

MISP AND DECAYING OF INDICATORS

PRIMER FOR INDICATOR SCORING IN MISP

TEAM CIRCL

INFO@CIRCL.LU

FEBRUARY 10, 2022



MISP
Threat Sharing

- Present the components used in MISP to expire IOCs
- Present the current state of Indicators life-cycle management in MISP

EXPIRING IOCs: WHY AND HOW?

- **Sharing information** about threats **is crucial**
- Organisations are sharing more and more

Contribution by **unique organisation** (Orgc.name) on MISPPriv:

Date	Unique Org
2013	17
2014	43
2015	82
2016	105
2017	118
2018	125
2019-10	135

```
1 {  
2   "distribution": [1, 2, 3]  
3 }
```

- Various users and organisations can share data via MISP, multiple parties can be involved
 - ▶ **Trust, data quality** and **relevance** issues
 - ▶ Each user/organisation have **different use-cases** and interests
 - Conflicting interests: Operational security VS attribution
- Can be partially solved with *Taxonomies*

INDICATORS LIFECYCLE - PROBLEM STATEMENT

- Various users and organisations can share data via MISP, multiple parties can be involved
 - ▶ **Trust, data quality** and **relevance** issues
 - ▶ Each user/organisation have **different use-cases** and interests
 - Conflicting interests: Operational security VS attribution
- Can be partially solved with *Taxonomies*

- Attributes can be shared in large quantities (more than 12M on MISPPRIV - Sept. 2020)
 - ▶ Partial info about their **freshness** (*Sightings*)
 - ▶ Partial info about their **validity** (*last_seen*)
- Can be partially solved with our *Data model*

MISP's *Decaying model* combines the two

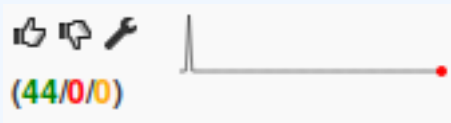
REQUIREMENTS TO ENJOY THE DECAYING FEATURE IN MISP

- Starting from **MISP 2.4.116**, the decaying feature is available
- **Update** decay models and **enable** some
- MISP Decaying strongly relies on *Taxonomies* and *Sightings*, don't forget to review their configuration

Note: The decaying feature has no impact on the information stored in MISP, it's just an **overlay** to be used in the user-interface and API

Sightings add a **temporal context** to indicators.

- *Sightings* can be used to represent that you saw the IoC
- **Usecase:** Continuous feedback loop MISP ↔ IDS



Sightings add a **temporal context** to indicators.

- *Sightings* give more credibility/visibility to indicators
- This information can be used to **prioritise and decay indicators**

TAXONOMIES - REFRESHER (1)

Taxonomies

< previous 1 2 next >

Id ↑	Namespace	Description	Version	Enabled	Required	Active Tags	Actions
181	workflow	Workflow support language is a common language to support intelligence analysts to perform their analysis on data and information.	9	Yes	<input type="checkbox"/>	27 / 26 (enable all)	- 🔍 🗑️
180	vocabulaire-des-probabilites-estimatives	Ce vocabulaire attribue des valeurs en pourcentage à certains énoncés de probabilité	2	Yes	<input type="checkbox"/>	5 / 5	- 🔍 🗑️
179	threats-to-dns	An overview of some of the known attacks related to DNS as described by Torabi, S., Boukhtouta, A., Assi, C., & Debbabi, M. (2018) in Detecting Internet Abuse by Analyzing Passive DNS Traffic: A Survey of Implemented Systems. IEEE Communications Surveys & Tutorials, 1-1. doi:10.1109/comst.2018.2849614	1	No	<input type="checkbox"/>	0 / 18	+ 🔍 🗑️
178	targeted-threat-index	The Targeted Threat Index is a metric for assigning an overall threat ranking score to email messages that deliver malware to a victim's computer. The TTI metric was first introduced at SecTor 2013 by Seth Hardy as part of the talk "RATastrophe: Monitoring a Malware Menagerie" along with Katie Kleemola and Greg Wiseman.	2	Yes	<input type="checkbox"/>	11 / 11	- 🔍 🗑️

- *Taxonomies* are a simple way to attach a classification to an *Event* or an *Attribute*
- Classification must be globally used to be efficient (or agreed on beforehand)

TAXONOMIES - REFRESHER (2)

ADMIRALTY-SCALE Taxonomy Library

Id	127
Namespace	admiralty-scale
Description	The Admiralty Scale or Ranking (also called the NATO System) is used to rank the reliability of a source and the credibility of an information. Reference based on FM 2-22.3 (FM 34-52) HUMAN INTELLIGENCE COLLECTOR OPERATIONS and NATO documents.
Version	4
Enabled	Yes (disable)

- previous next -

<input type="checkbox"/> Tag	Expanded	Numerical value	Events	Attributes	Tags	Action
<input type="checkbox"/> admiralty-scale:information-credibility="1"	Information Credibility: Confirmed by other sources	100	6	0	admiralty-scale:information-credibility="1"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:information-credibility="2"	Information Credibility: Probably true	75	21	1	admiralty-scale:information-credibility="2"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:information-credibility="3"	Information Credibility: Possibly true	50	16	5	admiralty-scale:information-credibility="3"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:information-credibility="4"	Information Credibility: Doubtful	25	2	0	admiralty-scale:information-credibility="4"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:information-credibility="5"	Information Credibility: Improbable	0	1	0	admiralty-scale:information-credibility="5"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:information-credibility="6"	Information Credibility: Truth cannot be judged	50	9	2	admiralty-scale:information-credibility="6"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="a"	Source Reliability: Completely reliable	100	1	0	admiralty-scale:source-reliability="a"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="b"	Source Reliability: Usually reliable	75	21	76	admiralty-scale:source-reliability="b"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="c"	Source Reliability: Fairly reliable	50	9	8	admiralty-scale:source-reliability="c"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="d"	Source Reliability: Not usually reliable	25	2	0	admiralty-scale:source-reliability="d"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="e"	Source Reliability: Unreliable	0	0	0	admiralty-scale:source-reliability="e"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="f"	Source Reliability: Reliability cannot be judged	50	10	7	admiralty-scale:source-reliability="f"	⏪ ⏩ -
<input type="checkbox"/> admiralty-scale:source-reliability="g"	Source Reliability: Deliberately deceptive	0	N/A	N/A		+

→ Cherry-pick allowed Tags

TAXONOMIES - REFRESHER (3)

- Some taxonomies have a `numerical_value`
- Allows concepts to be used in an mathematical expression
 - Can be used to prioritise IoCs

admiralty-scale taxonomy¹

Description	Value
Completely reliable	100
Usually reliable	75
Fairly reliable	50
Not usually reliable	25
Unreliable	0
Reliability cannot be judged	50
Deliberatly deceptive	0

Description	Value
Confirmed by other sources	100
Probably true	75
Possibly true	50
Doubtful	25
Improbable	0
Truth cannot be judged	50

¹<https://github.com/MISP/misp-taxonomies/blob/master/admiralty-scale/machinetag.json>

TAXONOMIES - REFRESHER (3)

admiralty-scale taxonomy²

Description	Value
Completely reliable	100
Usually reliable	75
Fairly reliable	50
Not usually reliable	25
Unreliable	0
Reliability cannot be judged	50 ?
Deliberately deceptive	0 ?

Description	Value
Confirmed by other sources	100
Probably true	75
Possibly true	50
Doubtful	25
Improbable	0
Truth cannot be judged	50 ?

→ Users can override tag numerical_value

²<https://github.com/MISP/misp-taxonomies/blob/master/admiralty-scale/machinetag.json>

$$\text{score}(\text{Attribute}) = \text{base_score}(\text{Attribute}, \text{Model}) \bullet \text{decay}(\text{Model}, \text{time})$$

■ $\text{base_score}(\text{Attribute}, \text{Model})$

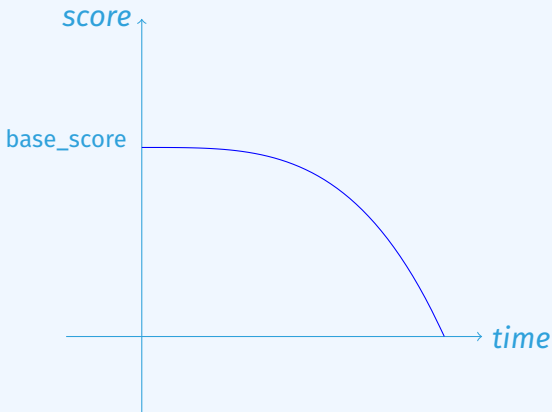
- ▶ Initial score of the *Attribute* only considering the context (*Attribute's type, Tags*)

■ $\text{decay}(\text{Model}, \text{time})$

- ▶ Function composed of the **lifetime** and **decay speed**
- ▶ Decreases the base_score over time

SCORING INDICATORS: OUR SOLUTION

$$\text{score}(\text{Attribute}) = \text{base_score}(\text{Attribute}, \text{Model}) \bullet \text{decay}(\text{Model}, \text{time})$$



CURRENT IMPLEMENTATION IN MISP

IMPLEMENTATION IN MISP: Event/view

The screenshot displays the MISP interface for viewing an event. At the top, there are navigation tabs: "Photos", "Galaxy", "Event graph", "Correlation graph", "ATTACK matrix", "Attributes", and "Discussion". Below this, a search bar contains the text "45: Decay...". A "Galaxies" section is visible with a search icon and a plus sign. Below that, there are navigation buttons: "previous", "next >", and "view all".

The main content area shows a table of events. The table has columns for "Date", "Org", "Category", "Type", "Value", "Tags", "Galaxies", "Comment", "Correlate", "Related Events", "Feed hits", "IDS", "Distribution", "Sightings", "Activity", "Score", and "Actions". The "Decay score" toggle is active, and the "Filtering tool (1)" is visible. The table lists several events with their respective scores and associated models.

Date	Org	Category	Type	Value	Tags	Galaxies	Comment	Correlate	Related Events	Feed hits	IDS	Distribution	Sightings	Activity	Score	Actions
2019-09-12		Network activity	ip-src	5.5.5.5								Inherit	(0/0)		NIDS Simple Decaying ... 65.26 Model 5 79.88	
2019-08-13		Network activity	ip-src	8.8.8.8	admiralty-scale:source-reliability="A" retention:expired				1 2 2 2 Show S1.1 S1.2 11 more...			Inherit	(5/0)		NIDS Simple Decaying ... 54.6 Model 5 52.69	
2019-08-13		Network activity	ip-src	9.9.9.9	admiralty-scale:source-reliability="C" misp:confidence-level="completely-confident" fingerprint				1 3 1 9 Show S1.1 28 more...			Inherit	(4/1)		NIDS Simple Decaying ... 37.43 Model 5 0	
2019-08-13		Network activity	ip-src	7.7.7.7	admiralty-scale:information-credibility="4" retention:20				41			Inherit	(3/0)		NIDS Simple Decaying ... 37.41 Model 5 0	
2019-07-18		Network activity	ip-src	6.6.6.6					41			Inherit	(0/0)		NIDS Simple Decaying ... 23.31 Model 5 0	

■ Decay score toggle button

- ▶ Shows Score for each Models associated to the Attribute type

IMPLEMENTATION IN MISP: API RESULT

/attributes/restSearch

```
1 "Attribute": [  
2   {  
3     "category": "Network activity",  
4     "type": "ip-src",  
5     "to_ids": true,  
6     "timestamp": "1565703507",  
7     [...]  
8     "value": "8.8.8.8",  
9     "decay_score": [  
10      {  
11        "score": 54.475223849544456,  
12        "decayed": false,  
13        "DecayingModel": {  
14          "id": "85",  
15          "name": "NIDS Simple Decaying Model"  
16        }  
17      }  
18    ],  
19  [...]
```

- **Automatic scoring** based on default values
- **User-friendly UI** to manually set *Model* configuration (lifetime, decay, etc.)
- **Simulation** tool
- Interaction through the **API**
- Opportunity to create your **own** formula or algorithm

$$\rightarrow score = base_score \cdot \left(1 - \left(\frac{t}{\tau}\right)^{\frac{1}{\delta}}\right)$$

Models are an instantiation of the formula with configurable parameters:

- Parameters: `lifetime`, `decay_rate`, `threshold`
- `base_score` computation
- default `base_score`
- associate *Attribute* types
- formula
- creator organisation

Two types of model are available

- **Default Models:** Created and shared by the community. Coming from `misp-decaying-models` repository³.
 - Not editable

- **Organisation Models:** Created by a user on MISP
 - ▶ Can be hidden or shared to other organisation
 - Editable

³<https://github.com/MISP/misp-decaying-models.git>

IMPLEMENTATION IN MISP: INDEX

Decaying Models

« previous next »

All Models My Models Shared Models Default Models										
ID	Organization	Usable to everyone	Name	Description	Parameters { }	Formula	# Assigned Types	Version	Enabled	Actions
29	1	✓	Phishing model	Simple model to rapidly decay phishing website.	<pre>{ "lifetime": 3, "decay_speed": 2.3, "threshold": 30, "default_base_score": 80, "base_score_config": { "estimative-language": 0.5, "phishing": 0.5 } }</pre>	Polynomial ⊖	9	1	✓	
85	1	✗	NIDS Simple Decaying Model NISP	Simple decaying model for Network Intrusion Detection System (NIDS).	<pre>{ "lifetime": 120, "decay_speed": 2, "threshold": 30, "default_base_score": 80, "base_score_config": { "estimative-language": 0.25, "priority-level": 0.25, "retention": 0.25, "targeted-threat-index": 0.125, "false-positive": 0.125 } }</pre>	Polynomial ⊖	13	1	✓	

Page 1 of 1, showing 2 records out of 2 total, starting on record 1, ending on 2

« previous next »

Standard CRUD operations: View, update, add, create, delete, enable, export, import

IMPLEMENTATION IN MISP: FINE TUNING TOOL

Decaying Of Indicator Fine Tuning Tool

Attribute Type | Category | Model ID

Attribute Type	Category	Model ID
aba-rtn	Financial fraud	
authenrhash	Payload delivery	
bank-account-iv	Financial fraud	
bc	Financial fraud	
bin	Financial fraud	
bro	Network activity	10-11
bc	Financial fraud	11
cc-number	Financial fraud	
cdhash	Payload delivery	
community-id	Network activity	
domain	Network activity	
domainip	Network activity	10-94
email-attachment	Payload delivery	
email-dst	Network activity	11
email-enc	Payload delivery	
headers	Payload delivery	
headers/authenrhash	Payload delivery	
headers/iphuzzy	Payload delivery	
headers/iphash	Payload delivery	
headers/ipv4	Payload delivery	12
headers/iphash	Payload delivery	13
headers/ipv4	Payload delivery	13

Polynomial

Lifetime: 3 days | Expire after (lifetime): 1 days and 7 hours
Decay speed: 2.3 | Score halved after (Half-life): 0 day and 6 hours
Cutoff threshold: 30

Adjust base score | Simulate this model

Phishing model | Simple model to rapidly decay | Edit

Parameters													
ID	Model Name	Org ID	Description	Formula	Lifetime	Decay speed	Threshold	Default basescore	Basescore config	Settings	# Types	Enabled	Action
29	Phishing model	1	Simple model to rapidly decay phishing website	Polynomial	3	2.3	30	80	estimate-language phishing	0.5	9	✓	Edit model

Configure models: Create, modify, visualise, perform mapping

IMPLEMENTATION IN MISP: base_score TOOL

Search Taxonomy x

Default basescore 80

3 not having numerical value

Taxonomies	Weight
admiralty-scale	
source-reliability	31
information-credibility	30
priority-level	
priority-level	53
retention	
retention	0
estimative-language	
likelihood-probability	0
confidence-in-analytic-judgment	0
misp	
confidence-level	0
threat-level	0
automation-level	0
phishing	
state	0
psychological-acceptability	0
Excluded	

Placeholder for "Organisation source confidence"

Example [↗](#)

Attribute	Tags	Base score
Tag your attribute	+	
Attribute 1	admiralty-scale:information-credibility="3"	0.0 ?
Attribute 2	priority-level:baseline-minor admiralty-scale:source-reliability="d" admiralty-scale:information-credibility="2"	38.2 ?
Attribute 3	priority-level:severe admiralty-scale:information-credibility="2"	84.6 ?

Computation steps

Tag	Computation		Result
	Eff. Ratio	Value	
priority-level:baseline-minor	0.46	* 25.00	11.62
admiralty-scale:source-reliability="d"	0.27	* 25.00	6.80

IMPLEMENTATION IN MISP: SIMULATION TOOL

NIDS Simple Decaying Model

RestSearch **Specific ID**

Attribute RestSearch®

```
{
  "includeDecayScore": 1,
  "includeFullModel": 0,
  "score": 30,
  "excludeDecayed": 0,
  "decayingModel": "BIS",
  "to_ids": 1,
  "tags": ["estimative-language%"], "priority-
  level%","retention%","timestamp%","text%"}

```

Search

Base score Base score configuration not set. Use default value sets.

Tag	Computation	Result
	Est. Ratio	Value
esp-confidence-level="usually-confident"	0 x 75.00	0
esp-confidence-level="fairly-confident"	0 x 50.00	0
adversity-score-source-reliability="A"	0 x 100.00	0
retention-expired	0 x NaN	0
base_score		88.00

Sighting: Wed Sep 4 12:18:09 2019 Current score: 54.60

Date	Score
August 1, 2019	88.00
September 4, 2019	54.60
December 31, 2019	0

ID	Event #	Date	Org	Category	Type	Value	Tags	Event Tags	Galaxies	Comment	IDS	Sightings	Score
36759	45	2019-08-13	ORGNOME	Network activity	ip-src	7.7.7.7	adversity-score-information-credibility="4" retention:2d	esp-confidence-level="usually-confident" esp-confidence-level="fairly-confident"			✓		NIDS Simple Decaying ... 37.41
36757	45	2019-08-13	ORGNOME	Network activity	ip-src	8.8.8.8	adversity-score-source-reliability="A" retention:expired	esp-confidence-level="usually-confident" esp-confidence-level="fairly-confident"			✓		NIDS Simple Decaying ... 54.6

Page 1 of 1, showing 2 records out of 2 total, starting on record 1, ending on 2

Simulate decay on *Attributes* with different *Models*

/attributes/restSearch

```
1 {  
2   "includeDecayScore": 1,  
3   "includeFullModel": 0,  
4   "excludeDecayed": 0,  
5   "decayingModel": [85],  
6   "modelOverrides": {  
7     "threshold": 30  
8   }  
9   "score": 30,  
10 }  
11
```

CREATING A NEW DECAY ALGORITHM

```
1 <?php
2 include_once 'Base.php';
3
4 class Polynomial extends DecayingModelBase
5 {
6     public const DESCRIPTION = 'The description of your new
7     decaying algorithm';
8
9     public function computeScore($model, $attribute, $base_score,
10     $elapsed_time)
11     {
12         // algorithm returning a numerical score
13     }
14
15     public function isDecayed($model, $attribute, $score)
16     {
17         // algorithm returning a boolean stating
18         // if the attribute is expired or not
19     }
20 }
```

- Improved support of *Sightings*
 - ▶ False positive *Sightings* should somehow reduce the score
 - ▶ Expiration *Sightings* should mark the attribute as decayed
- Potential *Model* improvements
 - ▶ Instead of resetting the score to `base_score` once a *Sighting* is set, the score should be increased additively (based on a defined coefficient); thus **prioritizing surges** rather than infrequent *Sightings*
 - ▶ Take into account related *Tags* or *Correlations* when computing score
- Increase *Taxonomy* coverage
 - ▶ Users should be able to manually override the `numerical_value` of *Tags*