Automating reasoning with ATT&CK?

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Document Markings

Introduction

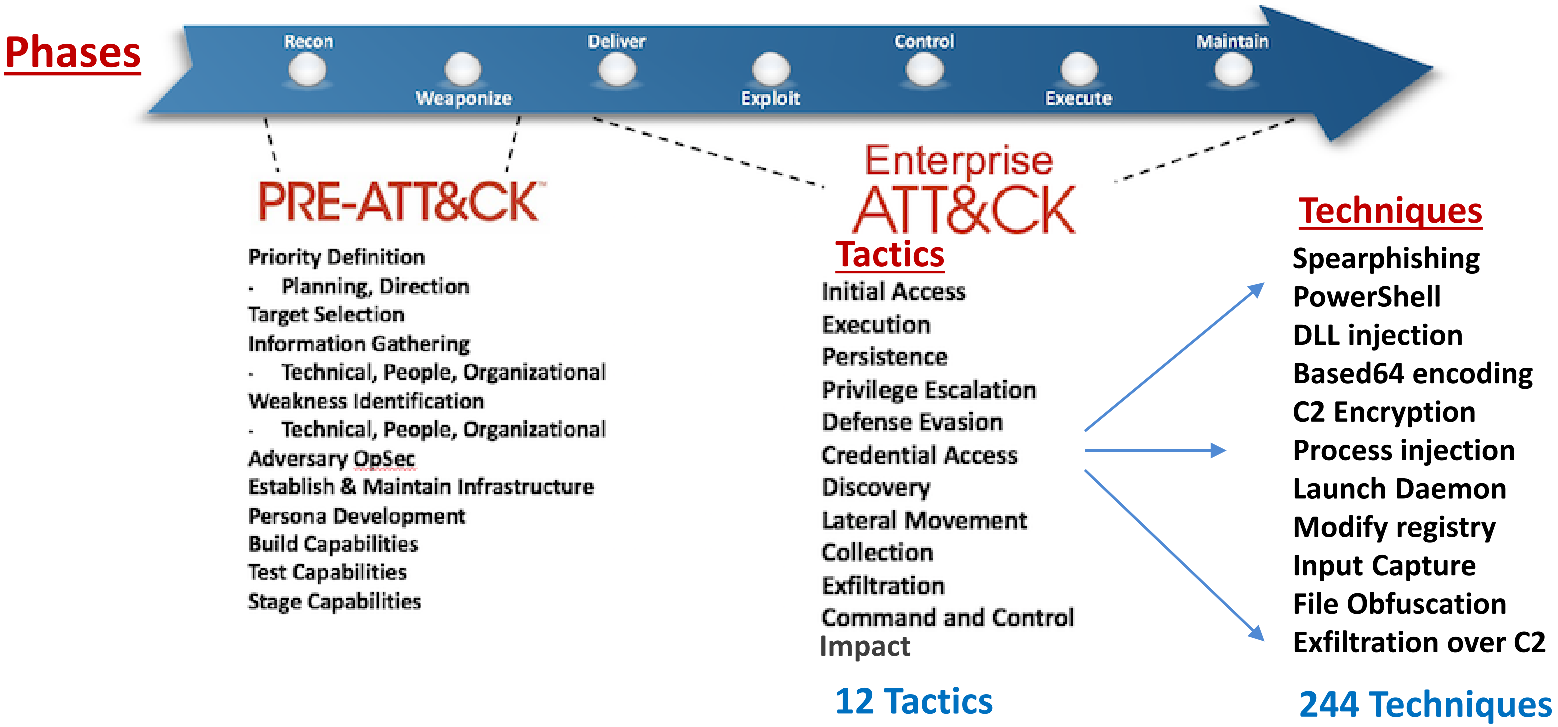
MITRE ATT&CK is made up of **TTPs** (Tactics, Techniques, Procedures)

- Tactics are general goals (e.g., initial access, exfiltration)
- Techniques are descriptions of adversarial actions that achieve tactical goals (e.g., Spearphishing Attachment, Modify Registry, Input Capture)
- The community is interested in using ATT&CK for detection, prediction, forensics, and threat hunting because it provides behavioral observables for detecting attacks

Our goal:

- Characterize ATT&CK's structure and usefulness for automated detection, etc., by analyzing their APT dataset

TTPs in MITRE ATT&CK Framework



Phases

PRE-ATT&CK™

Priority Definition
- Planning, Direction

Target Selection
Information Gathering
- Technical, People, Organizational

Weakness Identification
- Technical, People, Organizational

Adversary OpSec
Establish & Maintain Infrastructure
Persona Development
Build Capabilities
Test Capabilities
Stage Capabilities

Enterprise ATT&CK

Tactics

Initial Access
Execution
Persistence
Privilege Escalation
Defense Evasion
Credential Access
Discovery
Lateral Movement
Collection
Exfiltration
Command and Control
Impact

12 Tactics

Techniques

Spearphishing
PowerShell
DLL injection
Based64 encoding
C2 Encryption
Process injection
Launch Daemon
Modify registry
Input Capture
File Obfuscation
Exfiltration over C2

244 Techniques

Challenges for automated reasoning

MITRE ATT&CK TTPs are not *correlated* at the technique level

MITRE ATT&CK techniques are not *ordered temporally*

- A kill-chain ordered set of techniques would be, for example:

1. Account Discovery
2. [weaponization]
3. Spearphishing Attachment
4. User Execution
5. Bypass User Account Control
6. Automated Collection, Data Compressed
7. Exfiltration over C2 Channel

What do you mean uncorrelated?

Searched for meaningful correlations among techniques using:

- Partitioned Clustering
  - Finding the optimal K clusters
  - K means clustering
  - PAM clustering
  - Fuzzy Analysis clustering
  - Cluster Validation

(Paper on this due out soon)

- Hierarchical Clustering
  - Finding the optimal K clusters
  - Agglomerative clustering
  - Divisive clustering

Only the Agglomerative clustering produces some results

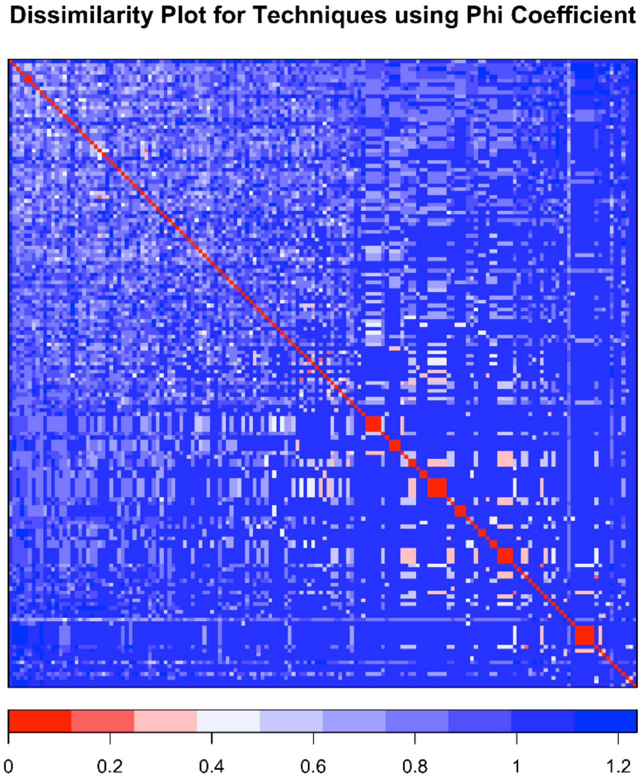
For intuition behind this result, consider clustering coefficient of APT data set

Hopkins Statistic: assess the clustering tendency of a dataset by measuring the probability that a given dataset is generated by a uniform distribution – tests the spatial randomness of the data

Interpretability:

- **H = 0.5**: The data set contains no meaningful clusters
- **H ≅ 1**: The data set contains meaningful clusters
- **H ≅ 0**: The data set is regularly spaced (neither clustered nor random)

Using Phi Coefficient : **H = 0.6**



Attacks and Campaigns

ATT&CK merges the concept of attack with that of campaign

This is true even though it uses the kill chain as a semi-organizational concept

In the kill chain, an attack is a single exploitation attempt

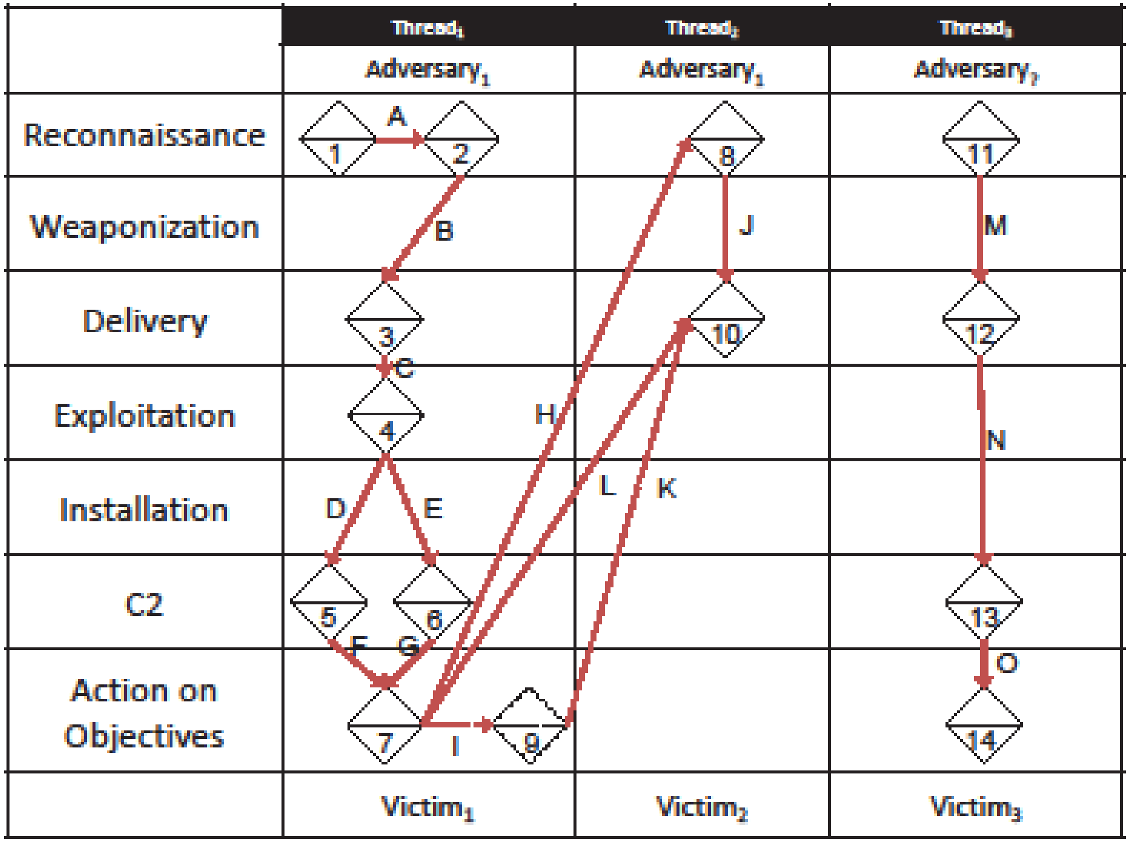
Campaigns are a series of planned or interrelated attacks

The kill chain and diamond model are not perfect, but they are useful mental models to organize general knowledge in security

- See Spring JM, Illari P. Building general knowledge of mechanisms in information security. Philosophy & Technology. 2018 Sep 17:1-33.

Diamond model and Campaigns

The diamond model for campaigns includes some things that ATT&CK does not



Sergio Caltagirone, Andrew Pendergast, Christopher Betz. The Diamond Model of Intrusion Analysis. 2014

Does it matter that ATT&CK is missing this temporal structure?

For automated reasoning, yes.

- (It would matter for other things, like real-time analysis, too)

At least, if you want to understand the relationship between MITRE’s APT data sets and the techniques they use, temporal kill-chain structure helps

Sequential Pattern Mining

Sequential pattern mining looks for technique rules based on which techniques often showed a related temporal order

Sequential Pattern Discovery using Equivalence Classes:

1. Find the most frequent single length sequence
2. Observe the two-type temporal sequences (A occurs before B) and two-element item groupings (A and B appear together)
3. Based on the most frequent length-two outputs, find three-element sequences and three element item groupings
4. Continues until no longer finds frequent outputs

<u>Confidence</u>: likelihood that the sequence rule A → B occurs among transactions containing item set A, where item set A is before B

- Extracted **19** technique rules with confidence of 0.5 or higher

* Beware base rate issues

Why should we care about related techniques?

To automate reasoning in incident analysis, it would help to know what adversary actions are most likely to look for, given what the analyst has seen already

ATT&CK could provide this, we’re working on how to suggest such temporal structure (basically reintegrate the diamond model / kill chain)

If we had it clear and formalized, we could use it in formal, automated reasoning

- See Spring JM, Pym D. Towards Scientific Incident Response. International Conference on Decision and Game Theory for Security 2018 Oct 29 (pp. 398-417). Springer.

Automated reasoning with ATT&CK?

Not yet

Spring and Pym (2018) proposes a system for automated incident analysis, but to make it work it needs a corpus of what is likely given what has been seen

- ATT&CK is an obvious place to looks for this
- Therefore we could make progress on automating incident and campaign analysis with some careful improvements

The target for automation is probably improving automated evidence collection and data discovery in a SIEM, so that an analyst can review **incidents**, and not *alerts*

One other barrier to automated reasoning with ATT&CK

Some techniques are subsets of others. For example:

- Scripting
- Powershell
- Bash scripting

There do not seem to be guidelines on when an analyst tags an intrusion with the more general or more specific option

The unified cyberspace ontology (UCO) tries to be a bit more rigorous about these relationships, but it does not have the same level of input from practitioners

Summary

The case studies captured in ATT&CK are valuable information for incident analysis

The ATT&CK structure is not currently amenable to automated reasoning

Two most important things to make it so:

- Restore the temporal relationships between the techniques (as in the Diamond Model)
- Make hierarchy or subset relationships between techniques explicit

Thanks! Questions?

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