Wireless Network Security
Spring 2016

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Class #17 – Statistical Attack Detection

Reminders

- HW#4 is due Thursday, **Mar 24**
- **No class, Mar 29**
- Progress presentations Thursday, **Mar 31**
- Exam Tuesday, **Apr 5**

Progress Presentation

- Important updates since SoW presentation
  - Any changes to project scope, planned deliverables, schedule of deliverables, etc.
  - Brief overview of what has been done so far
  - Preliminary results, possibly a quick demo
  - Every team member should present
  - MAX 12 minutes

Class #17

- Challenges in attack/intrusion detection

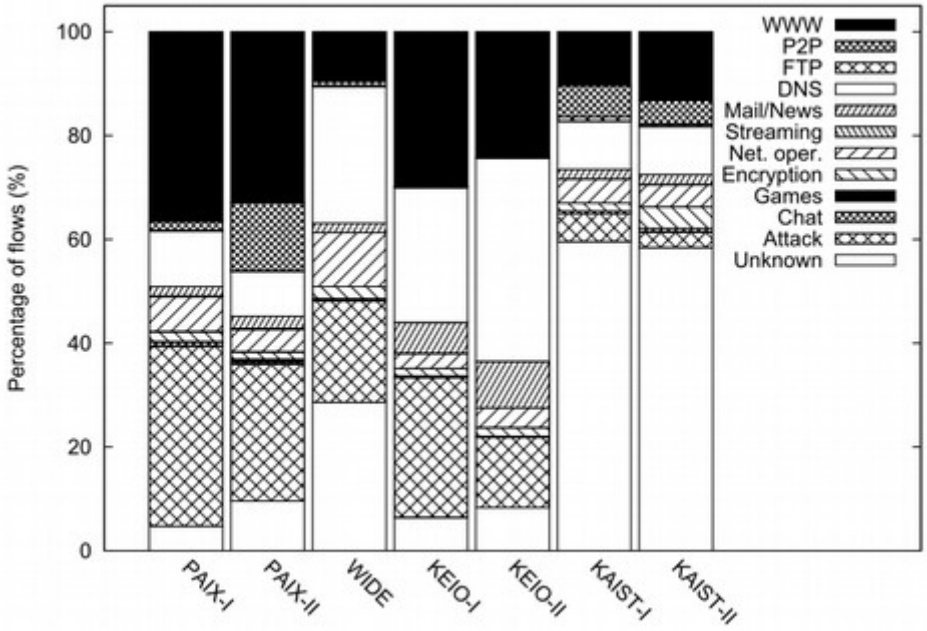
- Trade-offs between detection, security, privacy, performance, etc.

Attack/Intrusion Detection

- Most work on network attack/intrusion detection has focused on the Internet

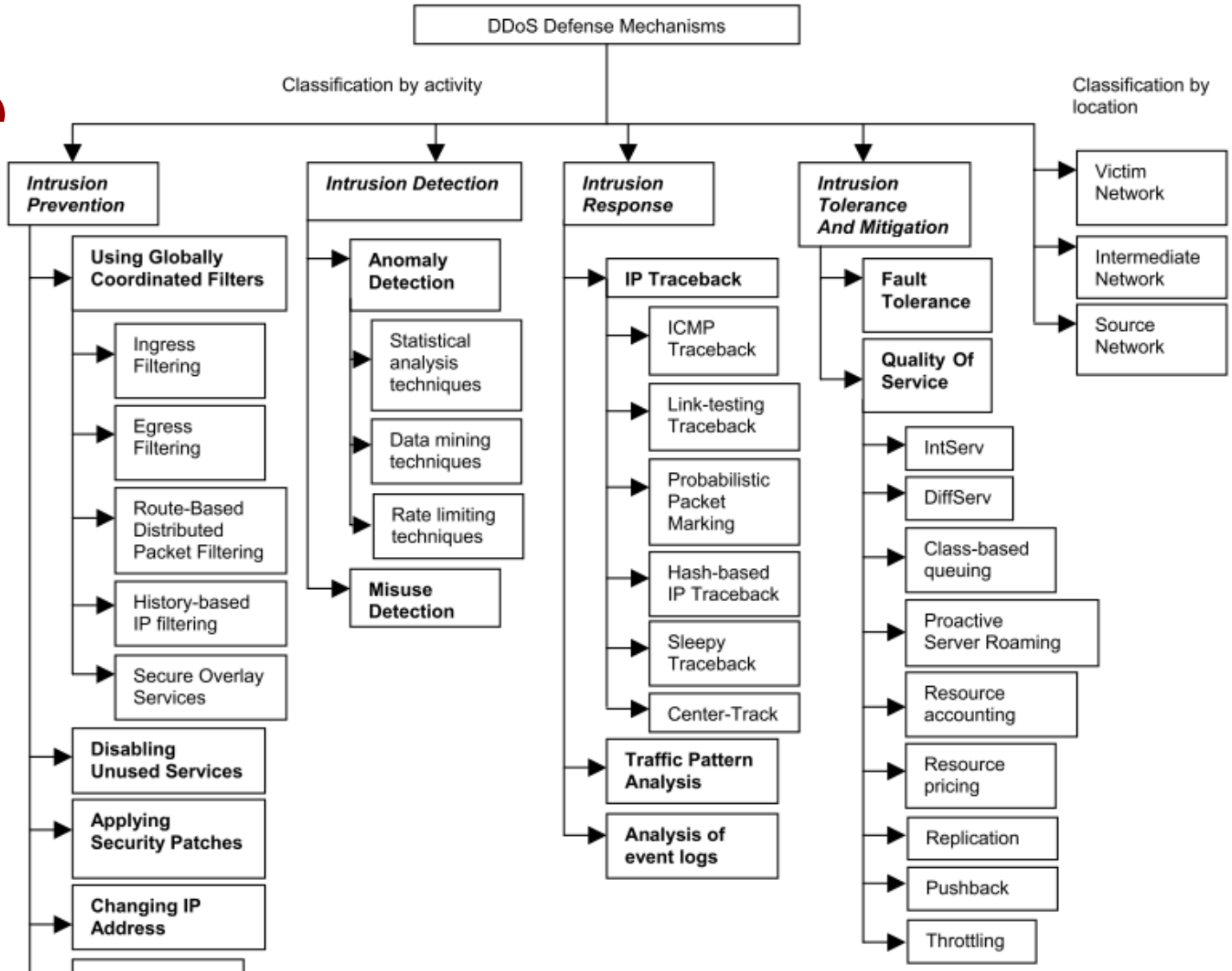
Table 2: Application categori

Category	Application/protocol
web	http, https
p2p	FastTrack, eDonkey, BitTorrent, Ares Gnutella, WinMX, OpenNap, MP2P SoulSeek, Direct Connect, GoBoogy Soribada, PeerEnabler
ftp	ftp
dns	dns
mail/news	smtp, pop, imap, identd, nntp
streaming	mms(wmp), real, quicktime, shoutcast vbrick streaming, logitech Video IM
network operation	netbios, smb, snmp, ntp, spamassassin GoToMyPc
encryption	ssh, ssl
games	Quake, HalfLife, Age of Empires, Battle fi eld Vietnam
chat	AIM, IRC, MSN Messenger, Yahoo messenger
attack	address scans, port scans
unknown	-



From [Kim et al., CoNEXT 2008]

Defense



From [Douligeris & Mitrokotsa, Computer Networks 2004]

Challenges

- Many Internet-type models and defenses don't translate to wireless networks, even those that are part of the Internet
  - Attacks on WiFi APs don't look like attacks on an Internet router or wired gateway
  - Attacks launched from mobile devices over LTE may look similar once traffic is on the Internet, but look different in the LTE network itself

Challenges

- Mobility breaks many of the assumptions of traditional detection/defense systems
  - Paths change much more quickly, preventing network-layer fingerprinting of sessions and complicating traffic analysis
  - However, mobility may provide additional information, if the detector is smart enough to look for it
    - Ex: if the detector is in the LTE core, it doesn't know much about device mobility, while if little detectors are in the base stations, mobility info may be available

Challenges

- Where are the detectors?
  - In many of the traditional Internet-based detection / defense models, networks are nicely partitioned using gateways, firewalls, etc. with a domain-based detector behind each one
  - What about a MANET / WSN?
    - Where should the detector go? How much visibility does it need?
    - What should it monitor?

Challenges

- Security measures at various layers may actually prevent or interfere with attack detection
  - Goals of data secrecy, network privacy, anonymity, etc. are in direct conflict with certain attack detection techniques
  - Ex: many corporations are struggling with wide adoption of TLS/SSL/HTTPS because it breaks their packet inspection-based models for attack detection
  - Ex: if anti-traffic-analysis techniques make all traffic look the same, how to differentiate normal and attack traffic?

Common Approaches

- Attack detection must be context-appropriate
  - Ex: in a sensor network, there's much less variance expected in network traffic, so anomaly detection may be easier, possibly making tradeoffs more reasonable

- Attack detection may require collaboration
  - Dependencies between layers mean detection is not a layered activity, may need monitoring across various layers of the protocol stack and various locations in the network

Open Questions

- Due to wide variety of network types and need for context-appropriate detection mechanisms, this is a hard problem.
  - What specific detection mechanisms are needed for specific network / application scenarios?
  - How much can detection mechanisms be generalized?
  - Can detection schema be learned / trained in situ?
  - …

Let's look at an example as an exercise

Example

- Consider a large-scale Wi-Fi network with dense deployment of monitors (watchdogs)
- Attack: [each malicious client, while moving around randomly]
  1) spoof a valid identity
  2) connect to a nearby AP
  3) flood SYN packets targeting a particular web server for a random duration
  4) stop flooding, disconnect, wait small random duration, go to 1).
- What useful statistics can the monitors collect?
- What useful analytics can be computed?

Mar 24:
Location Service Security