

MISP AND DECAYING OF INDICATORS

PRIMER FOR INDICATOR SCORING IN MISP

TEAM CIRCL

INFO@CIRCL.LU

SEPTEMBER 16, 2022



2022-09-16

MISP and Decaying of Indicators

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

└ Outline of the presentation

- 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 }
```

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MISP and Decaying of Indicators

└ Expiring IOCs: Why and How?

└ Indicators lifecycle - Problem Statement

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

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{  
  "distribution": [1, 2, 3]  
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- 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*

- 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

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MISP and Decaying of Indicators

└ Expiring IOCs: Why and How?

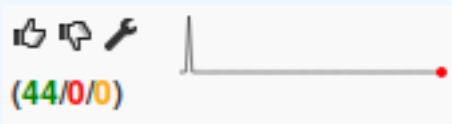
└ Requirements to enjoy the decaying feature in MISP

- 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**

└ Expiring IOCs: Why and How?

└ *Sightings* - Refresher (2)

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

< 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

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MISP and Decaying of Indicators
└ Expiring IOCs: Why and How?

└ Taxonomies - Refresher (2)

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

→ Cherry-pick allowed Tags

- 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
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

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

- Some taxonomies have a `numerical_value`
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Unreliable	0	Improbable	0
Reliability cannot be judged	50	Truth cannot be judged	50
Deliberately deceptive	0		

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admiralty-scale taxonomy²

Description	Value
Completely reliable	100
Usually reliable	75
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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>

admiralty-scale taxonomy ²		admiralty-scale taxonomy ²	
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$$\text{score}(\text{Attribute}) = \text{base_score}(\text{Attribute}, \text{Model}) \bullet \text{decay}(\text{Model}, \text{time})$$

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

- ▶ 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

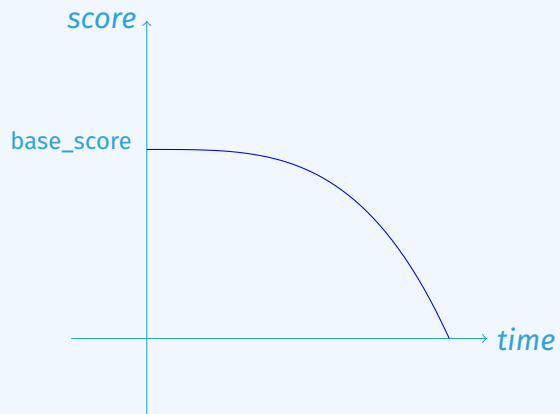
└ Expiring IOCs: Why and How?

└ Scoring Indicators: Our solution

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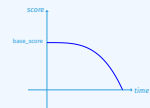
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- └ Expiring IOCs: Why and How?

- └ 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 shows the MISP Event/view interface. At the top, there are navigation tabs: "Plots", "Galaxy", "Event graph", "Correlation graph", "ATTACK matrix", "Attributes", and "Discussion". Below these is a "Galaxies" search box and navigation buttons for "previous", "next", and "view all". The main content area features a table of events with columns for "Date", "Org", "Category", "Type", "Value", "Tags", "Galaxies", "Comment", "Correlate", "Related Events", "Feed hits", "IDS", "Distribution", "Sightings", "Activity", "Score", and "Actions". A "Decay score" toggle button is visible in the top right of the table area. The table lists several events, each with a "NIDS Simple Decaying ..." model and a "Model 5" score.

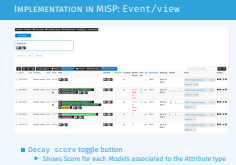
Date	Org	Category	Type	Value	Tags	Galaxies	Comment	Correlate	Related Events	Feed hits	IDS	Distribution	Sightings	Activity	Score	Actions
2019-09-12		Network activity	ip-svc	5.5.5.5								Inherit	(0/0)		NIDS Simple Decaying ... 65.26 Model 5 79.88	
2019-08-13		Network activity	ip-svc	8.8.8.8	adm_rality_scale:source-reliability="A"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

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MISP and Decaying of Indicators
└ Current implementation in MISP

└ Implementation in MISP: Event/view



/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  [...]
```

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MISP and Decaying of Indicators

└ Current implementation in MISP

└ Implementation in MISP: API result

```
/attributes/restSearch  
"Attribute": [  
  {  
    "category": "Network activity",  
    "type": "ip-src",  
    "to_ids": true,  
    "timestamp": "1565703507",  
    [...]  
    "value": "8.8.8.8",  
    "decay_score": [  
      {  
        "score": 54.475223849544456,  
        "decayed": false,  
        "DecayingModel": {  
          "id": "85",  
          "name": "NIDS Simple Decaying Model"  
        }  
      }  
    ],  
    [...]  
  }  
]
```

- **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

└ Current implementation in MISP

└ Implementation in MISP: Objectives

- 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

└ Current implementation in MISP

└ Implementation in MISP: Models definition

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

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>

└─ Current implementation in MISP

└─ Implementation in MISP: Models Types

- Two types of model are available
- **Default Models:** Created and shared by the community.
Coming from `misp-decaying-models` repository.
→ Not editable
 - **Organisation Models:** Created by a user on MISP
 - ▶ Can be hidden or shared to other organisation
 - Editable

Decaying Models

« previous next »

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 MSP	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

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MISP and Decaying of Indicators

└─ Current implementation in MISP

└─ Implementation in MISP: Index



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	
authn-hash	Payload delivery	
bank-account-iv	Financial fraud	
bc	Financial fraud	
bn	Financial fraud	
bn	Network activity	10 11
bc	Financial fraud	11
cc-number	Financial fraud	
cd-hash	Payload delivery	
community-id	Network activity	
domain	Network activity	
domainip	Network activity	10 94
email-attachment	Payload delivery	
email-att	Network activity	11
email-enc	Payload delivery	
headers	Payload delivery	
headers/authn-hash	Payload delivery	
headers/zipfuzzy	Payload delivery	
headers/ziphash	Payload delivery	
headers/zipmd5	Payload delivery	12
headers/ziphash	Payload delivery	13
headers/ziph1	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													
Model ID	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 using phishing website	Polynomial	3	2.3	30	80	estimate-language phishing	0.5	9	✓	Edit model

Configure models: Create, modify, visualise, perform mapping

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MISP and Decaying of Indicators

└ Current implementation in MISP

└ Implementation in MISP: Fine tuning tool



Configure models: Create, modify, visualise, perform mapping

Search Taxonomy

Default basescore 80

3 not having numerical value

Taxonomies Weight

admiralty-scale

source-reliability

information-credibility

priority-level

priority-level

retention

retention

estimative-language

likelihood-probability

confidence-in-analytic-judgment

misp

confidence-level

threat-level

automation-level

phishing

state

psychological-acceptability

Excluded

Placeholder for "Organisation source confidence"

Example [🔗](#)

Attribute	Tags	Base score
Tag your attribute	+	
Attribute 1	admiralty-scale-information-credibility="5"	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

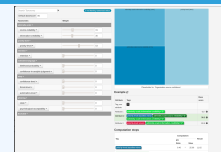
Tag	Computation		Result
	Eff. Ratio	Value	
priority-level:baseline-minor	0.46	25.00	11.62
admiralty-scale:source-reliability="d"	0.27	25.00	6.80

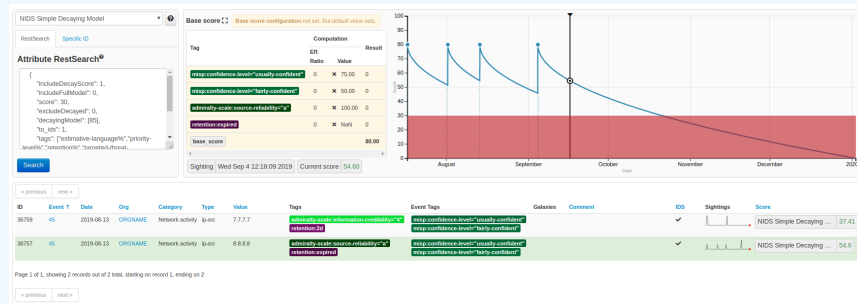
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MISP and Decaying of Indicators

└ Current implementation in MISP

└ Implementation in MISP: base_score tool





Simulate decay on *Attributes with different Models*

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MISP and Decaying of Indicators

└ Current implementation in MISP

└ Implementation in MISP: simulation tool



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
```

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MISP and Decaying of Indicators

└ Current implementation in MISP

└ Implementation in MISP: API query body

/attributes/restSearch

```
"includeDecayScore": 1,  
"includeFullModel": 0,  
"excludeDecayed": 0,  
"decayingModel": [85],  
"modelOverrides": {  
  "threshold": 30  
}  
"score": 30,
```

```
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 }
```

└─ Current implementation in MISP

└─ Creating a new decay algorithm

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```

- 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*

2022-09-16

- MISP and Decaying of Indicators
 - └ Current implementation in MISP
 - └ Decaying Models 2.0

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