MISP and Decaying of Indicators

Primer for indicator scoring in MISP

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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?

Indicators lifecycle - Problem Statement

- **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

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

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*

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- Various users and organisations can share data via MISP, multiple parties can be involved
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  - 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

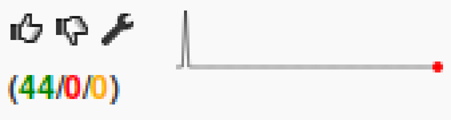
- Starting from **MISP 2.4.116**, the decaying feature is available
- **Update** decay models and **enable** some
- MISP Decaying strongly relies on *Taxonomies* and *Sightings*, don't forget to review their configuration

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 - Refresher (1)

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

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

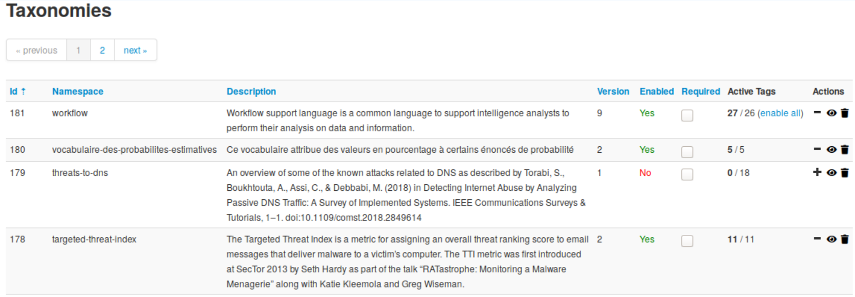


Sightings - Refresher (2)

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 - Refresher (1)



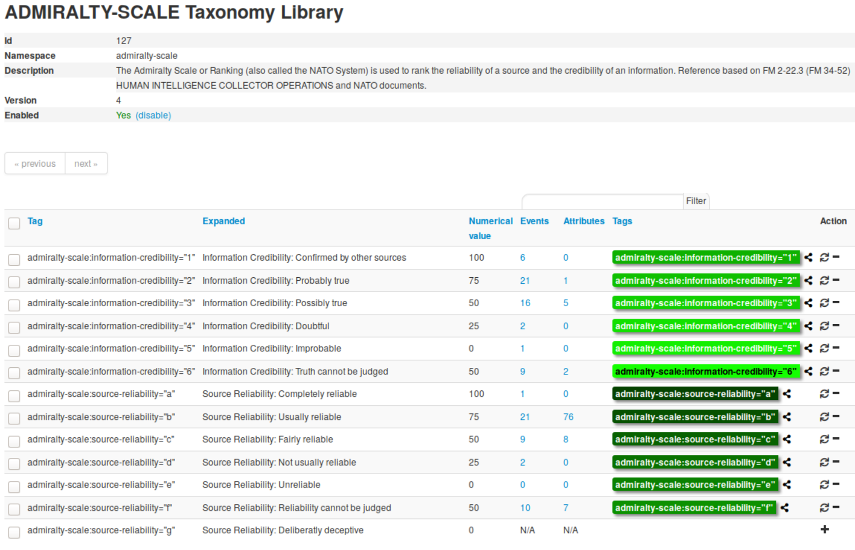
Taxonomies

« 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	☐	27 / 26 (enable all)	− 👁 🗑
180	vocabulaire-des-probabilites-estimatives	Ce vocabulaire attribue des valeurs en pourcentage à certains énoncés de probabilité	2	Yes	☐	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	☐	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	☐	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)

□	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" <	⟳ −
□	admiralty-scale:information-credibility="2"	Information Credibility: Probably true	75	21	1	admiralty-scale:information-credibility="2" <	⟳ −
□	admiralty-scale:information-credibility="3"	Information Credibility: Possibly true	50	16	5	admiralty-scale:information-credibility="3" <	⟳ −
□	admiralty-scale:information-credibility="4"	Information Credibility: Doubtful	25	2	0	admiralty-scale:information-credibility="4" <	⟳ −
□	admiralty-scale:information-credibility="5"	Information Credibility: Improbable	0	1	0	admiralty-scale:information-credibility="5" <	⟳ −
□	admiralty-scale:information-credibility="6"	Information Credibility: Truth cannot be judged	50	9	2	admiralty-scale:information-credibility="6" <	⟳ −
□	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: Deliberatly 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

`admirality-scale` taxonomy[1]

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)

admirality-scale taxonomy[2]

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 **?**

→ Users can override tag `numerical_value`

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

Scoring Indicators: Our solution

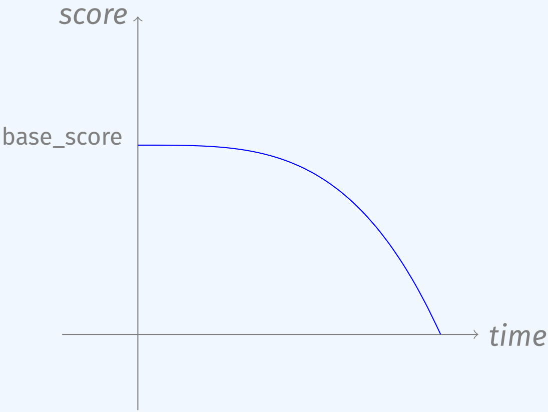
$$\texttt{score}(\texttt{Attribute}) = \texttt{base\_score}(\texttt{Attribute, Model}) \bullet \texttt{decay}(\texttt{Model, time})$$

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

- decay(Model, time)
  - Function composed of the **lifetime** and **decay speed**
  - Decreases the base_score over time

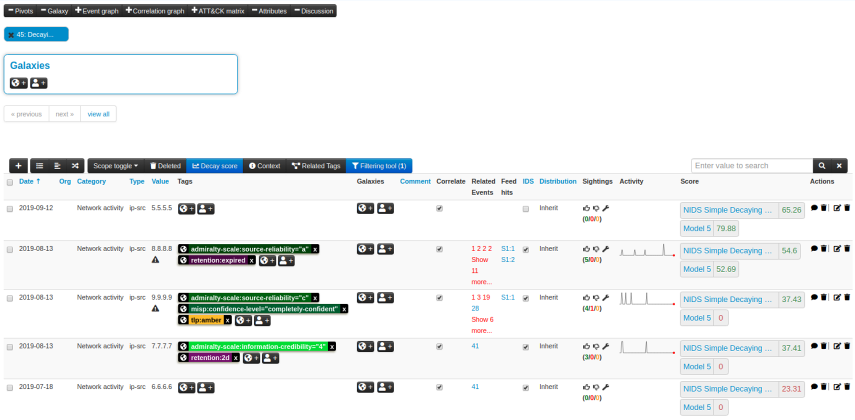
Scoring Indicators: Our solution

$$\texttt{score}(\texttt{Attribute}) = \texttt{base\_score}(\texttt{Attribute, Model}) \bullet \texttt{decay}(\texttt{Model, time})$$



Current implementation in MISP

Implementation in MISP: Event/view



☐	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	(0/0/0)		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" x retention:expired x			☑	1 2 2 2 Show 11 more...	S1:1 S1:2	☑	Inherit	(5/0/0)		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" x misp:confidence-level="completely-confident" x tlp:amber x			☑	1 3 19 28 Show 6 more...	S1:1	☑	Inherit	(4/1/0)		NIDS Simple Decaying ... 37.43 Model 5 0	
☐	2019-08-13		Network activity	ip-src	7.7.7.7	admiralty-scale:information-credibility="4" x retention:2d x			☑	41		☑	Inherit	(3/0/0)		NIDS Simple Decaying ... 37.41 Model 5 0	
☐	2019-07-18		Network activity	ip-src	6.6.6.6				☑	41		☑	Inherit	(0/0/0)		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

```
"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"
        }
      }
    ],
[...]
```

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

Implementation in MISP: Models definition

↱ $score = base\_score \cdot \left(1 - \left(\frac{t}{\tau}\right)^{\frac{1}{\delta}}\right)$

Models are an instanciation of the formula with configurable parameters:

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

Implementation in MISP: Models Types

Two types of model are available

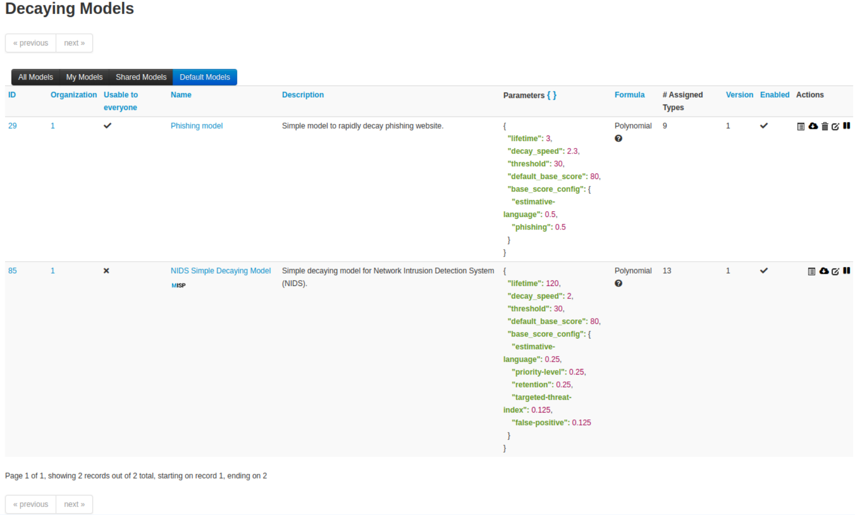
- **Default Models**: Created and shared by the community. Coming from `misp-decaying-models` repository[3].
  → Not editable

- **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

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.	{
					"lifetime": 3,
					"decay_speed": 2.3,
					"threshold": 30,
					"default_base_score": 80,
					"base_score_config": {
					"estimative-language": 0.5,
					"phishing": 0.5
					}
					}
						Polynomial	9	1	✓	

85	1	✕	NIDS Simple Decaying Model
			MISP
				Simple decaying model for Network Intrusion Detection System (NIDS).	{
					"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
					}
					}
						Polynomial	13	1	✓	

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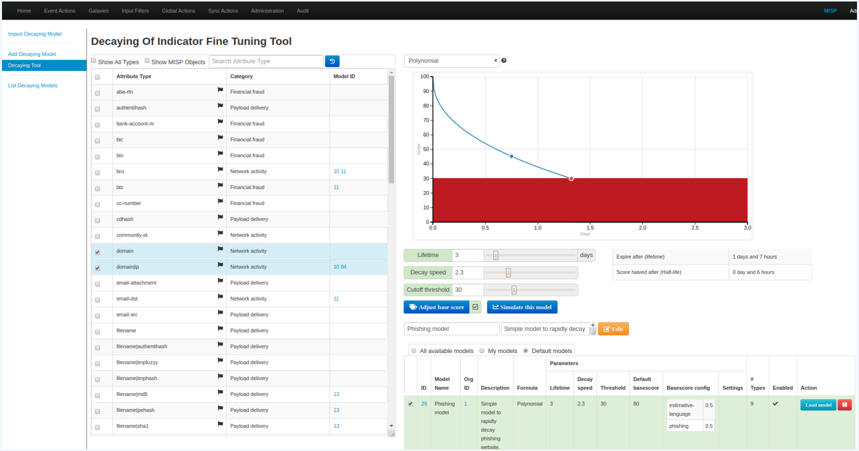
Standard CRUD operations: View, update, add, create, delete, enable, export, import

Implementation in MISP: Fine tuning tool



Decaying Of Indicator Fine Tuning Tool

□ Show All Types □ Show MISP Objects Search Attribute Type

□	Attribute Type	Category	Model ID
□	aba-rtn	Financial fraud	
□	authentihash	Payload delivery	
□	bank-account-nr	Financial fraud	
□	bic	Financial fraud	
□	bin	Financial fraud	
□	bro	Network activity	10 11
□	btc	Financial fraud	11
□	cc-number	Financial fraud	
□	cdhash	Payload delivery	
□	community-id	Network activity	
☑	domain	Network activity	
☑	domain|ip	Network activity	10 84
□	email-attachment	Payload delivery	
□	email-dst	Network activity	11
□	email-src	Payload delivery	
□	filename	Payload delivery	
□	filename|authentihash	Payload delivery	
□	filename|impfuzzy	Payload delivery	
□	filename|imphash	Payload delivery	
□	filename|md5	Payload delivery	13
□	filename|pehash	Payload delivery	13
□	filename|sha1	Payload delivery	13

Lifetime 3 days

Decay speed 2.3

Cutoff threshold 30

Expire after (lifetime)	1 days and 7 hours
Score halved after (Half-life)	0 day and 6 hours

Phishing model

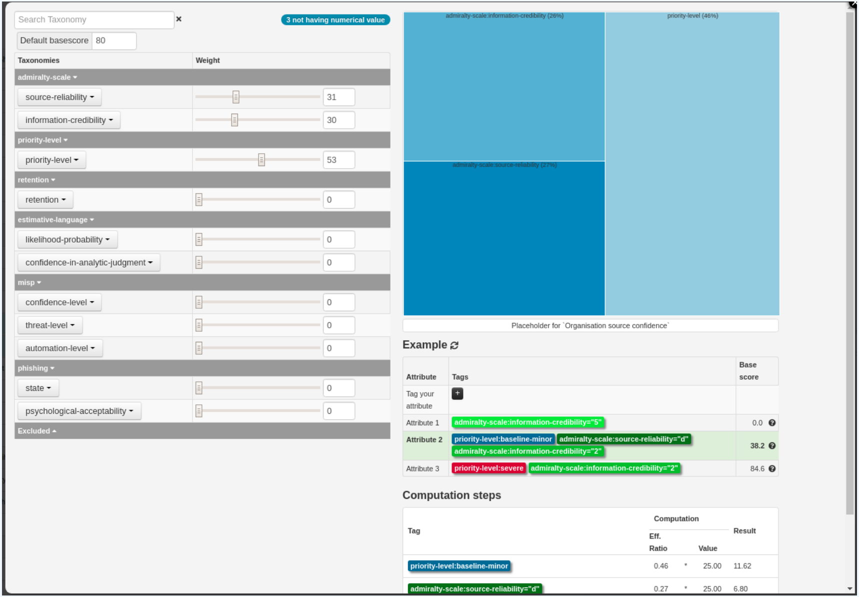
Simple model to rapidly decay

○ All available models ○ My models ● Default models

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

Configure models: Create, modify, visualise, perform mapping

IMPLEMENTATION IN MISP: base_score TOOL



Search Taxonomy ×

3 not having numerical value

Default basescore 80

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 ▴	

admiralty-scale:information-credibility (26%)

priority-level (46%)

admiralty-scale:source-reliability (27%)

Placeholder for `Organisation source confidence`

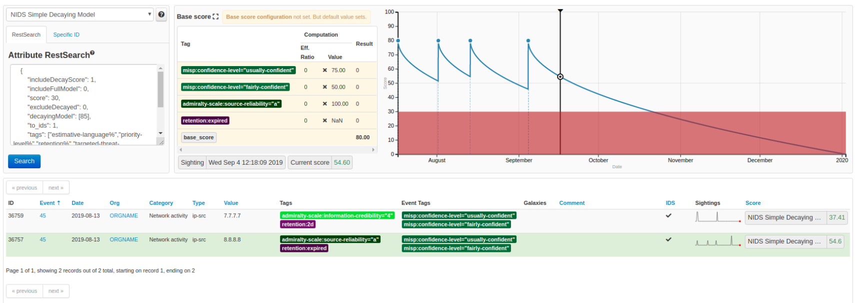
Example

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

Implementation in MISP: simulation tool



NIDS Simple Decaying Model

RestSearch | Specific ID

Attribute RestSearch

```
{
    "includeDecayScore": 1,
    "includeFullModel": 0,
    "score": 30,
    "excludeDecayed": 0,
    "decayingModel": [85],
    "to_ids": 1,
    "tags": ["estimative-language%","priority-
level%","retention%","targeted-threat-
```

Search

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

Tag	Computation			Result
	Eff. Ratio		Value	
misp:confidence-level="usually-confident"	0	×	75.00	0
misp:confidence-level="fairly-confident"	0	×	50.00	0
admiralty-scale:source-reliability="a"	0	×	100.00	0
retention:expired	0	×	NaN	0
base_score				80.00

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

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ID	Event ↑	Date	Org	Category	Type	Value	Tags	Event Tags	Galaxies	Comment	IDS	Sightings	Score
36759	45	2019-08-13	ORGNAME	Network activity	ip-src	7.7.7.7	admiralty-scale:information-credibility="4" retention:2d	misp:confidence-level="usually-confident" misp:confidence-level="fairly-confident"			✓		NIDS Simple Decaying ... 37.41
36757	45	2019-08-13	ORGNAME	Network activity	ip-src	8.8.8.8	admiralty-scale:source-reliability="a" retention:expired	misp:confidence-level="usually-confident" misp: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

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Simulate decay on *Attributes* with different *Models*

Implementation in MISP: API query body

/attributes/restSearch

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

```

Creating a new decay algorithm

```php
<?php
include_once 'Base.php';

class Polynomial extends DecayingModelBase
{
    public const DESCRIPTION = 'The description of your new decaying algorithm';

    public function computeScore($model, $attribute, $base_score, $elapsed_time)
    {
       // algorithm returning a numerical score
    }

    public function isDecayed($model, $attribute, $score)
    {
        // algorithm returning a boolean stating
        // if the attribute is expired or not
    }
}
?>

```

Decaying Models 2.0

- 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*