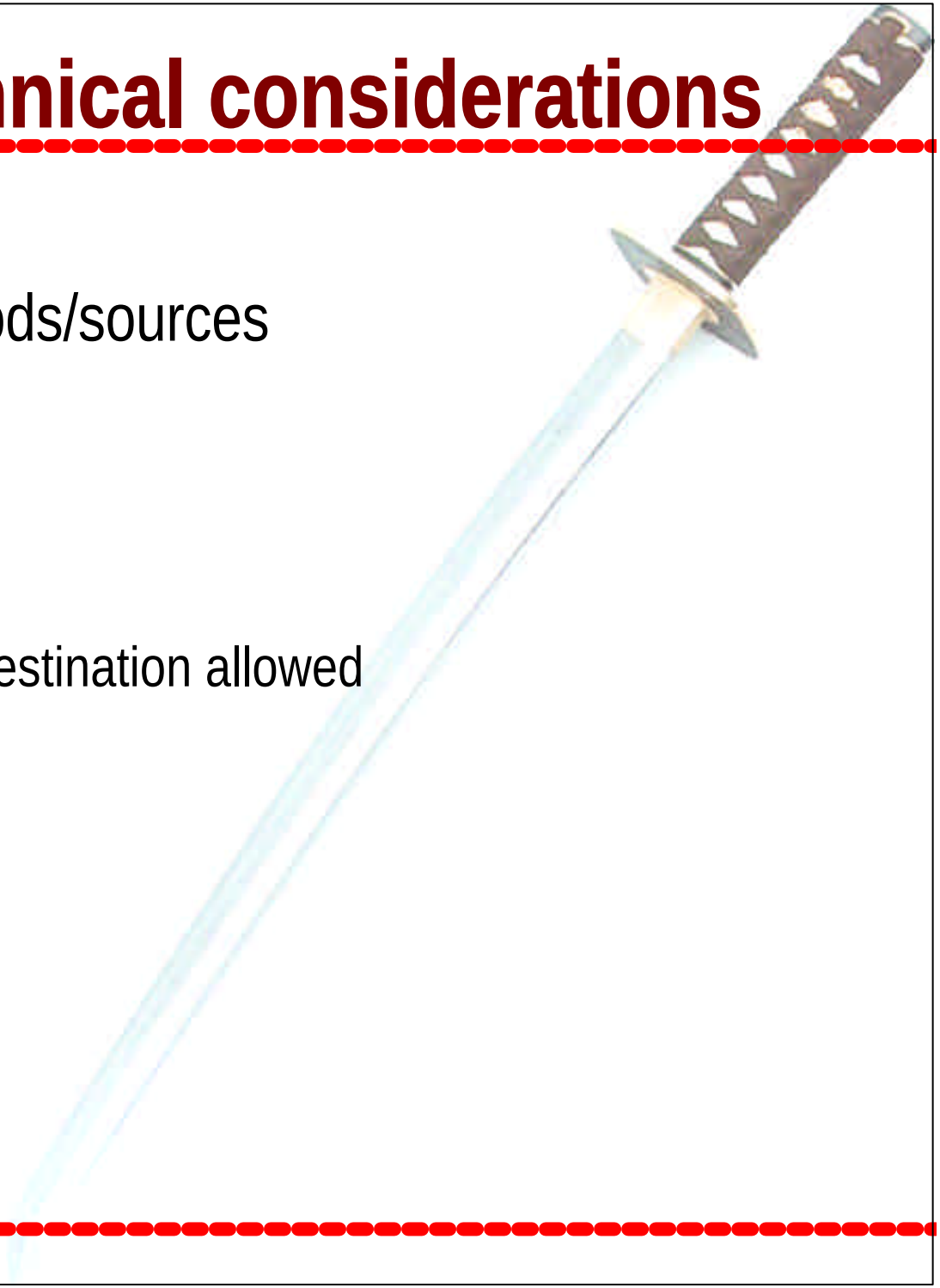
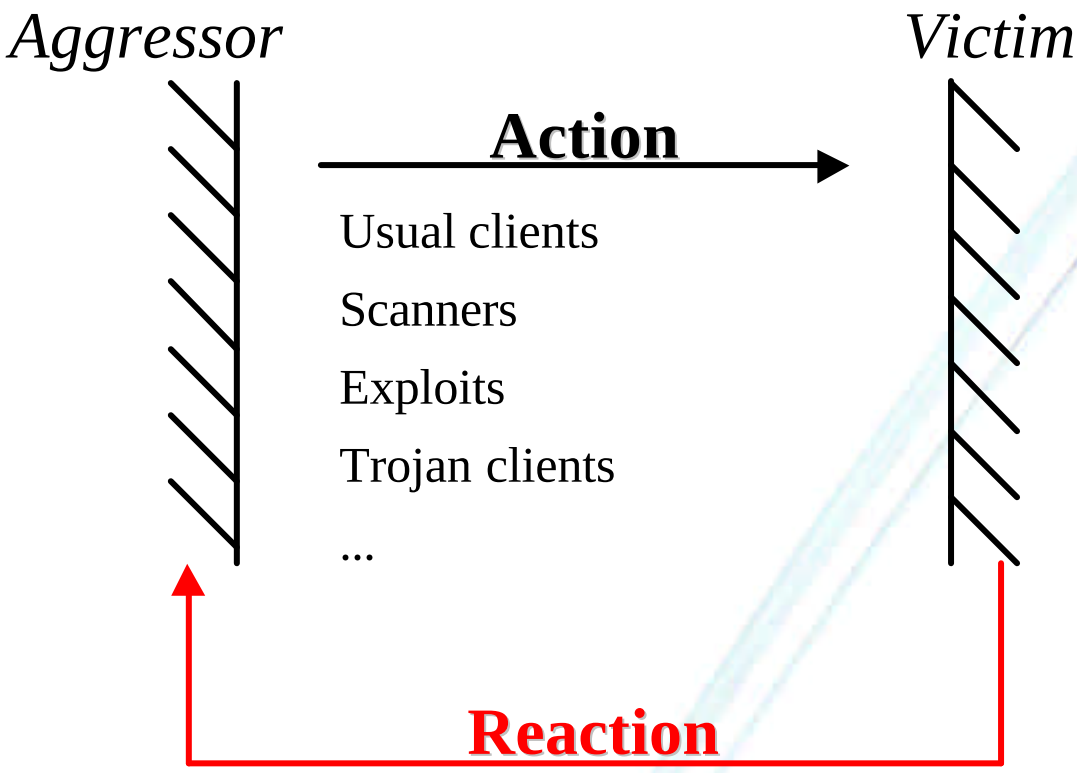
Technical considerations



- Striking back ?
  - Identify the tools/methods/sources
    - IDS…
    - Avoid spoofing…
  - Take a decision
    - White list / Black list : destination allowed
      - e.g. internal users
  - Strike back

Self Defense



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Fighting back usual clients

- Imagine what would happen if the aggressors used vulnerable or mis-configured clients ?
  - Web clients (IE…),
  - SSH clients (Putty, OpenSSH…),
  - Mail clients (Outlook…),
  - DNS resolvers,
  - IRC clients…
- Then a remote control/crash would be possible
  - Very interesting for Self Defense !

Fighting back usual clients ??

- This is a not a so easy task
  - Is it just theory ?
- Fighting back a listening client (mail client, etc) might be easier because you can try an attack multiple times (multiple mails...)
- Fighting back an incoming client may be a one shot operation (web client, etc) during a specific phase
- You will need specific information to launch such an attack : Operating System (p0f...), Version (“Banner”)...

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Exploiting Exploits ?

- Imagine what would occur if there were vulnerabilities in the code of an exploit ?
  - Buffer overflow, string format, etc
- Have you ever audit the source code of exploits ?
  - Not just talking about the payload
  - Script kiddies don't understand such sources
    - "When i launched dcom-xpl.c it did not work !?"
- Automatic tools used to launch remote attacks or audits are written properly
  - NASL for Nessus, Python for Core Impact...

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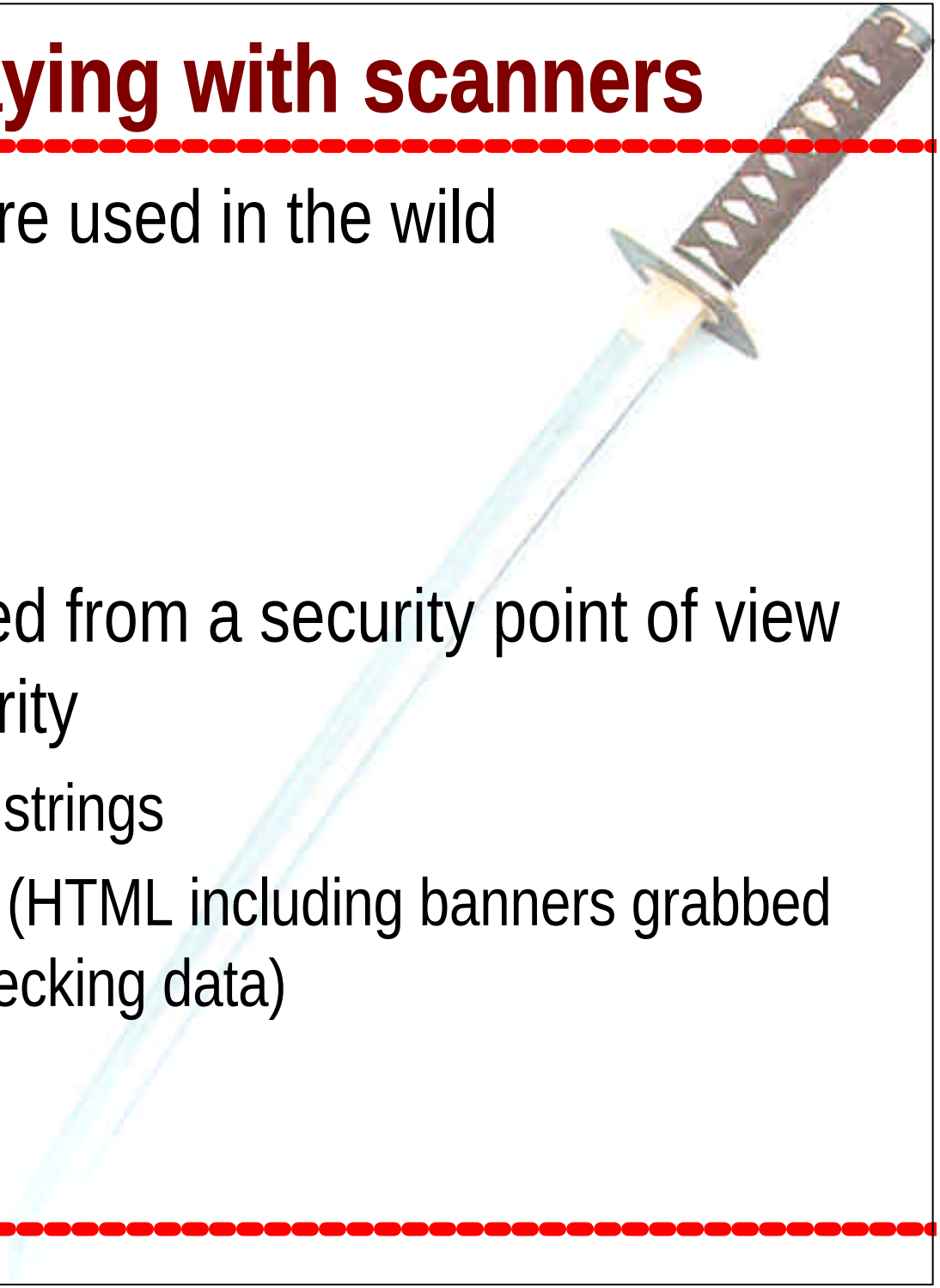
Playing with scanners

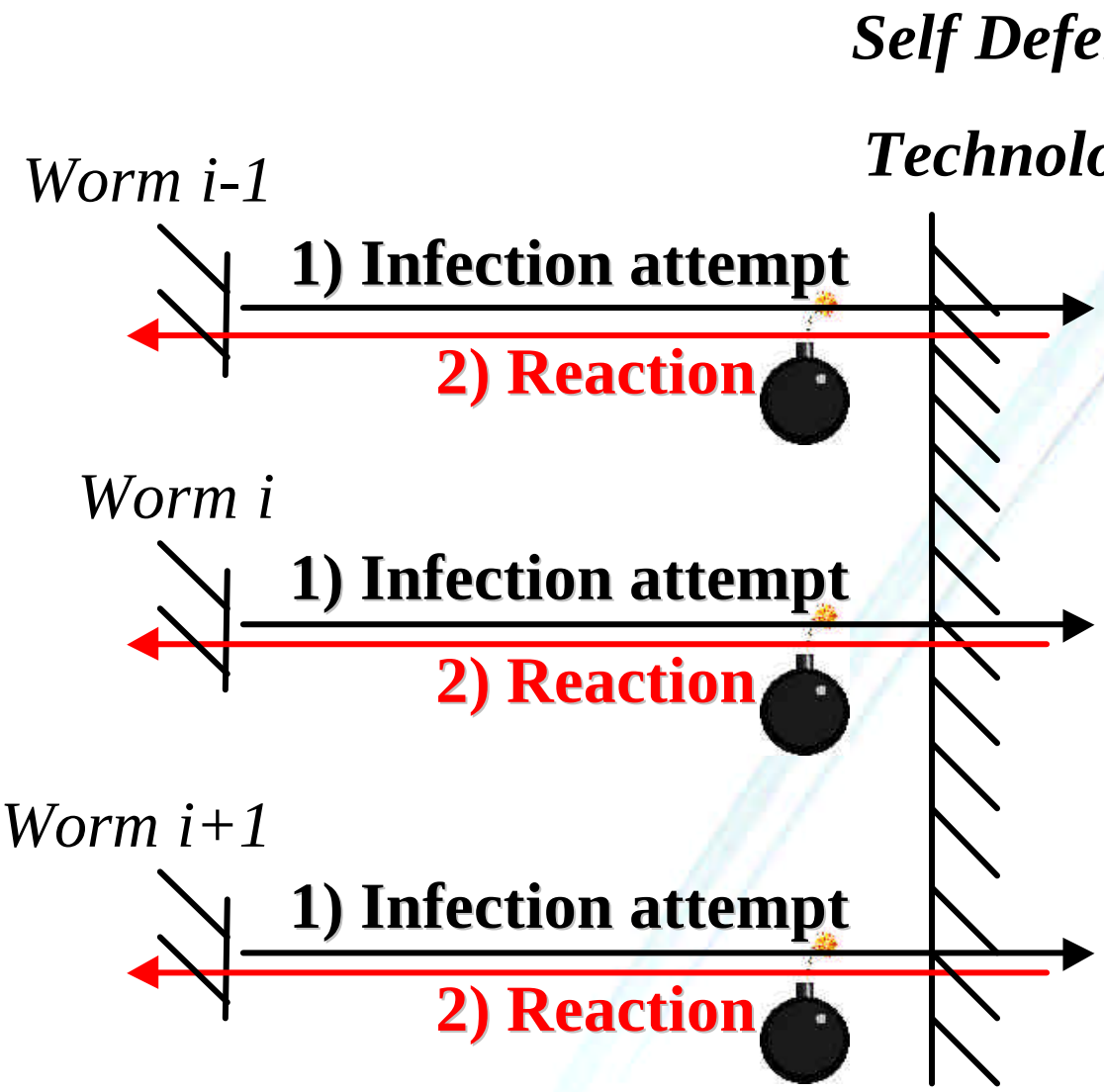


- Many kind of scanners are used in the wild
  - Network layers
  - Banners
  - Security tests
- Some are poorly designed from a security point of view and might lead to insecurity
  - Buffer overflows, Format strings
  - Reports badly generated (HTML including banners grabbed on the targets without checking data)

Clients of Trojan Horses

- How many times did you get an incoming probe for Trojan port toward your internal network ?
- Imagine if there were vulnerabilities in the code of a Trojan horse client ?
  - Then a counterattack would be possible !
- Moreover, it has been seen in the wild that some young blackhats use the same kind of backdoor on a chain of bounce
  - If you steal the password/method/tool on one host, you could probably try to climb the chain back to the real author of the cyber crime

Worms


Self Defense
Technology
Worm i-1
1) Infection attempt
2) Reaction
Worm i
1) Infection attempt
2) Reaction
Worm i+1
1) Infection attempt
2) Reaction

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Handling worms problems

- Theory : a worm W comes from host A to host H.
  - => A is infected by W (?)
  - => A is (was) vulnerable to the attack used by W
  - => A may still be vulnerable
  - => H attacks A through this vulnerability
  - => H takes the control of A,
  - => H cleans A, patches A, hardens A, etc
- Proof of concept with Honeyd versus MSBlast
  - SecurityFocus - Infocus, October 2003 : "Fighting Internet Worms With Honeypots"
    - http://www.securityfocus.com/infocus/1740
  - Black Hat Asia, December 2003
    - http://www.blackhat.com/presentations/bh-asia-03/bh-asia-03-oudot/slides/bh-asia-03-oudot.pdf

Honeyd versus MSBlast

Example : script to launch an automatic remote cleaning of infected hosts (!)

```
#!/bin/sh
# launch the exploit against the internal infected attacker
# then execute commands to purify the ugly victim

/usr/local/bin/evil_exploit_dcom -d $1 -t 1 -l 4445 << EOF

taskkill /f /im msblast.exe /t
del /f %SystemRoot%\System32\msblast.exe
echo Windows Registry Editor Version 5.00 > c:\cleaner_msblast.reg
echo [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run]
   >> c:\cleaner_msblast.reg
echo "windows auto update" = "REM msblast" >> c:\cleaner_msblast.reg
regedit /s c:\cleaner_msblast.reg
del /f c:\cleaner_msblast.reg
shutdown -r -f -t 0
exit

EOF
```

Others ideas

- B00mrang effect : proxy aggression back to aggressor
  - add template tcp port 80 proxy $ipsrc:80
- Audit the auditor
  - Try to get same kind of information on the aggressor (scan...)
- DOS/DDOS toward the client or its infrastructure
- ...

Real examples…

- Code Red II
  - Anti code red II « default.ida » script
    - Strike back that abuses the remote CRII
  - Attack occurs over a TCP session: might be the real source
  - Problem with attacks over simple UDP flows
    - e.g. MS SQL Server, UDP 1434, Litchfield related exploits
- Symbiot.com technologies
- …

Requirements

- Graduated response : level of reactions to strike back with a **proportional** response
  - A too aggressive posture could be dangerous
- Determination of hostile hosts (level of threats)
  - Behaviour, intrusion detection analysis, etc
  - Risk: false positive (huh! sorry)
- Profiling the attack
  - Probes, scanners, exploits, clients, malware, worms, Dos, etc
  - Choose the appropriate strike back possibility
  - Real life example: DEFense CONdition
    - DEFCON 5 Normal peacetime readiness
    - DEFCON 4 Normal, increased intelligence and strengthened security measures
    - DEFCON 3 Increase in force readiness above normal readiness
    - DEFCON 2 Further Increase in force readiness, less than maximum readiness
    - DEFCON 1 Maximum force readiness.

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Specific opportunities

- Though lawyers could argue that Self Defense is a very dangerous response to a digital threat, one can think about :
  - Honeypots
  - Internal Threats

Honeypots

- *« A honeypot is a security resource whose values lies in being probed, attacked or compromised »*
  - This is a non production system
    - Used to delude attackers
  - Incoming traffic is suspicious (should avoid false positive)
  - That implies that the decision of launching a counterstrike is probably easier
- Honeypots are really interesting technologies for aggressive defense purpose
  - Incoming traffic might be suspicious and should be considered as an aggression
  - Being “evil” with an aggressor might look like self defense

Internal Computers

- Official remote administrator access might be possible on internal computers/devices
  - On a final destination (potential attacker)
  - Near potential attackers
    - Network devices at one or two hops...
- Counterstrike might be used inside your own network in order to protect it
  - Might be an easy and clean method (no exploits, etc)
    - Stop processes, add firewalling rules, reboot/halt, modify files, patch…
    - Might be very useful to avoid fast propagation of worms...

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Handling internal threats

- Local Area Network
- Striking back your own computers
  - Those computers are under your legal control
  - If you have the right to pentest them, why could'nt you strike back in their direction ?
- Very useful to find evil end users
  - Corporate hackers, zealot end-users...
- Potential risk: spoofing is easier on a LAN
  - Layer 2 attacks, etc

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Technical limitations

- Counterstrike technologies might not exist for some kind of threats
  - Need remote exploits for each worms, evil tools, etc [!]
- False positive
- Spoofing
- Collateral damage

Conclusions

- Technology
  - Really interesting
  - Feeling of doing something right
  - New possibilities to explore in order to protect an infrastructure
- Organization
  - Counterstrike might be used to target internal computers/devices
  - Add In-Depth Security capabilities (kind of advanced intrusion prevention system)
  - Information Warfare battlefield
- Blackhats
  - Yet another way to attack (attackers ?!)
  - e.g. Evil Honeypots

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- Questions ?

- *Greetz : Dragos Ruiu, Dave Dittrich, Jennifer Granick, Barbara Moran, Nicolas Fischbach, Philippe Biondi*