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# Applying Security Metrics for Quality Control and Situational Awareness

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# Introduction and Motivation

- A large quantity of technical threat intelligence feeds is available
- Threat intelligence platforms share technical threat intelligence data: MISP, ACDC “Central Clearing House (CCH)”
- But:
  - How to measure and assure *data quality*?
  - How to achieve an *overview* of the data?
  - Does this data contribute to strategical threat intelligence (*situational awareness*)?

# Security Metrics: What is a „*good*“ Metric?

- Quantification of data characteristics
  - Number of incidents per month
  - Number of IDS alerts per day
- SMART or foolish?
  - Measurement should be well-defined
  - Measurement should contribute achieving a specific aim:
    - ⇒ Quality control
    - ⇒ Situational awareness

# Security Metrics: Classes of Metrics

- Performance vs effectiveness (Marika Chauvin and Toni Gidwani, FIRST TI Symposium, March 2019, London):
  - Performance: Reasonable to maintain technical systems and develop software. Easy to measure
  - Effectiveness: Indication if a purpose has been accomplished (e.g. number of incidents). Harder to measure, but usually more expressive!

# Security Metrics: Classes of Metrics

- Classification by use cases:
  - Quality metric: Assessment of data quality (effectiveness)
  - Operational metric: Gain insight into data properties (contributes to situational awareness)
  - Malware metric: Metrics focusing on Malware

# Security Metrics: Types of Metrics

- Divided by methods of quantification:
  - *Counter*: Counting number of events (e.g. number of submitted reports)
    - *Uniqueness*: Counting unique items in the data set (e.g. IP addresses)
  - *Histogram*: Grouping data into bins (e.g. for real numbers and time spans)
  - *Statistics*: Measuring statistical properties of the data

# Quality Metrics: 6 Dimensions

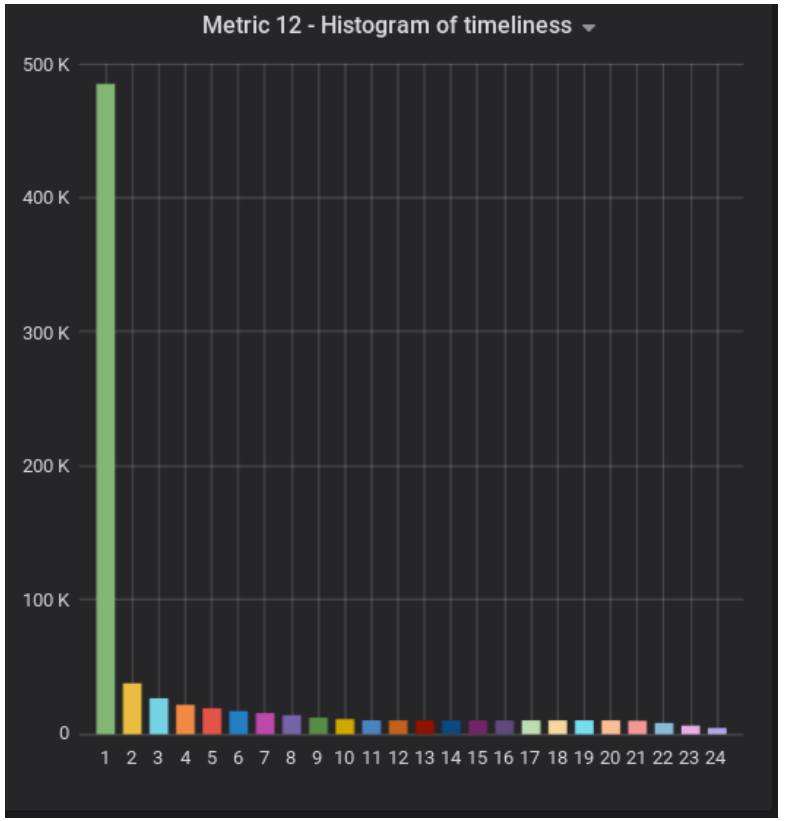
- *Accuracy*: Is the information correct?
- *Uniqueness*: Are duplicates in the data set?
- *Timeliness*: The time span between detection and submission
- *Consistency*: Do different partitions of the data have similar properties?
- *Completeness*: Are all submitted reports in the data set or are any reports missing?
- *Validity*: Are syntax and structure of reports correct?

# Quality Metrics: Accuracy

- Hard if not impossible to measure:
  - Often data itself does not contain relevant information about correctness: e.g. Proxy / NAT gateways
- Mitigation:
  - Focus on “low hanging fruits”: IP addresses from private address spaces or Bogons.
  - Interaction of participating sites: “sightings” in MISP

# Quality Metrics: Timeliness

- Time spans (e.g. difference between detection and submission) can be quantified as follows:
  - Histogram: E.g. one-hour bins
  - Statistical values: mean time (average) and standard deviation
- An acceptable delay depends on use case:
  - Incident handling
  - Blocking of attacks → fast reaction required



# Quality Metrics: Completeness

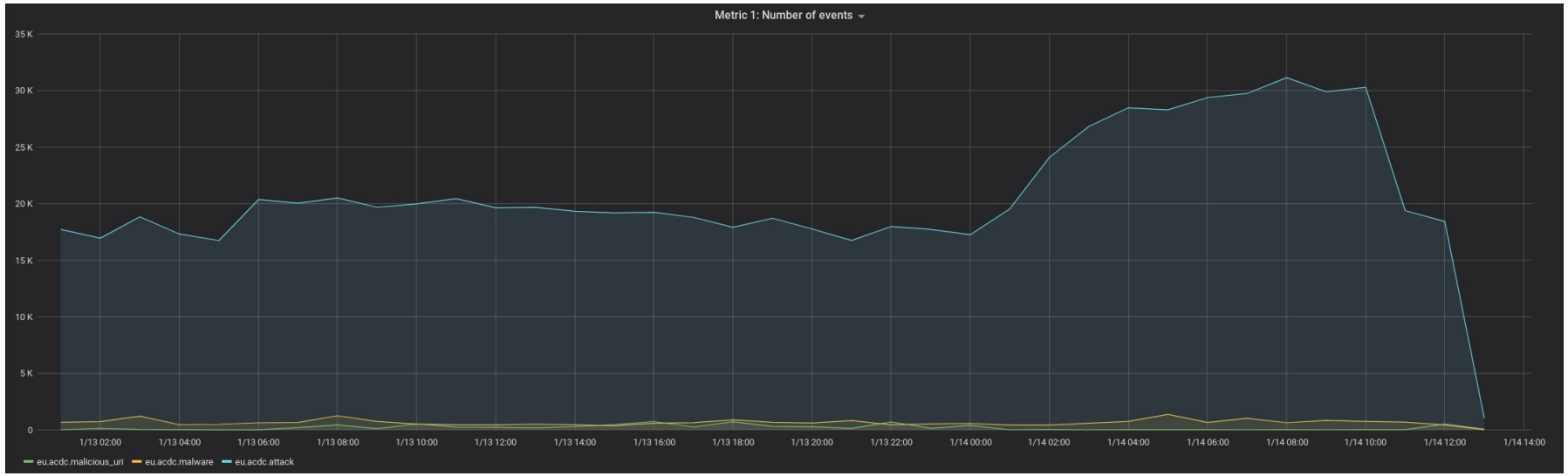
- Completeness on a data set is hard to guarantee:
  - Often no central instance can measure completeness
- What we can do:
  - Measurement of numbers of reports to find significant gaps
  - Is there a significant difference between the expected and measured number of reports/events?
  - Give participating sites feedback pertaining to their data submissions

# Quality Metrics: Uniqueness

- Not easy to define:
  - Identical events or duplicate features?
- Use case:
  - Count reports (e.g. DDoS): duplicates might be valuable
  - Incident reporting: rather avoid duplicates

# Metrics for situational awareness

- Spot new emerging threats (*strategic* threat intelligence): Internet worms, IoC botnets, large scale attacks
- Is a baseline in the data?
- Are there:
  - Outliers?
  - Anomalies?
  - Change points?



# Operational Metrics: Unique IP Addresses

- Number of unique IP addresses being submitted in a specific time span
- Special challenge: dynamically assigned IP addresses
- Contribution to situational awareness:
  - Reasonable to assume a “base line” if the number of events is sufficiently large
  - Significant increase over time points to large scale incident (e.g. new Internet worm or IoC Botnet)
  - May point to an incident in a network of a participating site

# Operational Metrics: Novelty and Intersection of IP Addresses

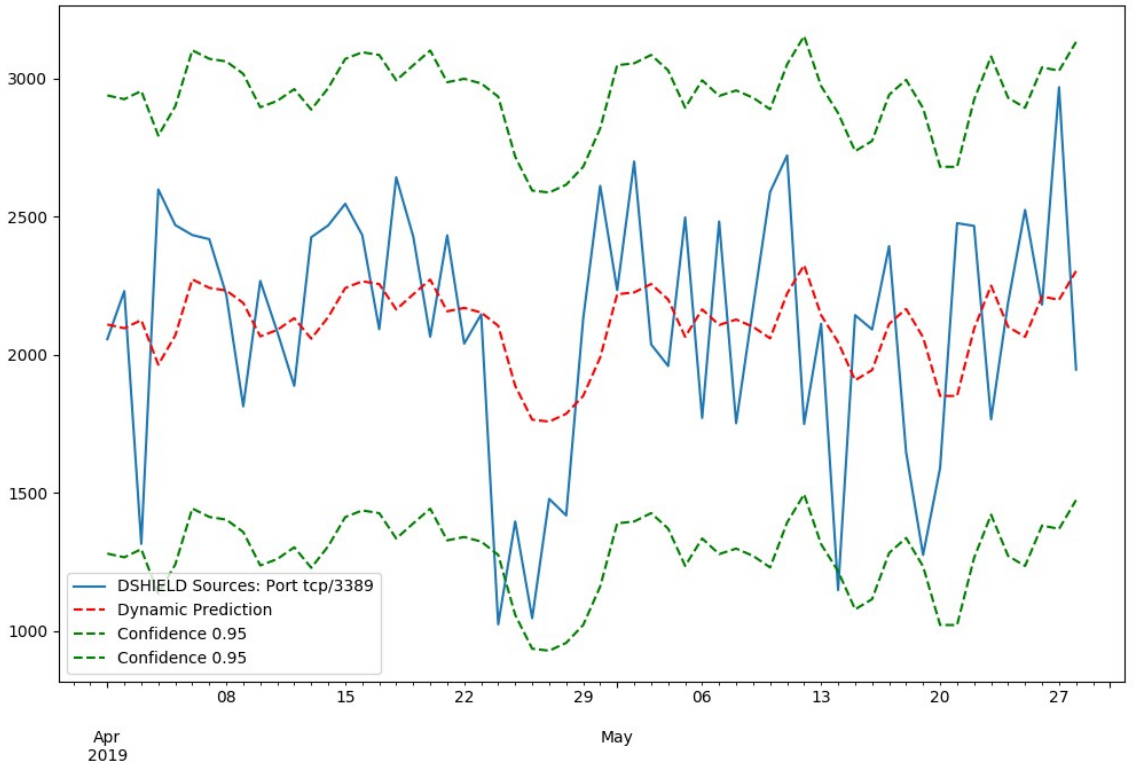
- Number of unique IP addresses that are not present in the last time slice
- Special challenge: dynamically assigned IP addresses
- Contribution to situational awareness:
  - Number of newly compromised or suspicious systems (novelty)
  - Time span a system is compromised (intersection): Indication for incident handling effectiveness

# Operational Metrics:  Other important features

- Number of IP addresses (unique, intersection, and novelty) per ASN
  - Be aware of „political“ issues (e.g. worst ASN)
- Number of connections targeting TCP/UDP ports
- Port TCP/3389:
  - Emerging Windows RDP worm?
- Specific metrics (e.g. Sources targeting tcp/3389) on demand?
  - Number of metrics may explode

# What comes next?

- Malware metrics: normalization of naming required
- Automation of baselining (*consistency*) and anomaly detection
- Test of statistical approach based on ARIMA



# Thanks for your attention!

# Questions?