

TURNING DATA INTO ACTIONABLE INTELLIGENCE

ADVANCED FEATURES IN MISP SUPPORTING YOUR ANALYSTS AND TOOLS

CIRCL / TEAM MISP PROJECT



13TH ENISA-EC3 WORKSHOP



2024-09-11

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- The Computer Incident Response Center Luxembourg (CIRCL) is a government-driven initiative designed to provide a systematic response facility to computer security threats and incidents. CIRCL is the CERT for the private sector, communes and non-governmental entities in Luxembourg and is operated by securitymadein.lu g.i.e.

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about CIRCL



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- CIRCL is mandated by the Ministry of Economy and acting as the Luxembourg National CERT for private sector.
- CIRCL leads the development of the Open Source MISP threat intelligence platform which is used by many military or intelligence communities, private companies, financial sector, National CERTs and LEAs globally.
- **CIRCL runs multiple large MISP communities performing active daily threat-intelligence sharing.**

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└ MISP and CIRCL

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- To give some insight into what sort of an evolution of our various communities' have gone through as observed over the past 8 years
- Show the importance of **strong contextualisation...**
- ...and how that can be leveraged when trying to make our data **actionable**

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└ The aim of this presentation

- To give some insight into what sort of an evolution of our various communities' have gone through as observed over the past 8 years
- Show the importance of **strong contextualisation...**
- ...and how that can be leveraged when trying to make our data **actionable**

- There are many different types of users of an information sharing platform like MISP:
 - ▶ **Malware reversers** willing to share indicators of analysis with respective colleagues.
 - ▶ **Security analysts** searching, validating and using indicators in operational security.
 - ▶ **Intelligence analysts** gathering information about specific adversary groups.
 - ▶ **Law-enforcement** relying on indicators to support or bootstrap their DFIR cases.
 - ▶ **Risk analysis teams** willing to know about the new threats, likelihood and occurrences.
 - ▶ **Fraud analysts** willing to share financial indicators to detect financial frauds.

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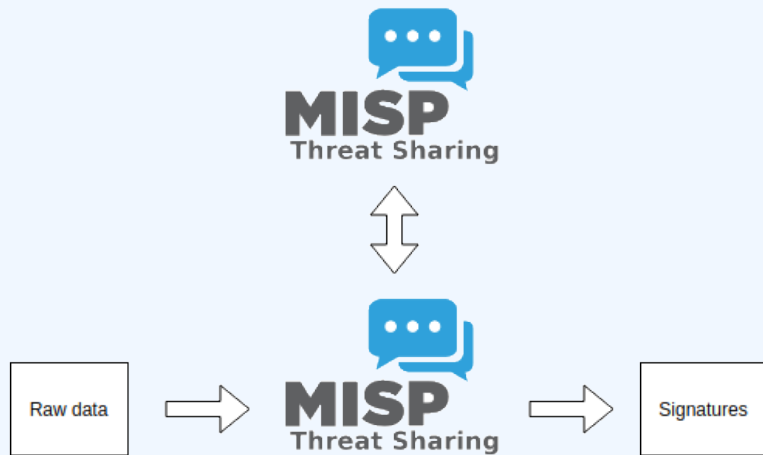
└ Development based on practical user feedback

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- **Extract information** during the analysis process
- Store and **correlate** these datapoints
- **Share** the data with partners
- Focus on technical indicators: IP, domain, hostname, hashes, filename, pattern in file/memory/traffic
- Generate protective signatures out of the data: snort, suricata, OpenIOC

└─ The initial scope of MISP

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Initial workflow

INITIAL WORKFLOW



WHY WAS IT SO SIMPLISTIC?

- This was both a reflection of our maturity as a community
 - ▶ Capabilities for **extracting** information
 - ▶ Capabilities for **utilising** the information
 - ▶ Lack of **willingness** to share context
 - ▶ Lack of **co-operation** between teams doing technical analysis/monitoring and threat-intel
- The more growth we saw in maturity, the more we tried to match it with our data-model, often against pushback

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- There were separate factors that made our data-sets less and less useful for detection/defense in general
 - ▶ **Growth of our communities**
 - ▶ Distinguish between information of interest and raw data
 - ▶ **False-positive** management
 - ▶ TTPs and aggregate information may be prevalent compared to raw data (risk assessment)
 - ▶ **Increased data volumes** leads to be able to prioritise

└ The growing need to contextualise data

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OUR INITIAL SOLUTION

- Allow users to **tag any information** created in MISP
- We wanted to be **lax with what we accept** in terms of data, but be **strict on what we fed to our tools**, with strong filter options
- We had some ideas on how to potentially move forward...

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└ Our initial solution

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OUR INITIAL FAILURES

- Try to capture different aspects of contextualisation into **normalised values** (threat level, source reliability, etc)
 - ▶ Didn't scale with needs other than our own
 - ▶ Incorporating new types of contextualisation would mean **the modification of the software**
 - ▶ Getting communities with **established naming conventions** to use anything but their go-to vocabularies was a pipe-dream
 - ▶ Heated arguments over numeric conversions

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HUMAN CREATIVITY

- We tried an alternate approach instead: Free tagging
 - ▶ Result was spectacularly painful, at least 7 different ways to spell tlp:amber
 - ▶ No canonisation for common terms lead to tagging ultimately becoming a highly flawed tool for filtering within a sharing community

TLP AMBER

TLP:AMBER

Threat tlp:Amber

tlp-amber

tlp::amber

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└ Human creativity

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HOW WE ENDED UP TACKLING THE ISSUE MORE SUCCESSFULLY

- We ended up with a mixed approach, currently implemented by the MISP-taxonomy system
 - ▶ Taxonomies are **vocabularies** of known tags
 - ▶ Tags would be in a **triple tag format**
namespace:predicate="value"
 - ▶ Create your own taxonomies, recipients should be able to use data you tag with them without knowing it at the first place
 - ▶ Avoid any coding, stick to **JSON**
- Massive success, approaching 100 taxonomies
- Organisations can solve their own issues without having to rely on us

| <input type="checkbox"/> Tag | Events | Attributes | Tags |
|--|--------|------------|-------------------------------|
| <input type="checkbox"/> workflow:state="complete" | 11 | 0 | workflow:state="complete" ↩ |
| <input type="checkbox"/> workflow:state="draft" | 0 | 0 | workflow:state="draft" ↩ |
| <input type="checkbox"/> workflow:state="incomplete" | 55 | 10 | workflow:state="incomplete" ↩ |
| <input type="checkbox"/> workflow:state="ongoing" | 0 | 0 | workflow:state="ongoing" ↩ |

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└─ How we ended up tackling the issue more successfully

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WE WERE STILL MISSING SOMETHING...

- Taxonomy tags often **non self-explanatory**
- Example: universal understanding of tlp:green vs APT 28
- For the latter, a single string was ill-suited
- So we needed something new in addition to taxonomies - **Galaxies**
 - ▶ Community driven **knowledge-base libraries used as tags**
 - ▶ Including descriptions, links, synonyms, meta information, etc.
 - ▶ Goal was to keep it **simple and make it reusable**
 - ▶ Internally it works the exact same way as taxonomies (stick to **JSON**)

| ₿ Ransomware galaxy | |
|---------------------|--------------------------------------|
| Galaxy ID | 373 |
| Name | Ransomware |
| Namespace | misp |
| Uuld | 3f44af2e-1480-4b6b-9aa8-f9bb21341078 |
| Description | Ransomware galaxy based on... |
| Version | 4 |
| Value ↓ | Synonyms |
| .CryptoHasYou. | |
| 777 | Sevleg |
| 7ev3n | 7ev3n-HONE\$T |

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BROADENING THE SCOPE OF WHAT SORT OF CONTEXT WE ARE INTERESTED IN

- **Who** can receive our data? **What** can they do with it?
- **Data accuracy, source reliability**
- **Why** is this data relevant to us?
- **Who** do we think is behind it, **what tools** were used?
- What sort of **motivations** are we dealing with? Who are the **targets**?
- How can we **block/detect/remediate** the attack?
- What sort of **impact** are we dealing with?

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└─ Broadening the scope of what sort of context we are interested in

BROADENING THE SCOPE OF WHAT SORT OF CONTEXT WE ARE INTERESTED IN

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- What sort of impact are we dealing with?

PARALLEL TO THE CONTEXTUALISATION EFFORTS: FALSE POSITIVE HANDLING

- Low quality / false positive prone information being shared
- Lead to **alert-fatigue**
- Exclude organisation xy out of the community?
- False positives are often obvious - **can be encoded**
- **Warninglist system**¹ aims to do that
- Lists of well-known indicators which are often false-positives like RFC1918 networks, ...

LIST OF KNOWN IPV4 PUBLIC DNS RESOLVERS

| | |
|--------------------------|--|
| Id | 89 |
| Name | List of known IPv4 public DNS resolvers |
| Description | Event contains one or more public IPv4 DNS resolvers as attribute with an IDS flag set |
| Version | 20181114 |
| Type | string |
| Accepted attribute types | ip-src, ip-dst, domain ip |
| Enabled | Yes (disable) |
| Values | 1.0.0.1 1.1.1.1 1.1.1.4 |

Warning: Potential false positives

List of known IPv4 public DNS resolvers
Top 1000 website from Alexa
List of known google domains

¹<https://github.com/MISP/misp-warninglists>

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└ Parallel to the contextualisation efforts: False positive handling



- Atomic attributes were a great starting point, but lacking in many aspects
- **MISP objects**² system
 - ▶ Simple **templating** approach
 - ▶ Use templating to build more complex structures
 - ▶ Decouple it from the core, allow users to **define their own** structures
 - ▶ MISP should understand the data without knowing the templates
 - ▶ Massive caveat: **Building blocks have to be MISP attribute types**
 - ▶ Allow **relationships** to be built between objects

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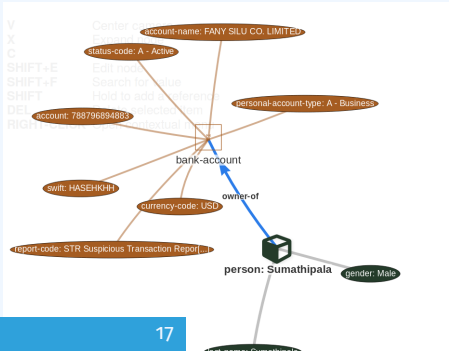
└ More complex data-structures for a modern age

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SUPPORTING SPECIFIC DATAMODEL

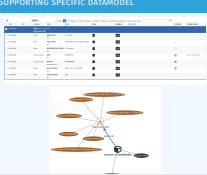
| Date | Org | Category | Type | Value | Tags | Galaxies | Comment | Correlate | Related Events |
|------------|-----------------|------------------------|------|-----------------------------------|------|----------|---------------|-------------------------------------|------------------|
| 2018-09-28 | | | | Name: bank-account | | | References: 0 | | |
| 2018-09-28 | Other | status-code: | text | A - Active | | Add | | | |
| 2018-09-28 | Other | report-code: | text | STR Suspicious Transaction Report | | Add | | | |
| 2018-09-28 | Other | personal-account-type: | text | A - Business | | Add | | | |
| 2018-09-28 | Financial fraud | swift: | text | HASEH09H | | Add | | <input checked="" type="checkbox"/> | 3840 11320 11584 |
| 2018-09-28 | Financial fraud | account: | text | 788796894883 | | Add | | <input checked="" type="checkbox"/> | |
| 2018-09-28 | Other | account-name: | text | FANY SILU CO. LIMITED | | Add | | <input checked="" type="checkbox"/> | |
| 2018-09-28 | Other | currency-code: | text | USD | | Add | | <input type="checkbox"/> | |



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Supporting specific datamodel



- Data ingested by MISP was in a sense frozen in time
- We had a creation data, but lacked a way to use the output of our detection
- Lead to the introduction of the **Sighting system**
- The community could sight indicators and convey the time of sighting
- Potentially powerful tool for IoC lifecycle management, clumsy query implementation default

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└ Continuous feedback loop

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SUPPORTING SPECIFIC DATAMODEL

| Events | | | | |
|-------------------------------------|----|--|---------|--|
| <input checked="" type="checkbox"/> | No | Sightings CIRCL: 2 (2017-03-19 16:17:59) | | |
| <input checked="" type="checkbox"/> | No | Inherit | (2/0/0) | |
| <input checked="" type="checkbox"/> | No | Inherit | (0/0/0) | |

| Tags | + |
|------------------|--|
| Date | 2016-02-24 |
| Threat Level | High |
| Analysis | Initial |
| Distribution | Connected communities |
| Sighting Details | freetext test |
| MISP: 2 | No |
| CIRCL: 2 | 4 (2) - restricted to own organisation only. |
| Discussion | |

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Supporting specific datamodel



- Most obvious goal: Improve the way we query data
 - ▶ Unified all export APIs
 - ▶ Incorporate all contextualisation options into **API filters**
 - ▶ Allow for an **on-demand** way of **excluding potential false positives**
 - ▶ Allow users to easily **build their own** export modules feed their various tools

└─ Making use of all this context

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EXAMPLE QUERY

/attributes/restSearch

```
{
  "returnFormat": "netfilter",
  "enforceWarninglist": 1,
  "tags": {
    "NOT": [
      "tlp:white",
      "type:OSINT"
    ],
    "OR": [
      "misp-galaxy:threat-actor=\"Sofacy\"",
      "misp-galaxy:sector=\"Chemical\""
    ],
  }
}
```

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└ Example query

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- Make decisions on whom to share data with based on context
 - ▶ MISP by default decides based on the information creator's decision who data gets shared with
 - ▶ Community hosts should be able to **act as a safety net** for sharing
 - **Push filters** - what can I push?
 - **Pull filters** - what am I interested in?
 - **Local tags** allow for information flow control

└ Synchronisation filters

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THE EMERGENCE OF ATT&CK AND SIMILAR GALAXIES

- Standardising on high-level **TTPs** was a solution to a long list of issues
- Adoption was rapid, tools producing ATT&CK data, familiar interface for users
- A much better take on kill-chain phases in general
- Feeds into our **filtering** and **situational awareness** needs extremely well
- Gave rise to other, ATT&CK-like systems tackling other concerns
 - ▶ **attck4fraud** ³ by Francesco Bigarella from ING
 - ▶ **Election guidelines** ⁴ by NIS Cooperation Group

³https://www.misp-project.org/galaxy.html#_attck4fraud

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└ The emergence of ATT&CK and similar galaxies

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EXAMPLE QUERY TO GENERATE ATT&CK HEATMAPS

/events/restSearch

```
{
  "returnFormat": "attack",
  "tags": [
    "misp-galaxy:sector=\"Chemical\""
  ],
  "timestamp": "365d"
}
```

└ Example query to generate ATT&CK heatmaps

```
/events/restSearch
{
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```

A SAMPLE RESULT FOR THE ABOVE QUERY

| Pie Attack - Attack Pattern | | | | | | | | | | | |
|-------------------------------------|------------------------------------|---|----------------------------------|----------------------------------|--|--|------------------------------------|------------------------------------|---|---------------------------------------|--|
| Enterprise Attack - Attack Pattern | | | Mobile Attack - Attack Pattern | | | | | | | | |
| Initial access | Execution | Persistence | Privilege escalation | Defense evasion | Credential access | Discovery | Lateral movement | Collection | Exfiltration | Command and control | |
| Spearphishing Attachment | Scripting | Screensaver | File System Permissions Weakness | Process Hollowing | Securityd Memory | Password Policy Discovery | AppleScript | Data from Information Repositories | Exfiltration Over Alternative Protocol | Standard Application Layer Protocol | |
| Spearphishing via Service | Command-Line Interface | Login Item | AppCert DLLs | Code Signing | Input Capture | System Network Configuration Discovery | Distributed Component Object Model | Data from Removable Media | Exfiltration Over Command and Control Channel | Communication Through Removable Media | |
| Trusted Relationship | User Execution | Trap | Application Shimming | Rootkit | Bash History | Process Discovery | Pass the Hash | Man in the Browser | Data Compressed | Custom Command and Control Protocol | |
| Replication Through Removable Media | Regsvcs/Regasm | System Firmware | Scheduled Task | NTFS File Attributes | Exploitation for Credential Access | Network Share Discovery | Exploitation of Remote Services | Data Staged | Automated Exfiltration | Multi-Stage Channels | |
| Exploit Public-Facing Application | Trusted Developer Utilities | Registry Run Keys / Start Folder | Startup Items | Exploitation for Defense Evasion | Private Keys | Peripheral Device Discovery | Remote Desktop Protocol | Screen Capture | Scheduled Transfer | Remote Access Tools | |
| Spearphishing Link | Windows Management Instrumentation | LC_LOAD_DYLIB Addition | New Service | Network Share Connection Removal | Brute Force | Account Discovery | Pass the Ticket | Email Collection | Data Encrypted | Uncommonly Used Port | |
| Valid Accounts | Service Execution | LSASS Driver | Sudo Caching | Process Doppelganging | Password Filter DLL | System Information Discovery | Windows Remote Management | Clipboard Data | Exfiltration Over Other Network Medium | Multilayer Encryption | |
| Supply Chain Compromise | CMSTP | Rc.common | Process Injection | Disabling Security Tools | Two-Factor Authentication Interception | System Network Connections Discovery | Windows Admin Shares | Video Capture | Exfiltration Over Physical Medium | Domain Fronting | |
| Drive-by Compromise | Control Panel Items | Authentication Package | Bypass User Account Control | Timestamp | LLMNR/NBT-NS Poisoning | Network Service Scanning | Remote Services | Audio Capture | Data Transfer Size Limits | Data Obfuscation | |
| Hardware Additions | Dynamic Data Exchange | Component Firmware | Extra Window Memory Injection | Modify Registry | Credentials in Files | File and Directory Discovery | Taint Shared Content | Data from Network Shared Drive | Connection Proxy | | |
| | Source | Windows Management Instrumentation Event Subscription | Setuid and Setgid | Indicator Removal from Tools | Forced Authentication | Security Software Discovery | Application Deployment Software | Data from Local System | Commonly Used Port | | |
| | Space after Filename | Change Default File | Launch Daemon | Hidden Window | Keychain | System Service Discovery | Third-party Software | Automated Collection | Data Encoding | | |

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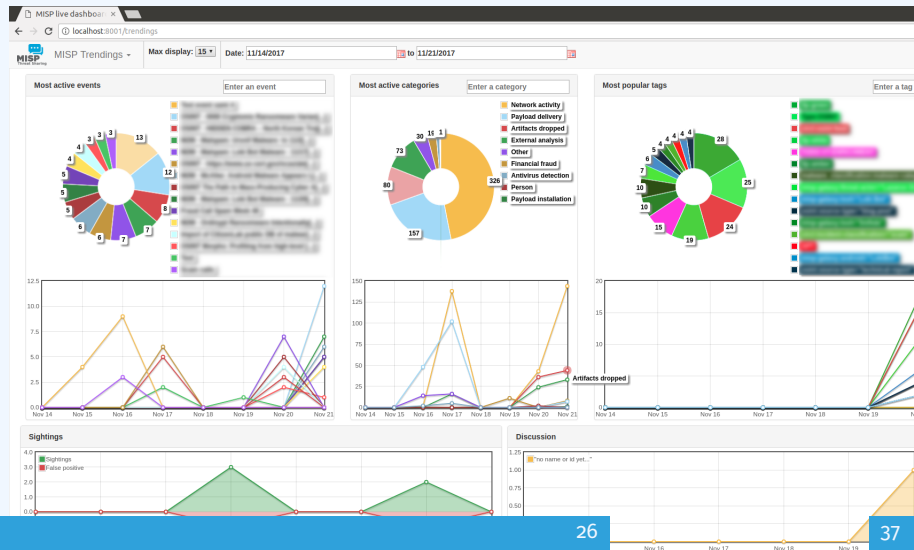
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A sample result for the above query



A SAMPLE RESULT FOR THE ABOVE QUERY

MONITOR TRENDS OUTSIDE OF MISP (EXAMPLE: DASHBOARD)



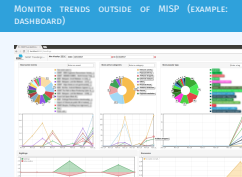
26

37

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└ Monitor trends outside of MISP (example: dashboard)



- We were still missing a way to use all of these systems in combination to decay indicators
- Move the decision making **from complex filter options to complex decay models**
- Decay models would take into account various **taxonomies, sightings**, the **type** of each indicator **Sightings** and **Creation date**
- The first iteration of what we have in MISP now took:
 - ▶ 2 years of research
 - ▶ 3 published research papers
 - ▶ A lot of prototyping

└─Decaying of indicators

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

Where,

- $\text{score} \in [0, 100]$
- $\text{base_score} \in [0, 100]$
- decay is a function defined by model's parameters controlling decay speed
- Attribute Contains *Attribute's* values and metadata
(*Taxonomies, Galaxies, ...*)
- Model Contains the *Model's* configuration

└ Scoring Indicators: Our solution

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

Where,

- $\text{score} \in [0, 100]$
- $\text{base_score} \in [0, 100]$
- decay is a function defined by model's parameters controlling decay speed
- Attribute Contains *Attribute's* values and metadata
(*Taxonomies, Galaxies, ...*)
- Model Contains the *Model's* configuration

IMPLEMENTATION IN MISP: Event/view

The screenshot shows the MISP Event/view interface. At the top, there are tabs for Plots, Galaxy, Event graph, Correlation graph, ATTACK matrix, Attributes, and Discussion. Below these is a search bar and a 'Galaxies' section. The main table displays a list 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. The 'Decay score' toggle button is visible in the top right of the table.

| 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 | | | | | | | | | | | 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 | | | 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:number x | | | | 1 3 19 Show 6 more... | S1:1 | | Inherit | | | 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 | | | NIDS Simple Decaying ... 37.41 Model 5 0 | |
| 2019-07-18 | | Network activity | ip-src | 6.6.6.6 | | | | | 41 | | | Inherit | | | 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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Implementation in MISP: Event/view



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"
        }
      }
    ]
  }
]
```

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└ Implementation in MISP: API result

```
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"
        }
      }
    ]
  }
]
```

Decaying Models

« previous

next »

| All ModelsMy ModelsShared ModelsDefault 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 | ✓ |     |

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

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next »

View, update, add, create, delete, enable, export, import

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Implementation in MISP: Index



IMPLEMENTATION IN MISP: base_score TOOL

Search Taxonomy ✕

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 ▼

3 not having numerical value

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 ? |

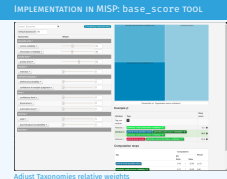
Computation steps

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

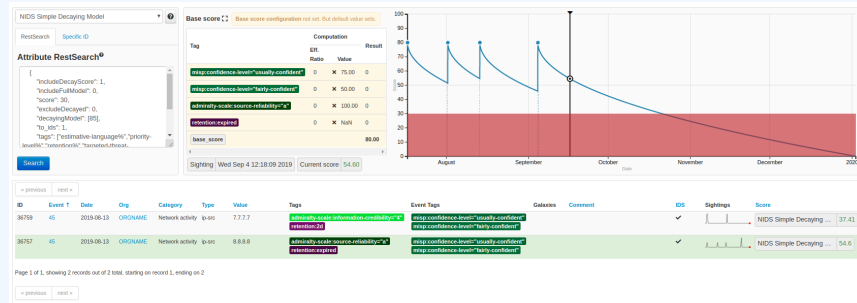
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Implementation in MISP: base_score tool



IMPLEMENTATION IN MISP: SIMULATION TOOL



Simulate *Attributes* with different *Models*

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Turning data into actionable intelligence

Implementation in MISP: simulation tool



/attributes/restSearch

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

└ Implementation in MISP: API query body

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

- Massive rise in **user capabilities**
- Growing need for truly **actionable threat intel**
- Lessons learned:
 - ▶ **Context is king** - Enables better decision making
 - ▶ **Intelligence and situational awareness** are natural by-products of context
 - ▶ Don't lock users into your **workflows**, build tools that enable theirs

└ To sum it all up...

- Massive rise in **user capabilities**
- Growing need for truly **actionable threat intel**
- Lessons learned:
 - ▶ **Context is king** - Enables better decision making
 - ▶ **Intelligence and situational awareness** are natural by-products of context
 - ▶ Don't lock users into your **workflows**, build tools that enable theirs

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└─ Get in touch if you have any questions

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