Carnegie Mellon
Software Engineering Institute

CERT
Situational
Awareness

Analysis of the US-CERT DAC

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The CERT Network Situational Awareness Group is part of the Software Engineering Institute. The Software Engineering Institute is sponsored by the U.S. Department of Defense.

Outline

- Data
- Graphical Displays
- Detecting Trends
- Anomaly Detection
- Roadmap

Data

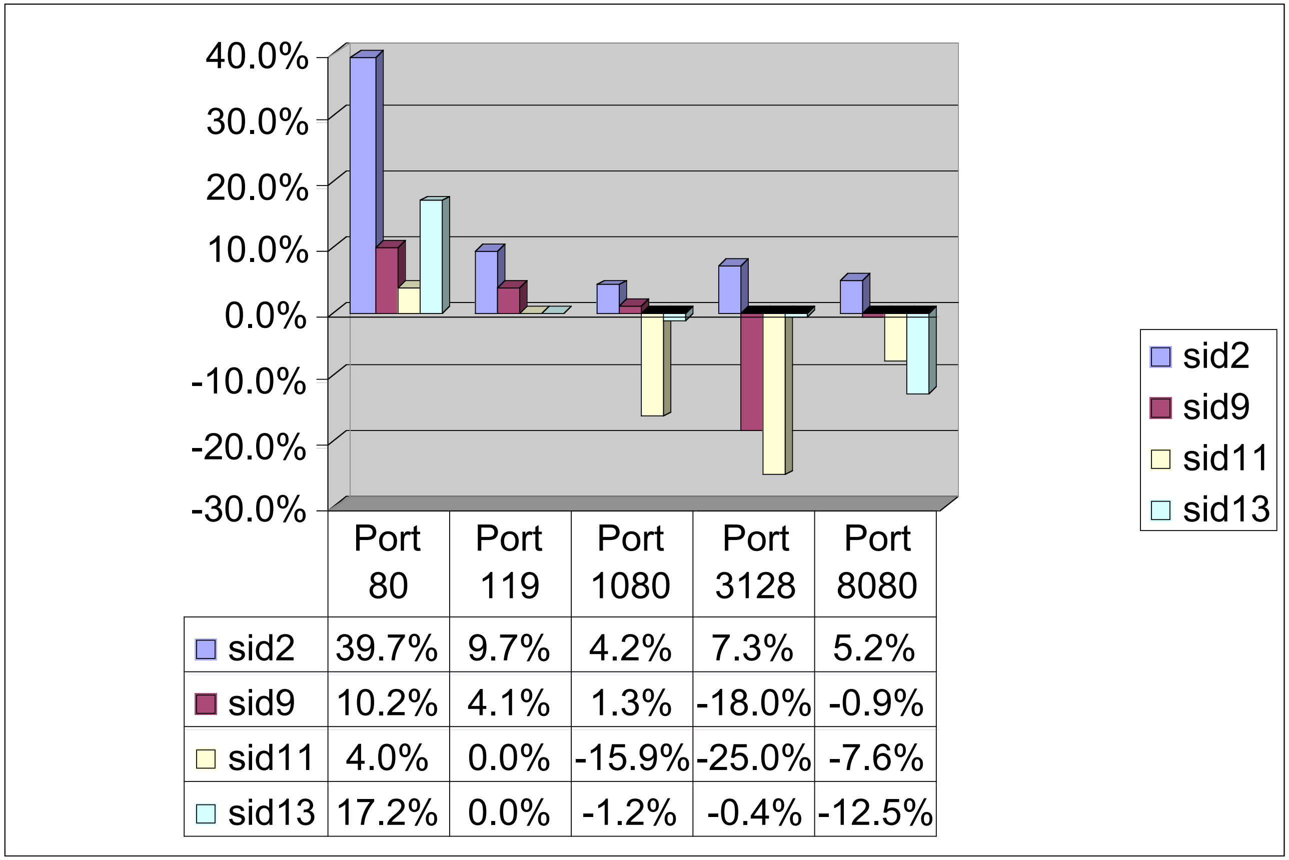
- Snort
  - Signature-based alerts
  - Pre-processor alerts
- Origin
  - Multiple networks of varying size
- Volume
  - ~30-50 million alerts per month
- Ancillary Information
  - Country code
  - Netblock

IDS Data: challenges

- No new attacks
  - Only matches known signatures
- Lack of context
  - Don’t know what we are not seeing
- Non-standardized signature rule sets
  - No administrative control
- Missing Data
  - Uncertainty: Sensor failure vs. no intrusion attempts

TCP Destination Port Changes

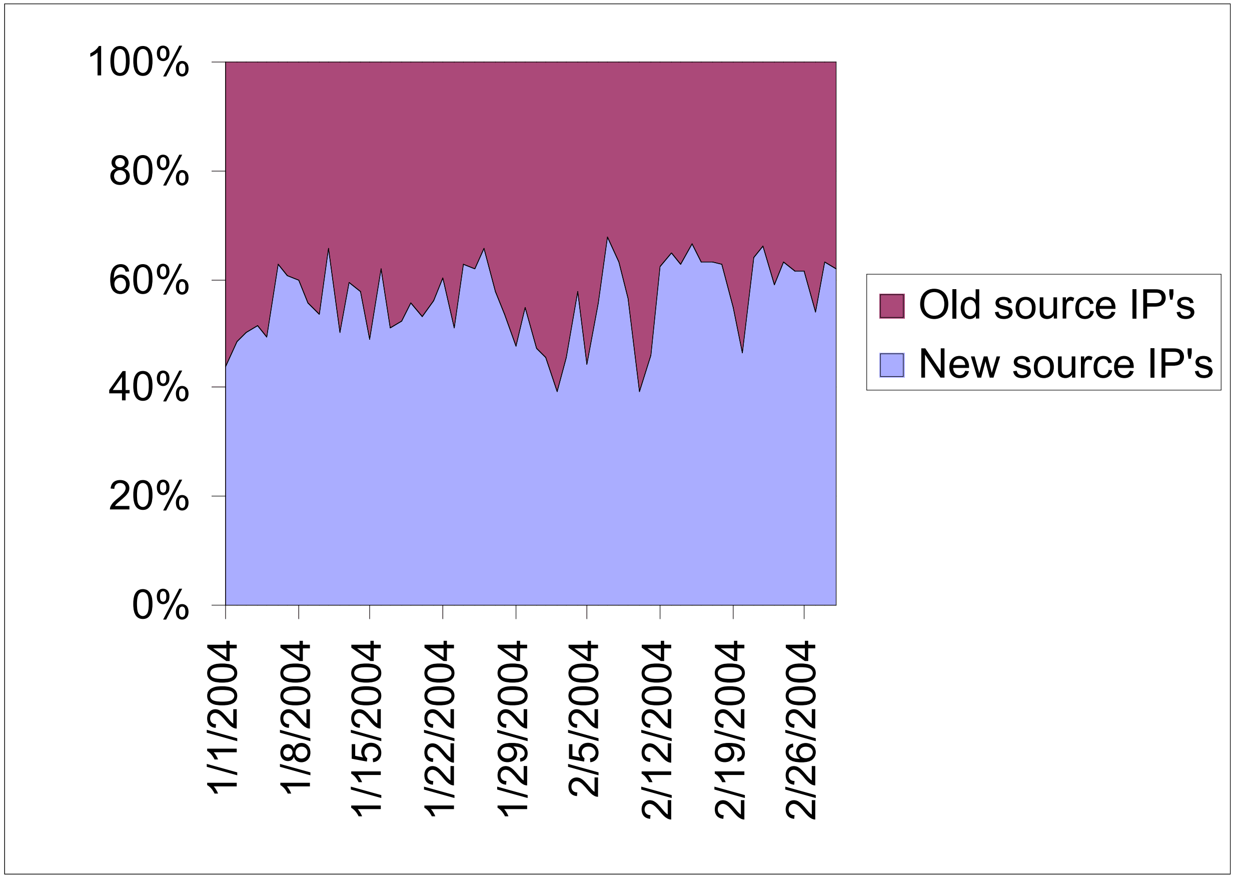
Comparison of port activity across organizations shows monthly trends.



	Port 80	Port 119	Port 1080	Port 3128	Port 8080
sid2	39.7%	9.7%	4.2%	7.3%	5.2%
sid9	10.2%	4.1%	1.3%	-18.0%	-0.9%
sid11	4.0%	0.0%	-15.9%	-25.0%	-7.6%
sid13	17.2%	0.0%	-1.2%	-0.4%	-12.5%

Share of New Source IP Addresses

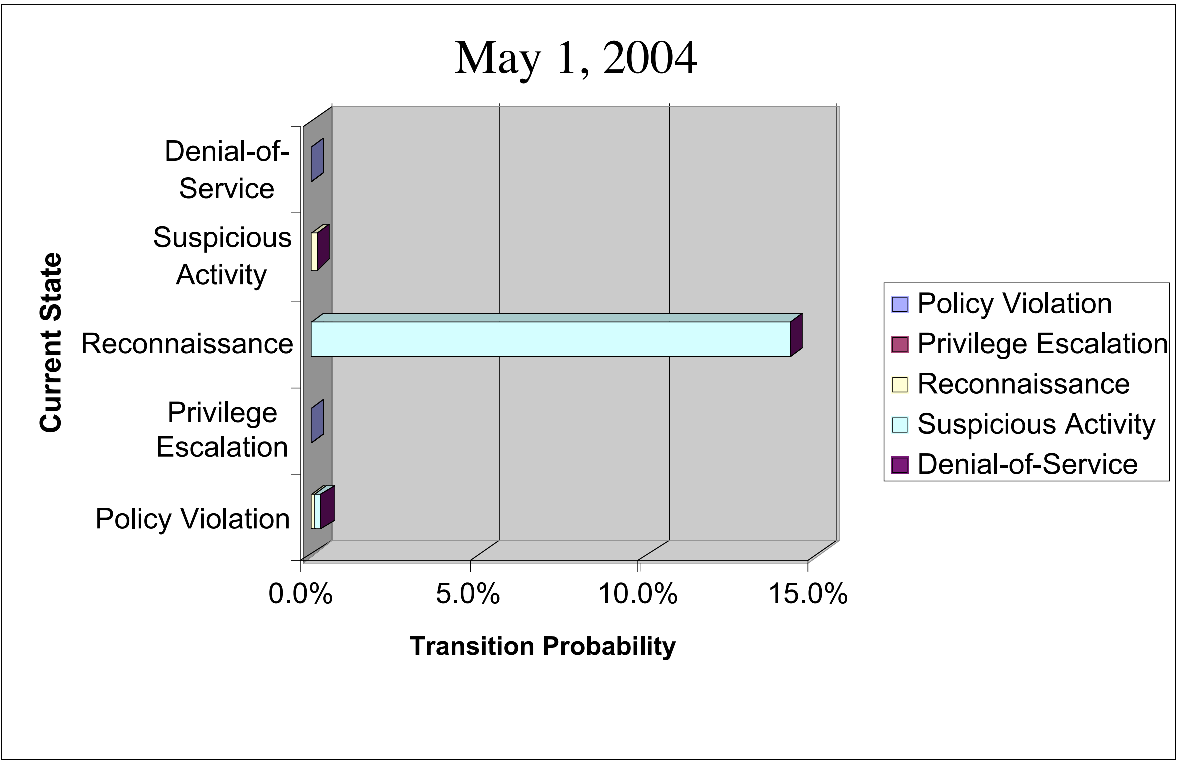
Share of new daily source IP addresses stays fairly consistent.



Signature Class Transition

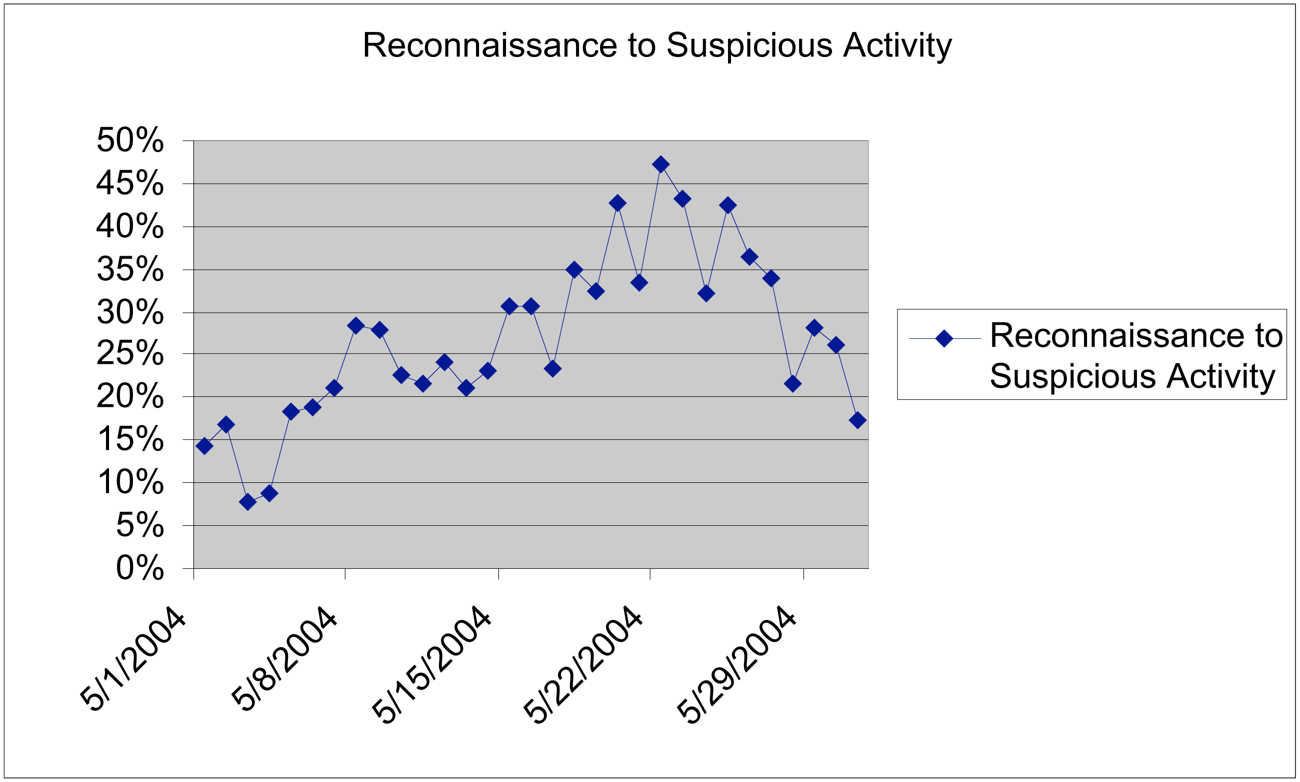
Transition probabilities highlight sequential patterns in data.

- Current State
  - Source IP records alert on Destination IP
- Transition probability
  - Percent chance for next class of alert recorded
- Most source/dest combos involve only one signature class
- Small transition probabilit for
  - Privilege Escalation



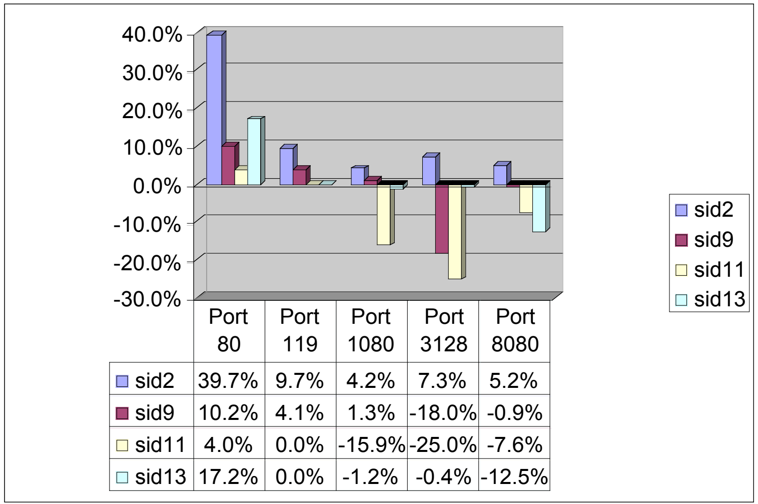
Daily Transition Probabilities

Transition probabilities can be monitored over time to identify consistent sequences.



Trend Detection

- Current month vs. previous month
  - Across organizations
  - % changes



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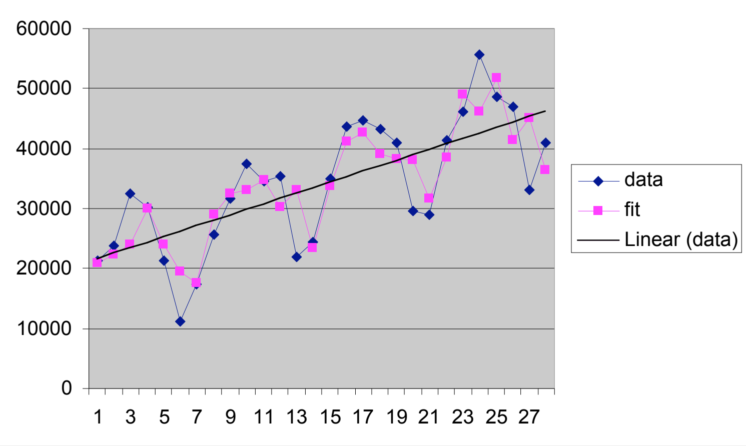
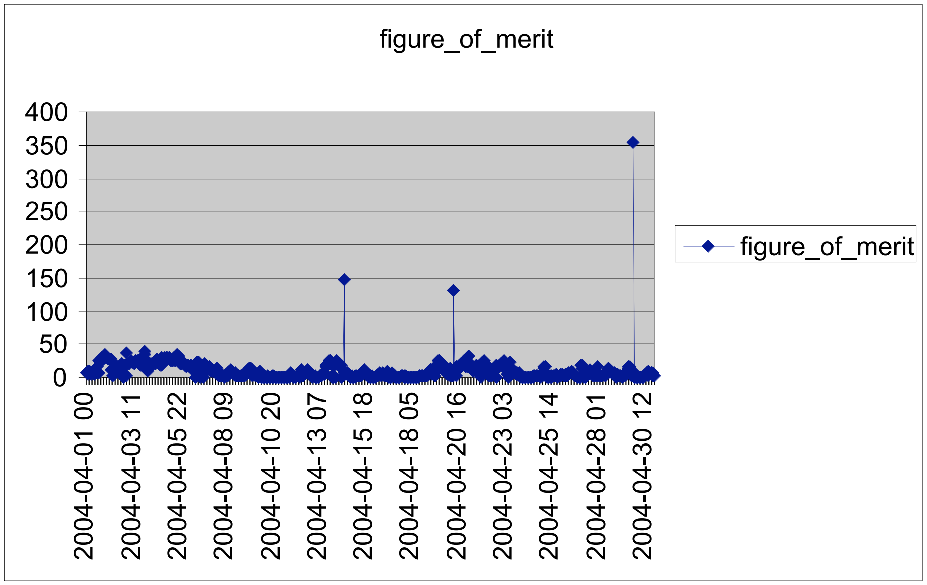
- Time Series
  - Fit trend line
    - Arbitrary time period
  - Seasonal Components
  - Regression with ARMA errors



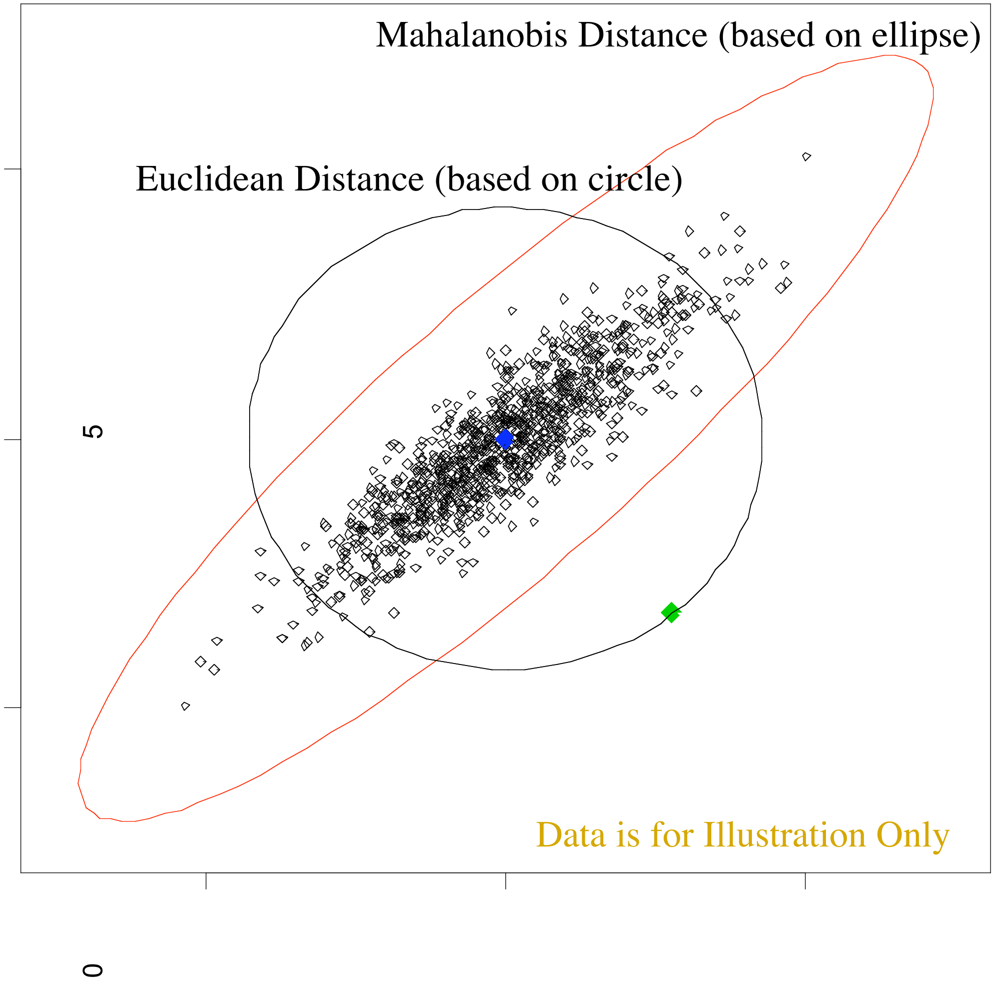
Anomaly Detection

- Goal: Identify data points which deviate from overall pattern of data
- Our current implementation (Figure of Merit)
  - Evaluate hours
  - Record # alerts, # source IP addresses, # destination IP addresses, # signatures
- For each hour, we want measure of how deviant it was.



Mahalanobis distance: 2D case

- Compute distance metric between each hour and the ***average*** hour
- When measuring Euclidean (Mahalanobis) Distance, all points along circle (ellipse) are same distance from the center
  - Points on larger circle/ellipse are greater distance from center
- Shape of the ellipse
  - Function of correlation between variables
- Generalizes to n dimensions (Ellipsoid)



Analysis Roadmap

- Incorporate flow data
- Automating trend detection
  - Time series analysis
- Clustering
  - Group sources by similar activity patterns
    - Temporal correlation
    - Targeting similarities
    - Signature usage
  - Look for evidence of possible coordination