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Mapping Cyber Threat Intelligence to Probabilistic Attack Graphs

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KTH VETENSKAP OCH KONST

RICS

SOCCRATES

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Agenda

Introduction

About the project

Method

Design & Implementation

Results

& Discussions

Conclusion

What's next?

Introduction

- Problem:
  - Growing Threats, limited resources
- Related Solutions:
  - ADGs (Attack-defense graphs)
  - CTI being made more accessible (E.g. by ACT)
  - Limited work on connection between ADGs/CTI
  - No work takes real time CTI information to create an attacker profile to enhance ADGs

- Question: *How can Cyber Threat Intelligence be used to enrich probabilistic attack graphs in real time, so that they represent a specific Threat Actor's common attack vectors?*
- Assess ICT systems' security:
  - W.r.t Specific Threat Actors - CTI
  - Visual Presentation – ADG
  - Proactive measures
    - Response & Actions

EU H2020

Background
Concepts

CTI

MITRE | ATT&CK®

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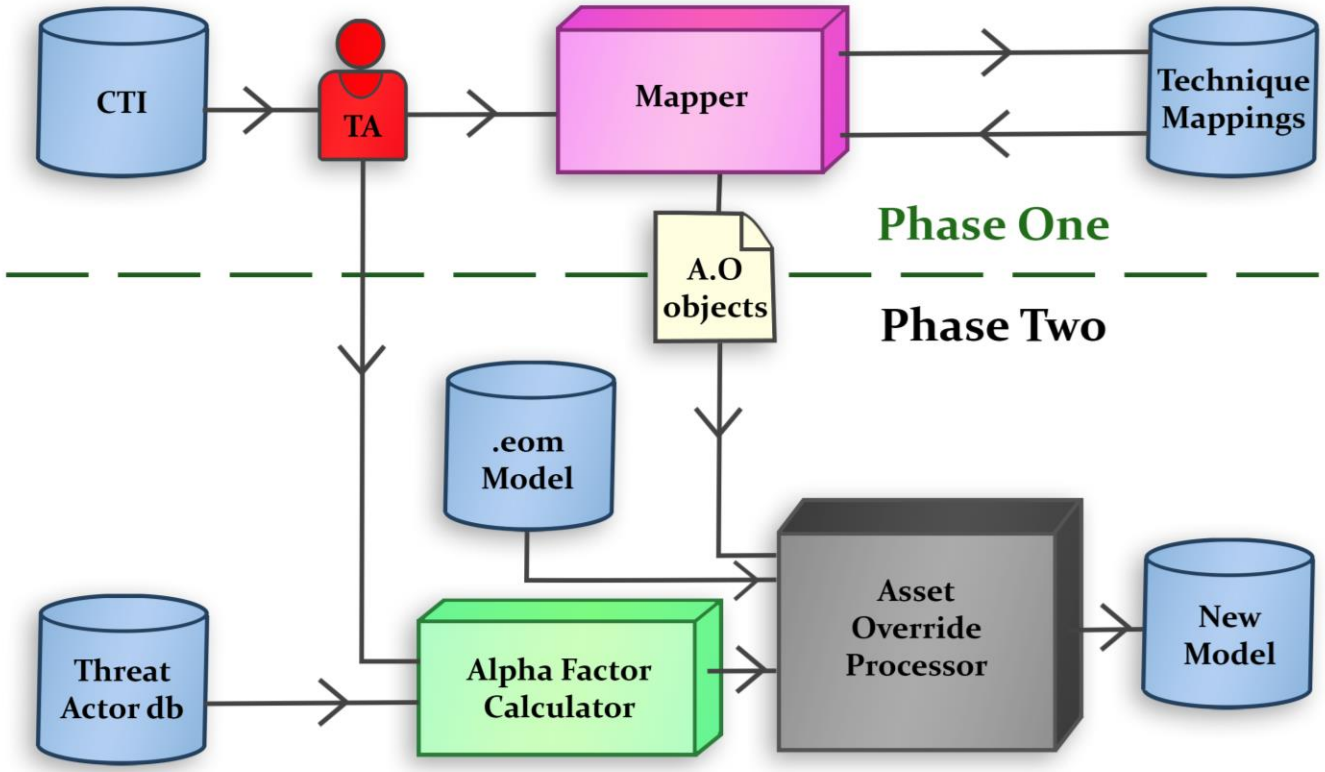
Design



- Threat Actor (TA)
- Scope of TA's abilities
- Overall Skill
- Model

Mapping Procedure

Technique

1. Identify Assets
2. Identifying Attack Steps
3. Isolation
4. Platform Specific
5. Defenses

DEP	ASLR	TTC
0	0	exponential(default*α)
1	0	exponential(default*α)
0	1	exponential(default*α)
1	1	exponential(default*α)

6. Scaling

securiLang

```
<Asset>: {
    "Tag": {
      "Type": [<Platform>, <Platform>, ...],
      "connectedTo": [                                  Optional
        <Type>,
        ...
      ]
    }
    AttackSteps: {
      <attackStep> : {
        <Distribution> : {
          <parameters>
        },"Defenses": {
          <Defense>: 0/1/<probability>,
          ...
        },"Alpha" : {
          "Affects" : true/false
        },"Epsilon": {                                  Optional
            "Action" : <Operator>
            "Value":  <Numerical>
        }
      }, ...
    }
}
```

Techniques Mapping

Initial Access	Execution	Defence Evasion	Credential Access	Lateral Movement
Drive-by Compromise	Command-Line Interface	Indicator Removal on Host	Input Capture	Remote File Copy
		File Deletion		
		Modify Registry		
		Software Packing		

securiLang

Alpha Factor – Overall Skill

Sophistication Properties

Code/Tools Developed	Copied	0
	Modified	1
	In-house	2
If In-house development: Actively maintained code	False	0
	True	1
Uses complex Components	False	0
	True	1
Familiar with Victims	False	0
	True	1
Heavy Reconnaissance Effort	False	0
	True	1
Familiar with Victim's Systems	False	0
	True	1
Consistent Operator Practices	False	0
	True	1
Operational Tempo	Low	0
	Medium	1
	High	2
Resource Level	Individual, Club, Contest	0
	Team	1
	Organization	2
	Government	3
Zero Day Capable	False	0
	True	0

$$\delta = \sum(\text{Sophistication Properties})$$

$$\alpha = alpha(\delta) = \begin{cases} 0.9, & \text{if } 6 \leq \delta < 7 \\ 0.8, & \text{if } 7 \leq \delta < 9 \\ 0.7, & \text{if } 9 \leq \delta < 11 \\ 0.6, & \text{if } 11 \leq \delta < 13 \\ 0.5, & \text{if } 13 \leq \delta \\ 1.0, & \text{otherwise} \end{cases}$$

$\alpha = 0.5$

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Model

- Smart grid use cases
- Describes a real world scenario
  - connected systems and suppliers
- Manual Tagging in securiCAD
  - WebBrowsers / WebServers
  - Linux / macOS / Windows

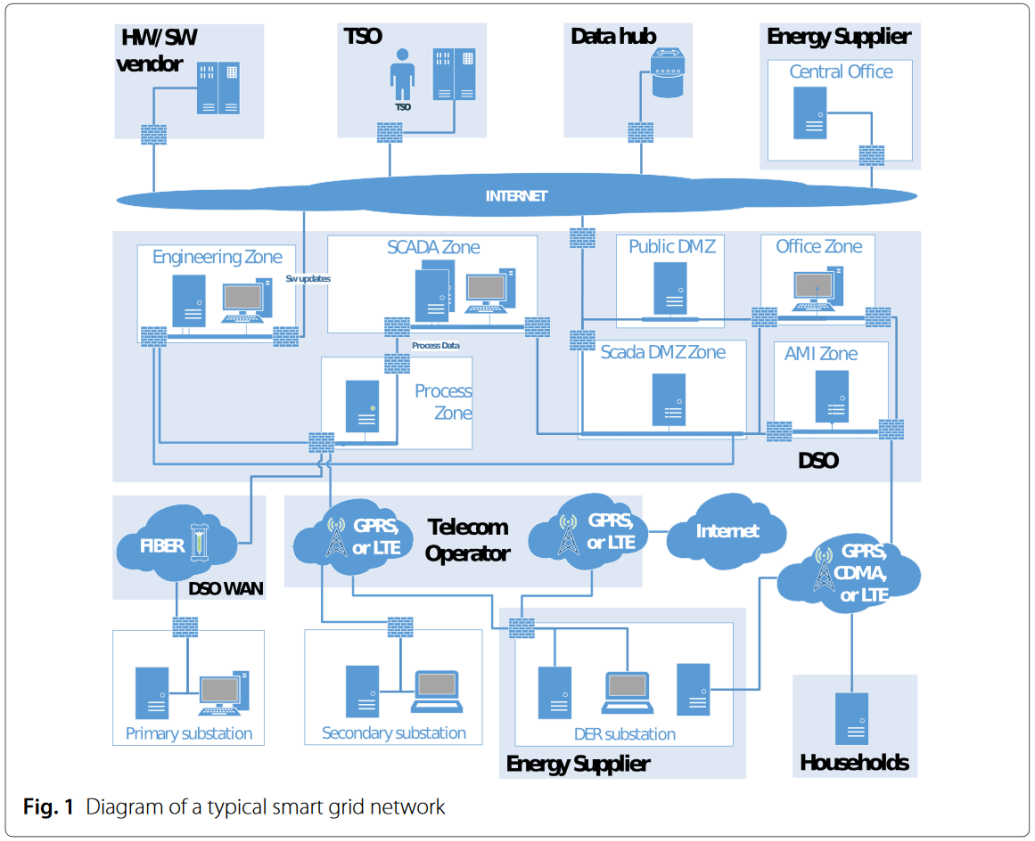
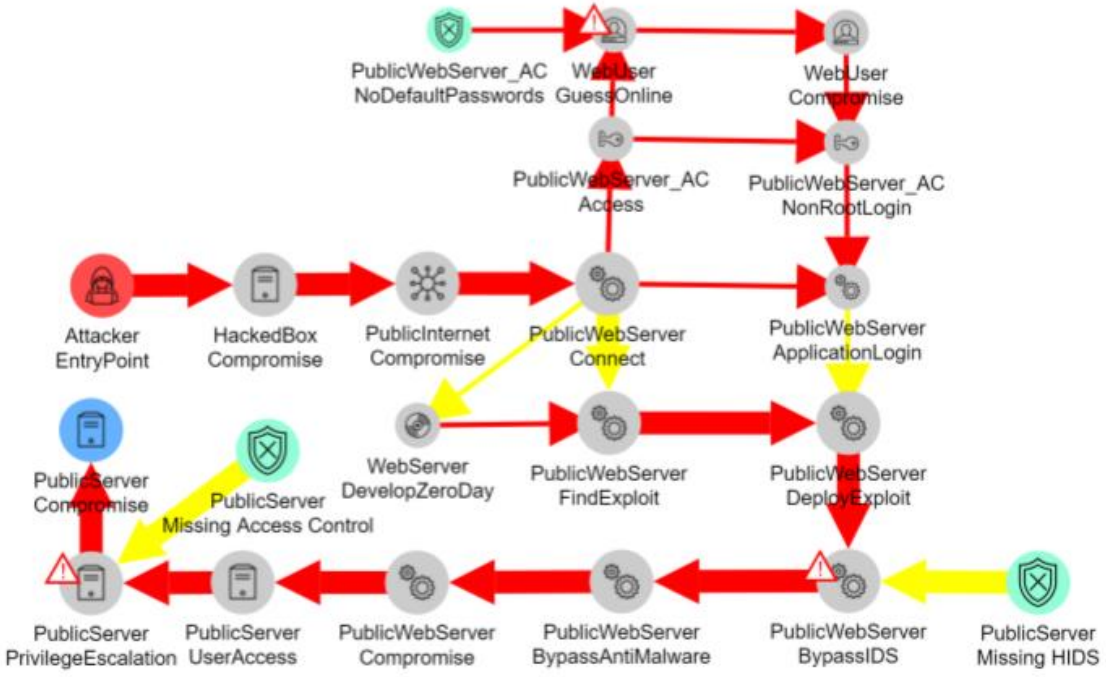
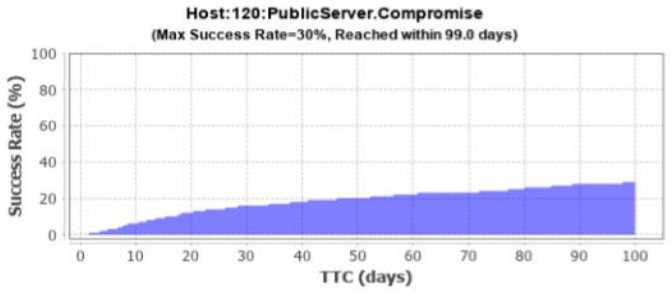


Fig. 1 Diagram of a typical smart grid network

Source: https://community.securicad.com/scada-reference-architecture/

Standard Pentester



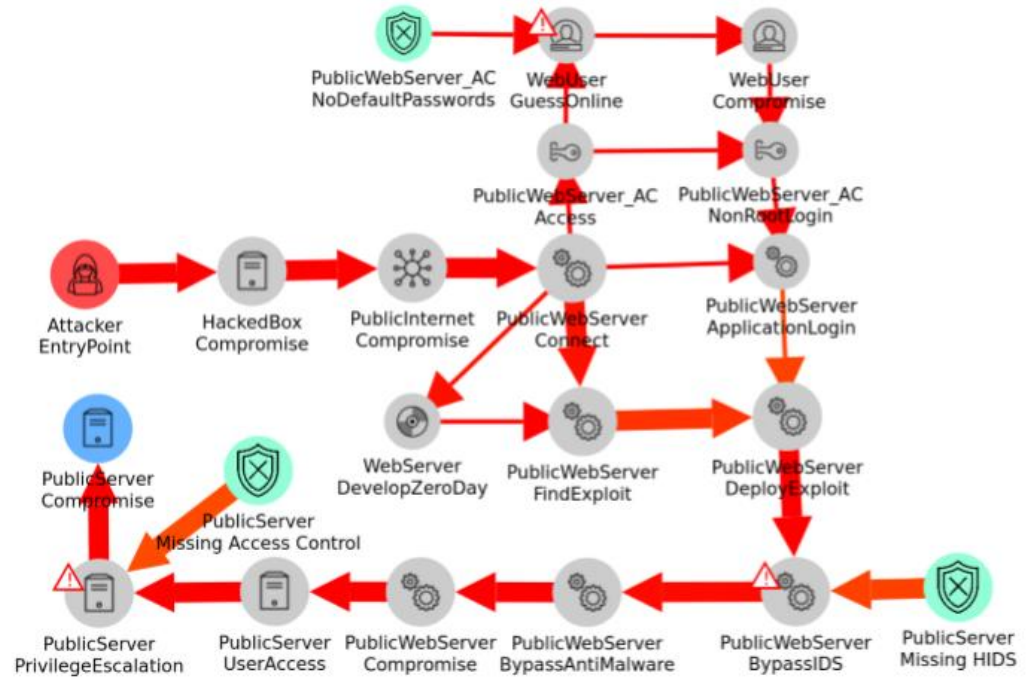


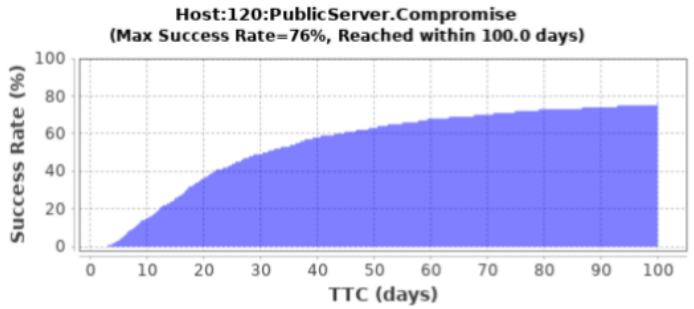
TTC (Days)	Success Rate (%)
10	7
20	13
50	21

Success Rate (%)	TTC (Days)
5	8
50	100
95	100

Figure 5.3: Standard TTC for Compromising a Public WebServer

APT38 Attacker Profile

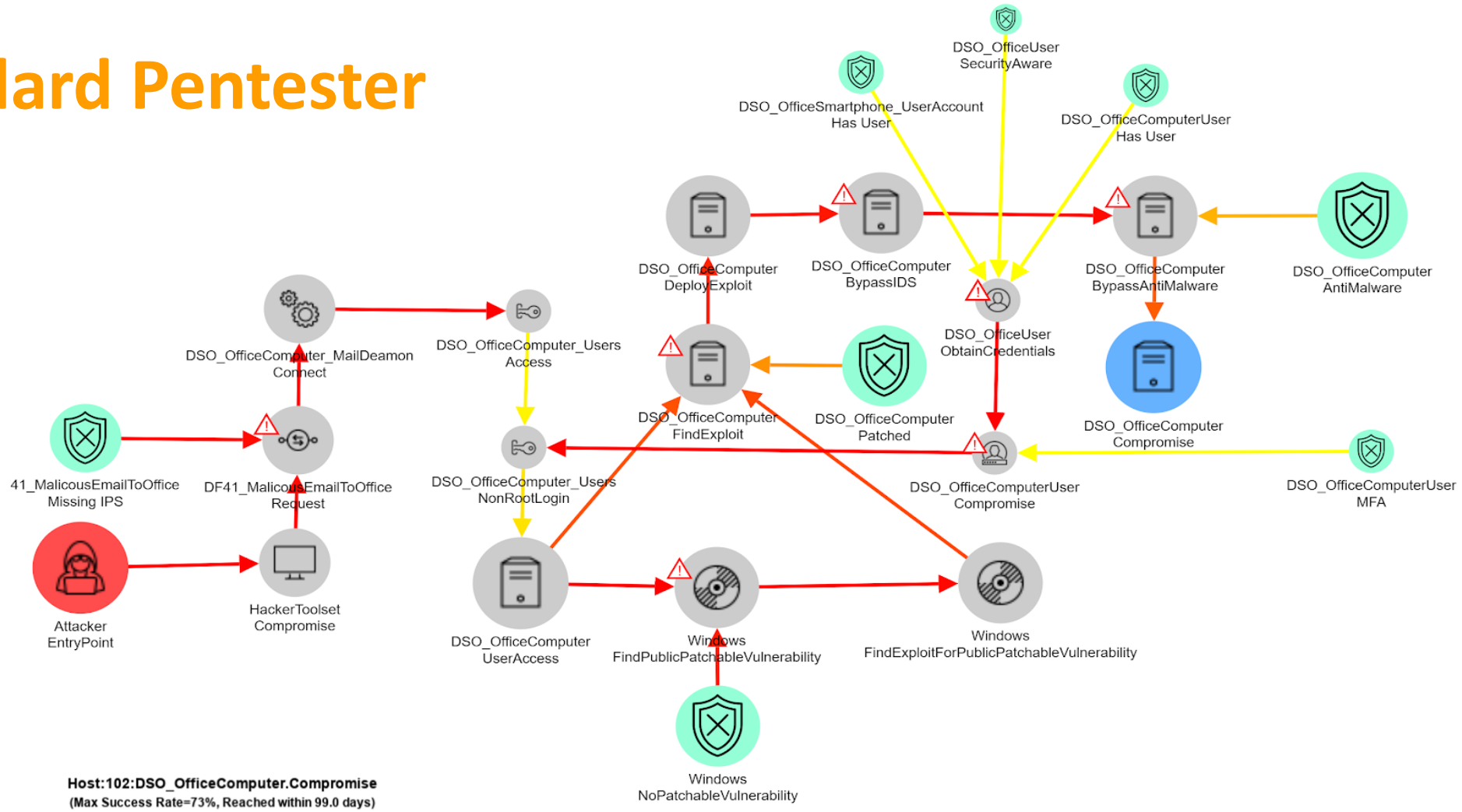


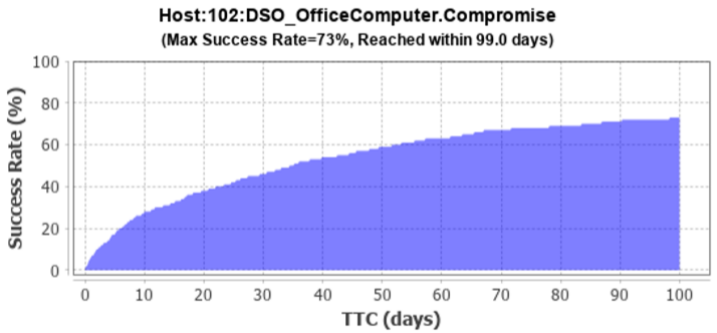


TTC (Days)	Success Rate (%)
10	16
20	37
50	64

Success Rate (%)	TTC (Days)
5	6
50	31
95	100

Standard Pentester

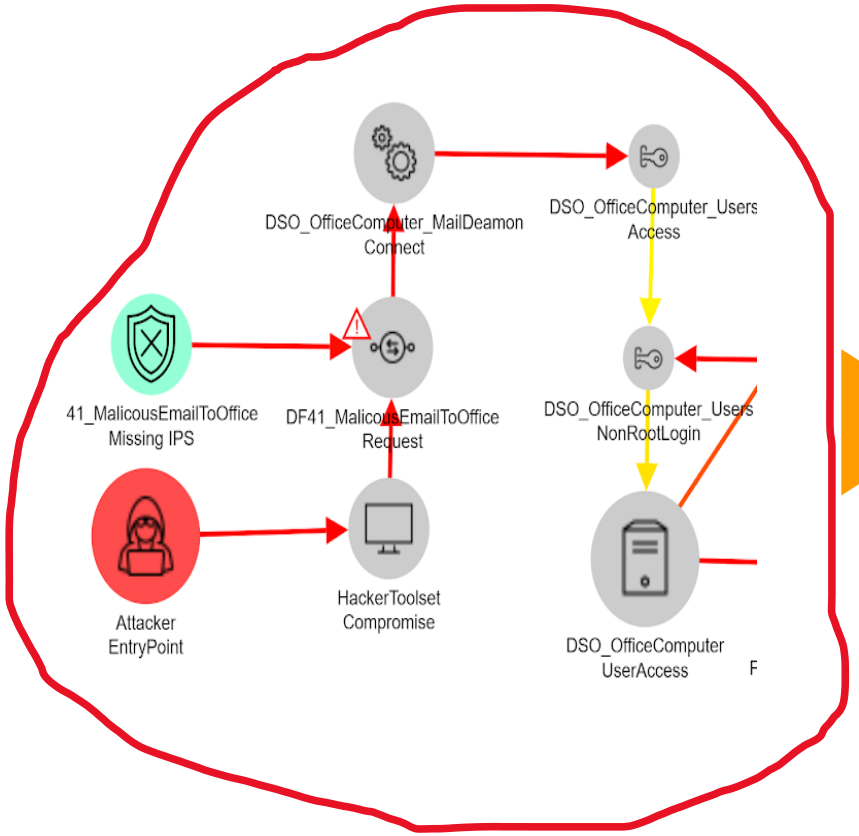


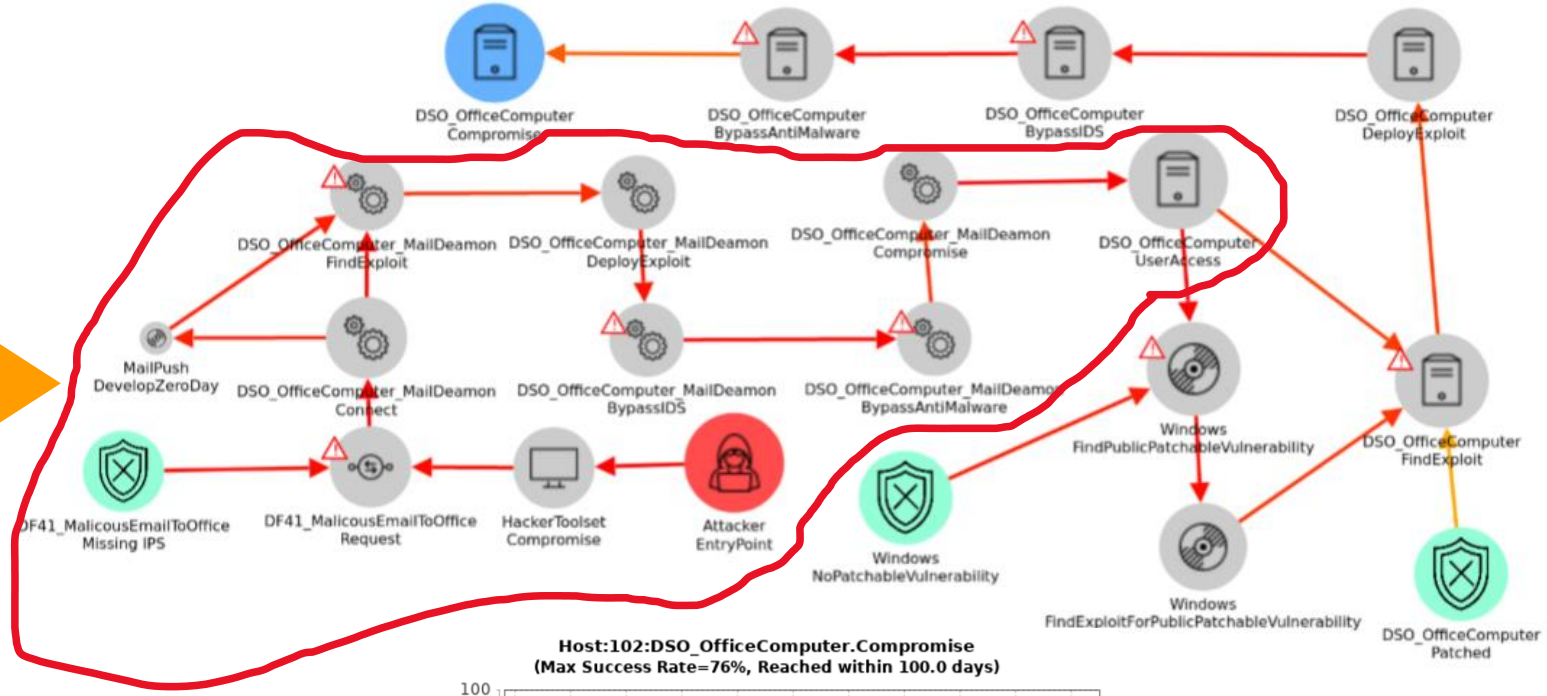


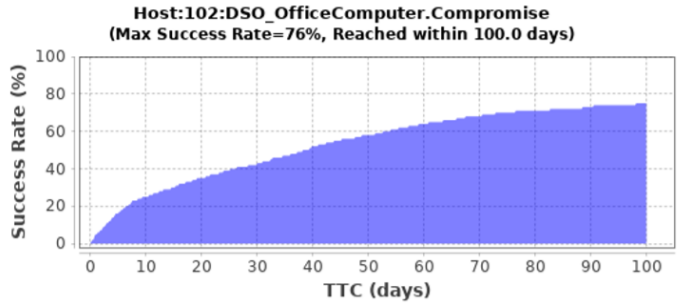
TTC (Days)	Success Rate (%)
10	28
20	35
50	60

Success Rate (%)	TTC (Days)
5	1
50	35
95	100

APT38 Attacker Profile



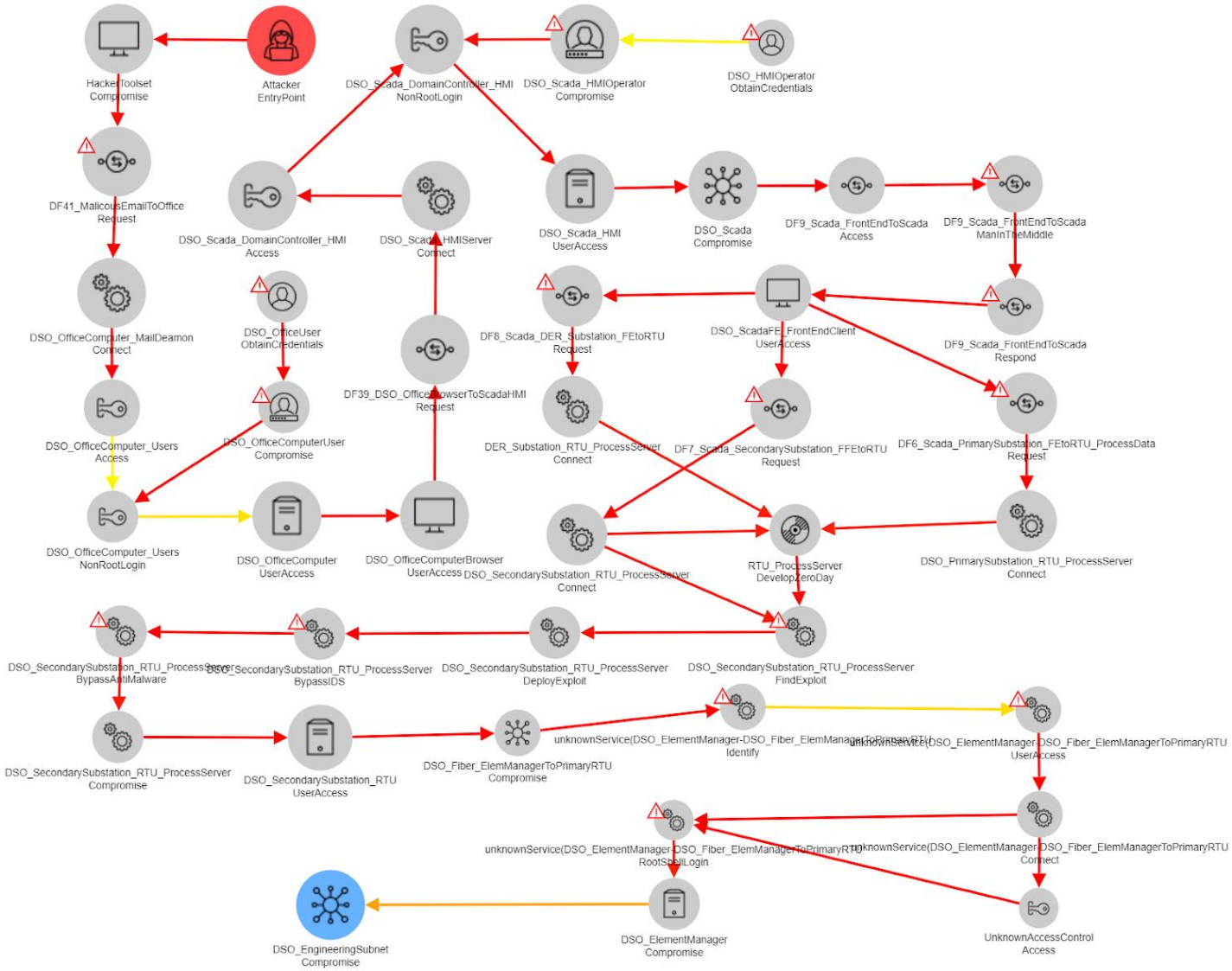


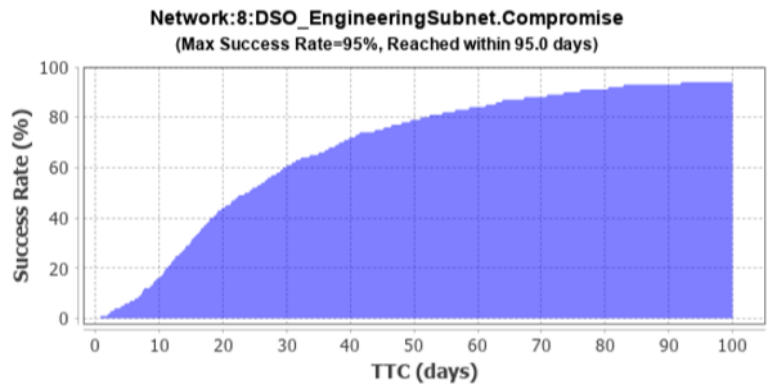


TTC (Days)	Success Rate (%)
10	26
20	36
50	59

Success Rate (%)	TTC (Days)
5	1
50	39
95	100

Standard Pentester

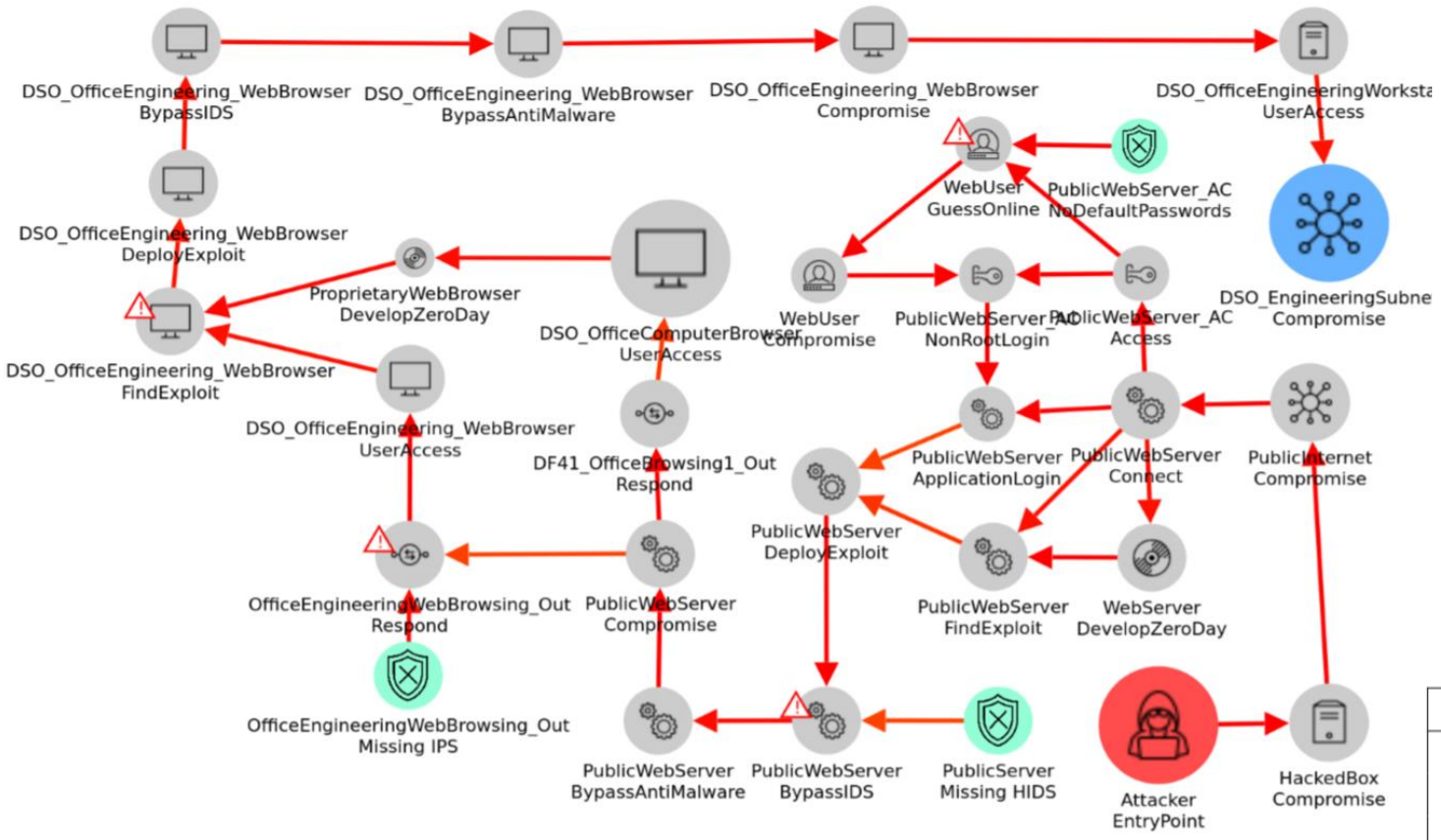


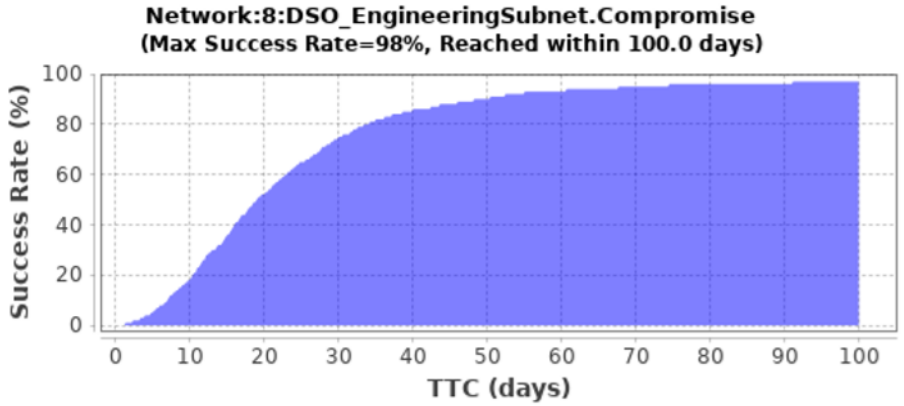


TTC (Days)	Success Rate (%)
10	17
20	45
50	80

Success Rate (%)	TTC (Days)
5	4
50	24
95	100

APT38





TTC (Days)	Success Rate (%)
10	19
20	53
50	91

Success Rate (%)	TTC (Days)
5	5
50	19
95	69

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Limitations

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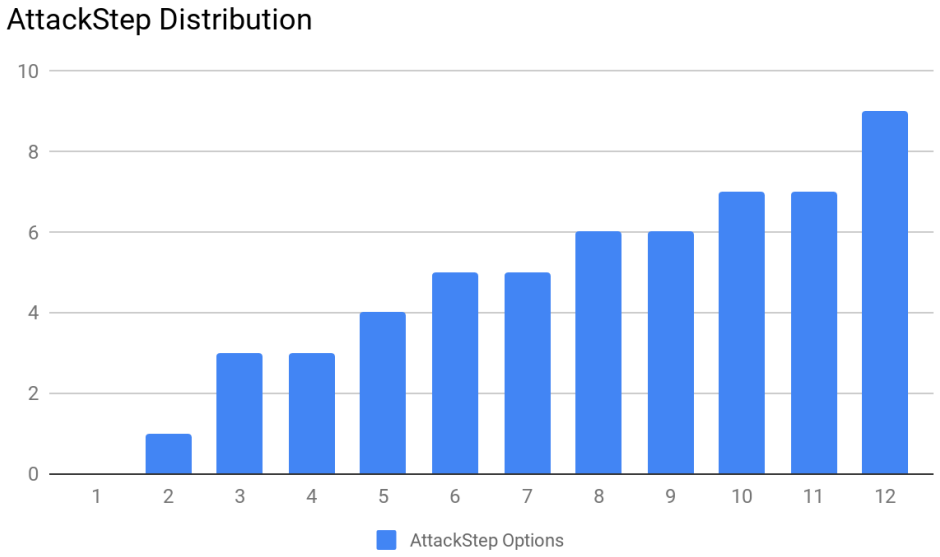
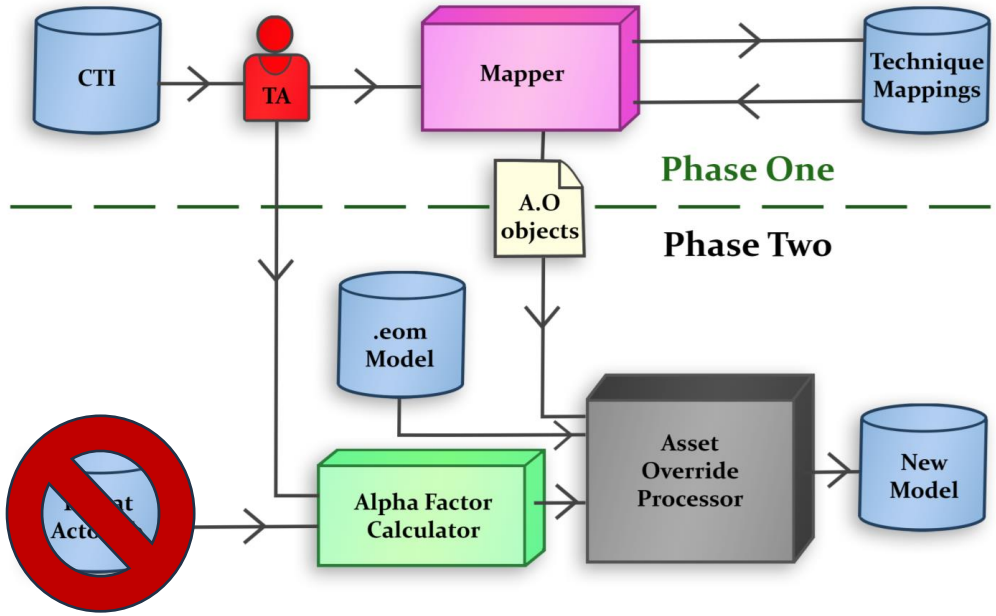
Consistent Operator Practices	False	0
	True	1
Operational Tempo	Low	0
	Medium	1
	High	2
Resource Level	Individual, Club, Contest	0
	Team	1
	Organization	2
	Government	3
Zero Day Capable	False	0
	True	0

- Sophistication Property Weights
  - Discrete assignment
- Multiple Options for attack steps
  - No added benefit
- Shortest path calculation
  - Attacker's TTPs not always present

Future Work

- Several Attack Step Options
  - Attack Step Distribution
- Full technique coverage
  - Test more TAs
- Usability
  - Automatic Tagging
  - Direct access to TA α-properties

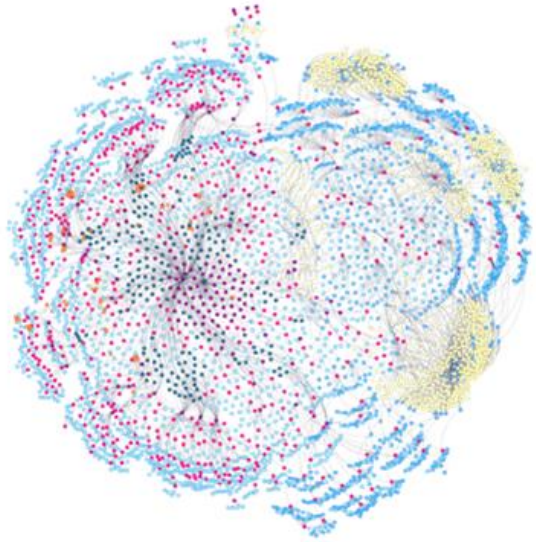




Conclusion

How can Cyber Threat Intelligence be used to enrich probabilistic attack graphs in real time, so that they represent a specific Threat Actor's common attack vectors?

- Identify CTI-objects that:
  - Represents scope of abilities
    - Accurately Map Techniques
  - Overall Skill
    - Sophistication Properties
- Model Tagging
- Attacker Profile similar to APT38's TTPs



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Thanks for listening!

Questions ?

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