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Internet Analysis System (IAS)

Module of the German IT Early Warning System

Martin Bierwirth, André Vorbach
Federal Office for Information Security (BSI), Germany

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Agenda

- BSI and CERT-Bund
- Situation center and situation awareness
- Internet-Analysis-System:
  - Concept / implementation
  - Sensor network
  - Examples, incident research, incident handling
  - Distinction from other systems
- Conclusion

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Federal Office for Information Security (BSI)

The national IT-Security authority

- High level federal public agency within the area of responsibility of the Federal Ministry for the Interior
- Independent and neutral authority for IT security in Germany
- Founded in 1991, ~ 500 employees, 64 Mio Budget
- Primary tasks:
  Internet security, Secure e-government, IT baseline protection, National / international security cooperation, Cryptographic innovation, Biometrics, Security from eavesdropping, Awareness campaign on IT security, Certification and approval, Protection of critical infrastructure
- Constituency: Federal administration, CI, citizen, partners
- **Responsible for IT-security of federal networks!**

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CERT-Bund

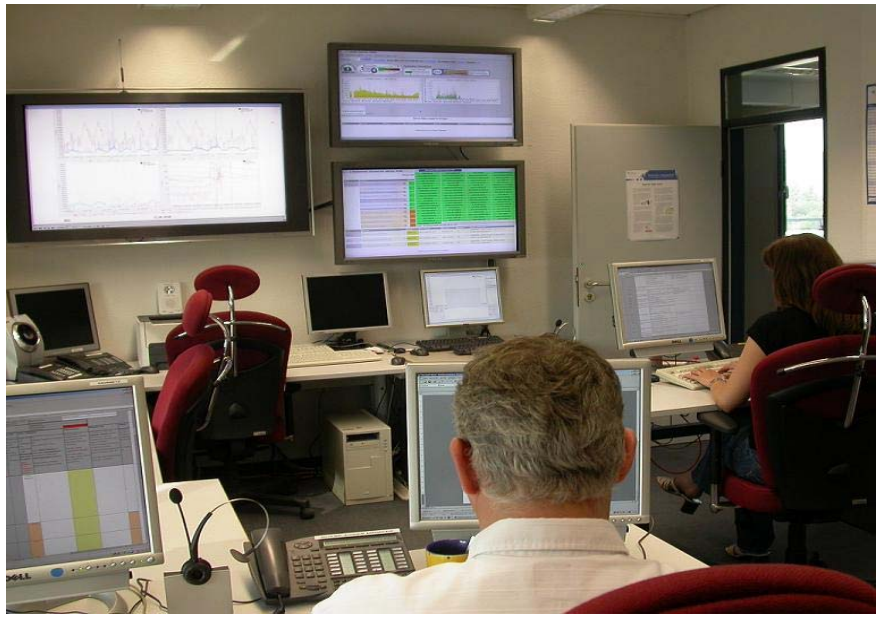
The Federal Incident Response Team

- Governmental CERT for the federal administration since 2001
- Provide central 24/7 PoC for national and international cooperation
- Analyze incoming incident reports and information about vulnerabilities and malware
- Publish advisories or information on counter measures and / or workarounds by running a *Warning & Information Service*
- Coordinate incident handling & malware reports
- Support the investigation of incidents and the recovery process
- **Run the *IT-Situation Centre* for monitoring sources and technical sensors**
- Run an alerting service for the federal administration
- Run the *National IT-Crisis Response Centre*

The National IT-Situation Centre

Generating Situation Awareness

- 24x7 availability, 8x7 staff on site
- Regular analysis of various sources and technical sensors
- Monitoring of the government networks using technical sensors
- Monitoring of availability of governmental web sites and services
- Close contact with national and international professional organizations
- Generating situation awareness
- Longterm monitoring generates situation reports for different levels
- Organizational and technical preparation for expansion to the IT Crisis Response Centre



Relevance of Sensor Networks

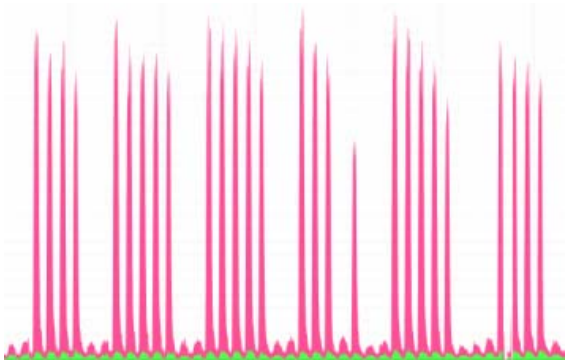
- Support analysts during research and the evaluation of incidents like
  - DDoS
  - Malware traffic, mass exploits
  - Spam and malware waves
- Extend and validate other sources
- Not necessarily „early warning capabilities“, but they can detect anomalies
  - caused by technical failures
  - caused by IT-attacks

- Deeper research after alerting of availability monitoring
- EVAA, CarmentiS, **Internet Analysis System (IAS)**

Internet-Analysis-System (IAS)

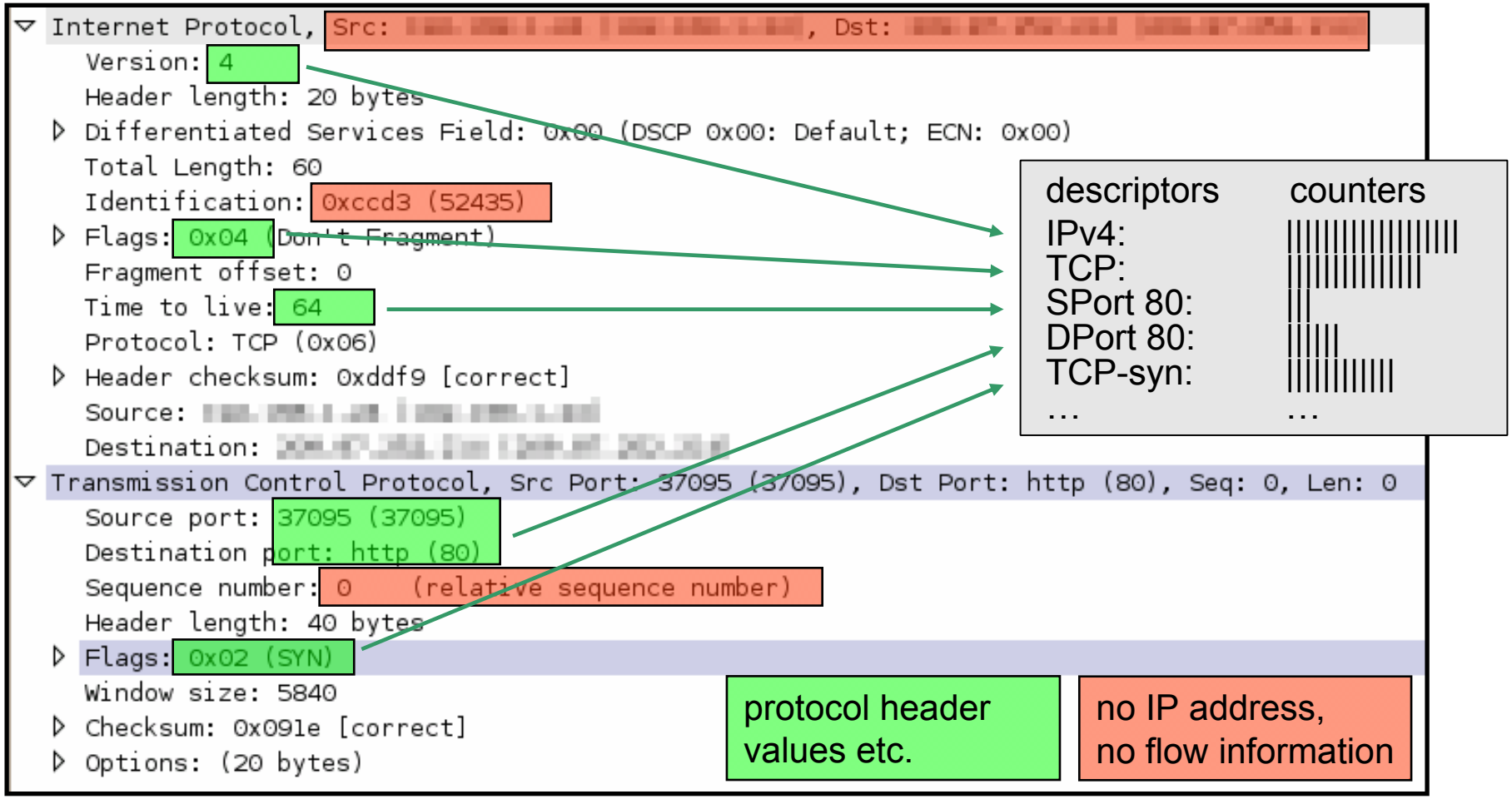
Motivation & background

- German government passed the „National plan for the protection of critical information infrastructures“ (2005).
  - Implementation plan for federal administration (2007).
  - Build a national IT early warning system.



- Among other aspects, one ambition was to
  - monitor statistical data in several networks of different authorities → find partners.
  - do not monitor data with personal reference (IP-address, content etc.) or flow information → implicit sanitization.
  - establish a central analysis station to gain a larger monitoring scope → compare data.

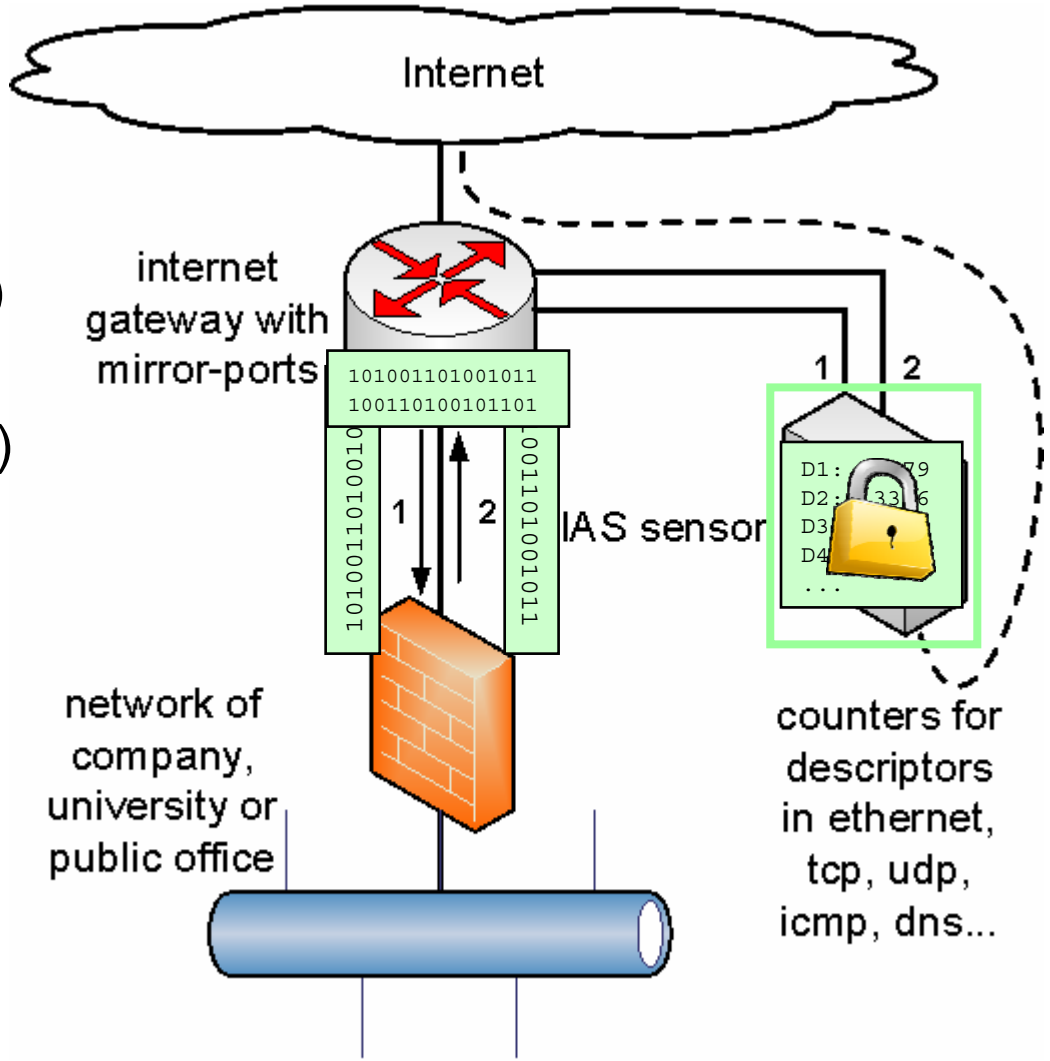
Monitoring concept of the IAS



Screenshot taken from Wireshark.

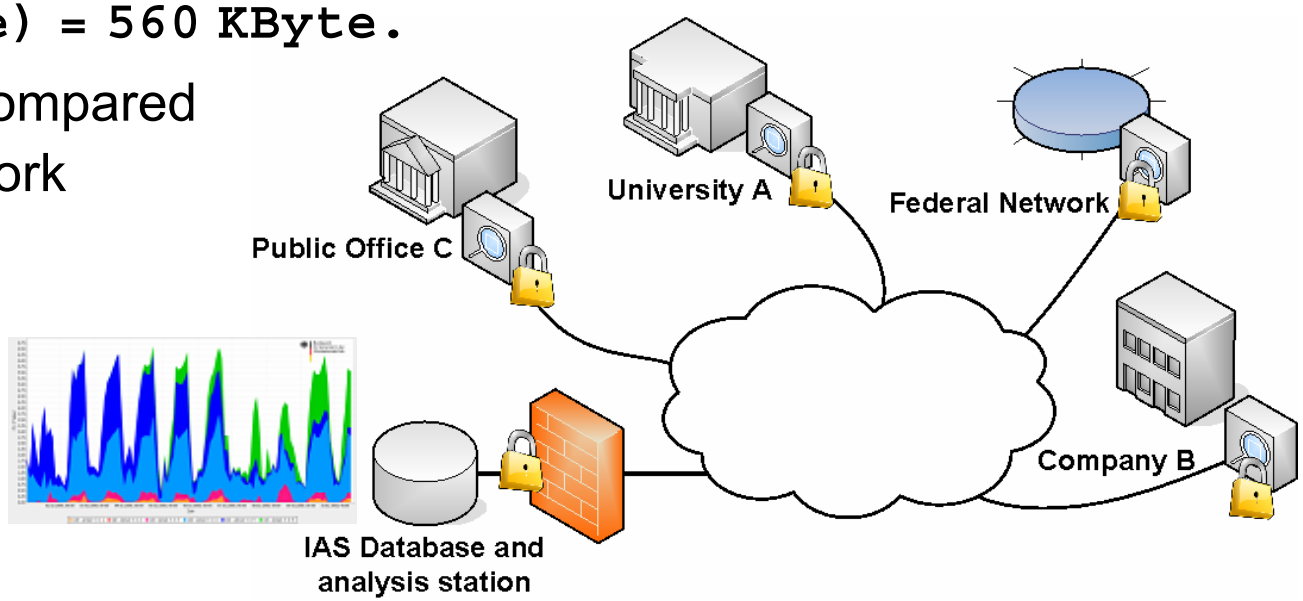
Functionality of an IAS sensor

- Passive sensor that receives the inbound / outbound traffic.
- Duplication by mirror (span) port or by network tap.
- Output (descriptor counters) is sent to analysis station every N seconds through a separate link (encrypted, usually + VPN tunnel).
- Hardware: 'small' server, xeon cpu, 1 GB RAM, 1U.



Sensor network, data aggregation

- Sensors in use: government networks + some partners.
- At each location one logical sensor per direction. In case of redundant internet links one logical sensor per link → up to 4 sensors.
- In one interval (N = 300 seconds), about 50K – 90K different attributes occur in network traffic. → Store counters and corresponding ID.
- Every five minutes, a sensor has to transmit about
  `70K * (4 + 4 Byte) = 560 KByte.`
- Extremely ‘small‘ compared to the original network throughput.



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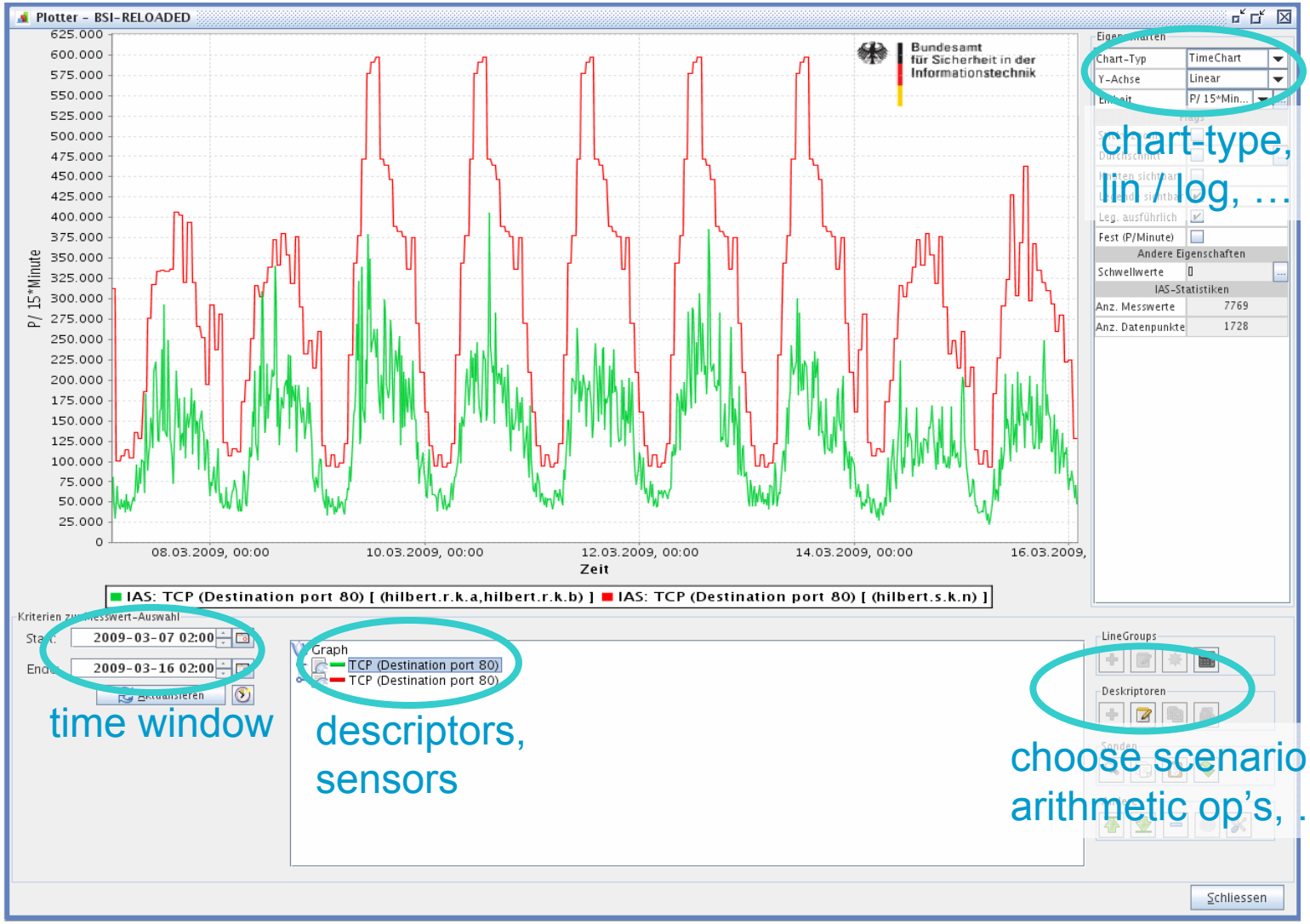
Accessing the IAS data

Client for manual research



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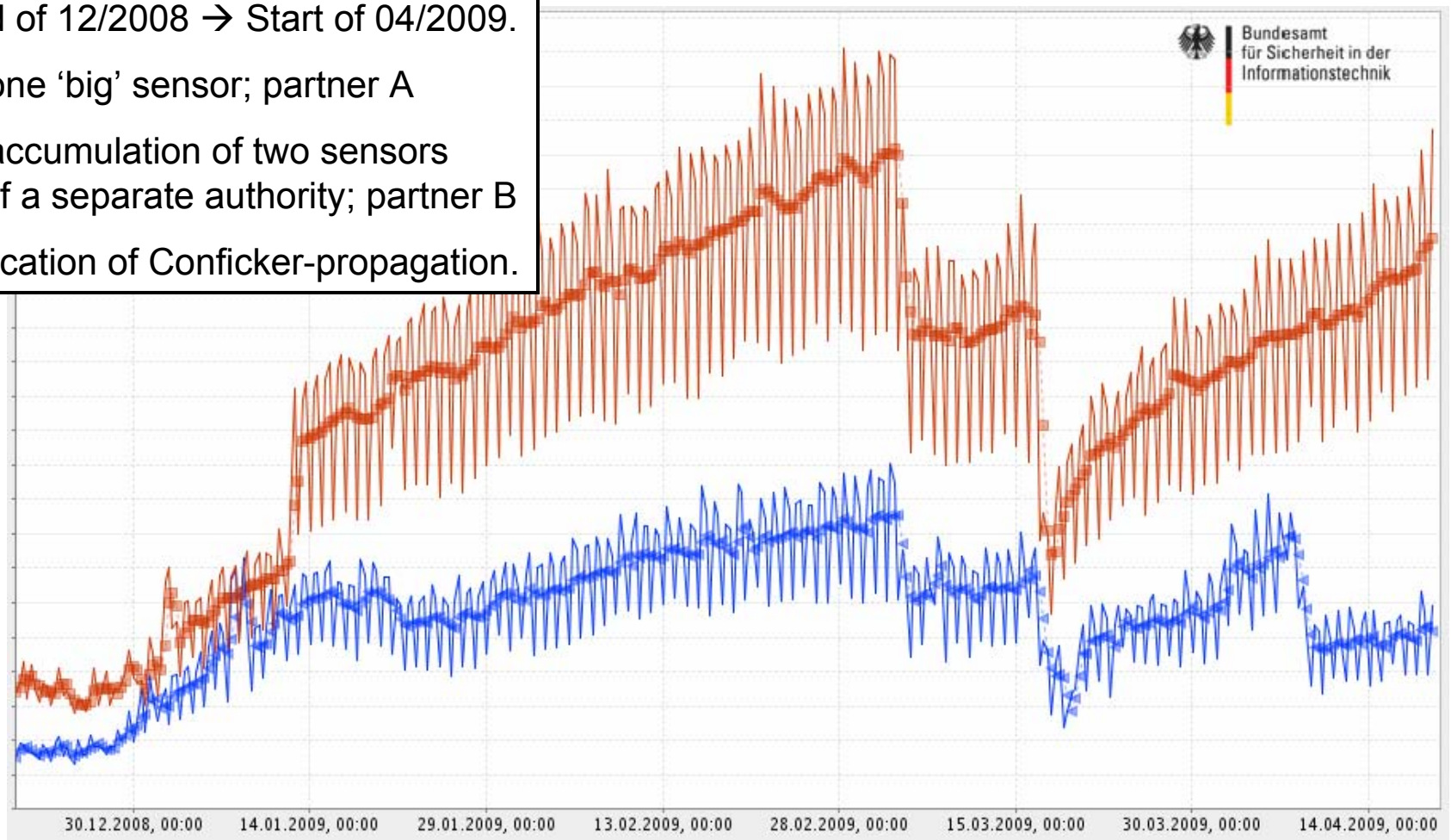
IAS trend analysis
Example: Conficker

- Scans on port 445/tcp.
- End of 12/2008 → Start of 04/2009.
  - one ‘big’ sensor; partner A
  - accumulation of two sensors of a separate authority; partner B
- Indication of Conficker-propagation.



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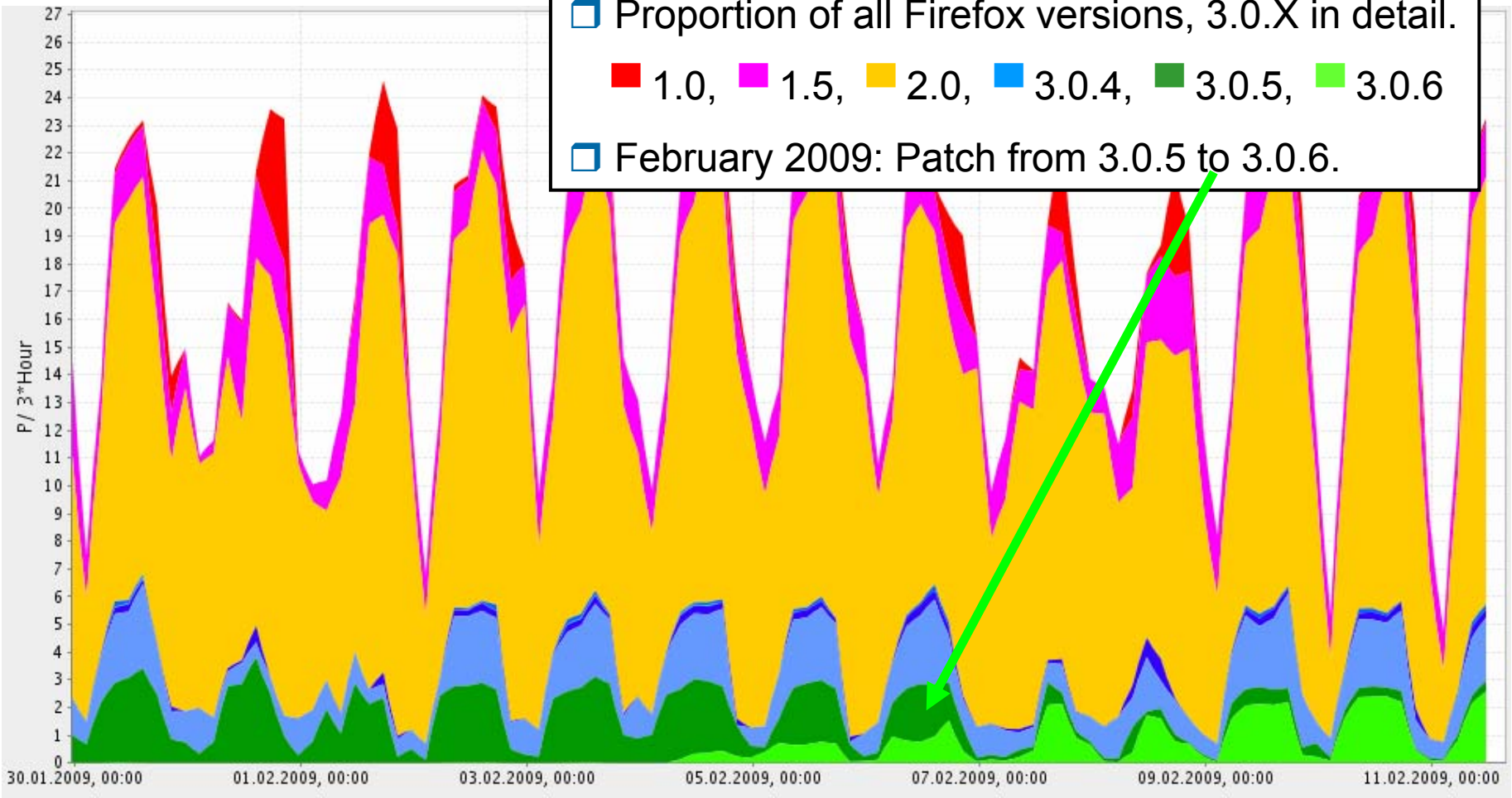
IAS trend analysis

Example: distribution of browser versions

- Outgoing HTTP traffic, get-request user-agent.
- Proportion of all Firefox versions, 3.0.X in detail.
  - 1.0, 1.5, 2.0, 3.0.4, 3.0.5, 3.0.6
- February 2009: Patch from 3.0.5 to 3.0.6.



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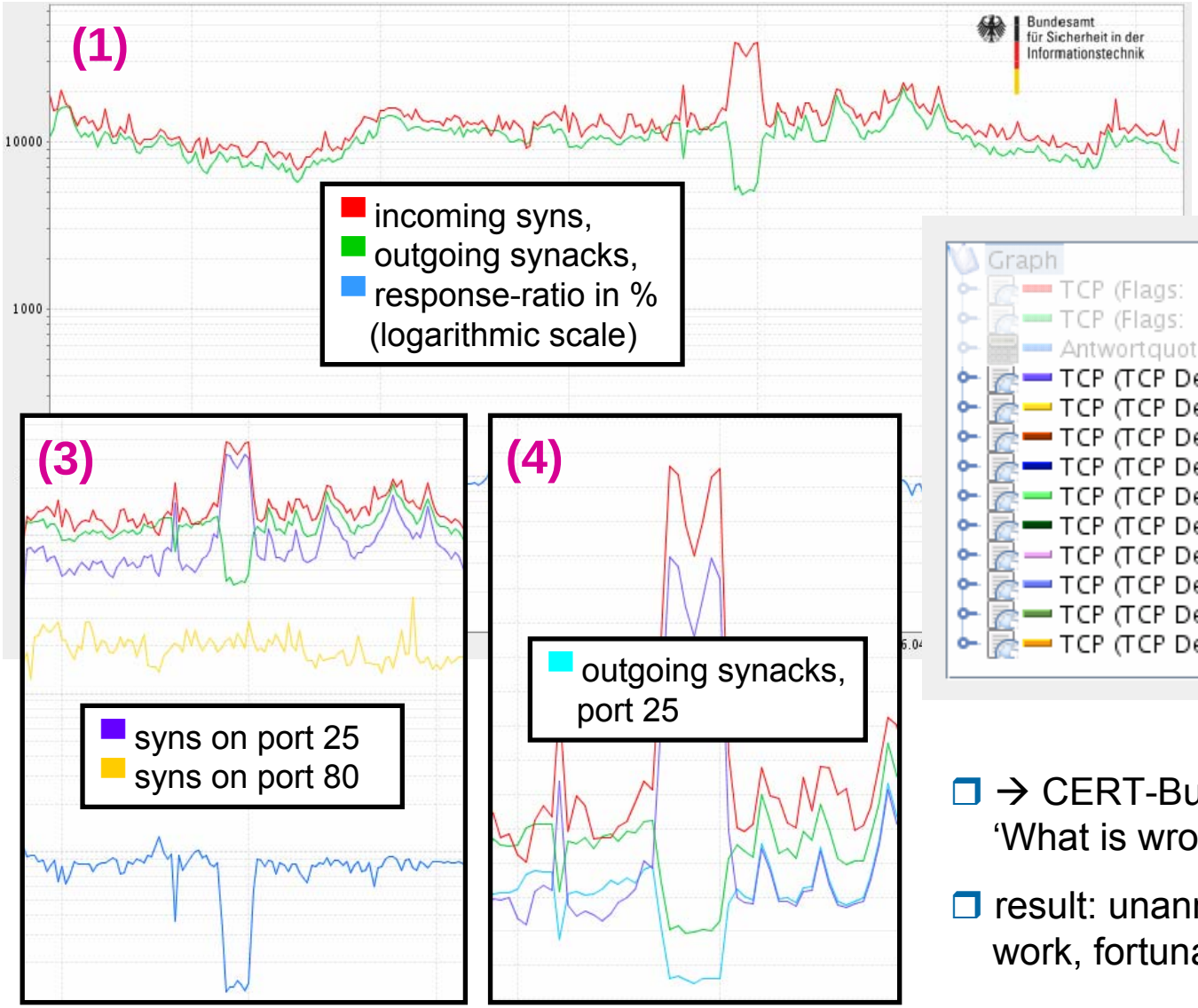
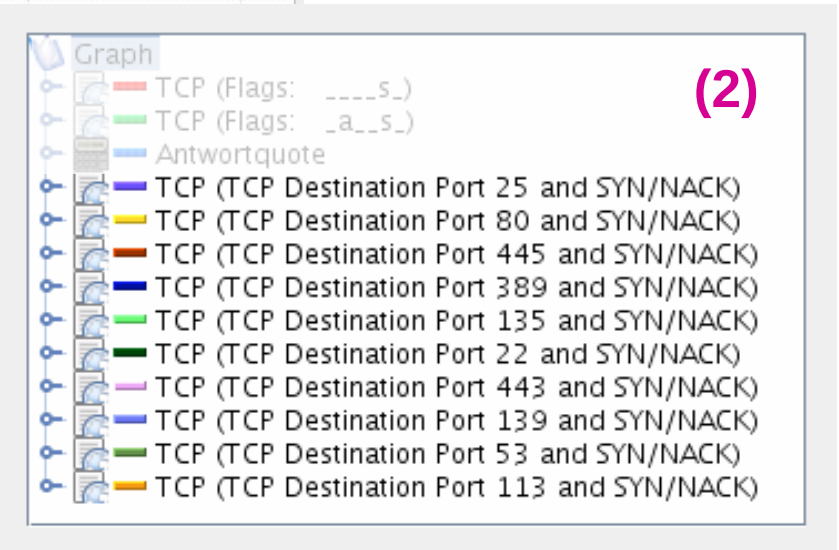
Research in case of an incident

Example: TCP SYN ‘anomaly’



query-result:
top 10 ports



- → CERT-Bund, calling the operator: ‘What is wrong with the MTA?’
- result: unannounced maintenance work, fortunately no serious problem

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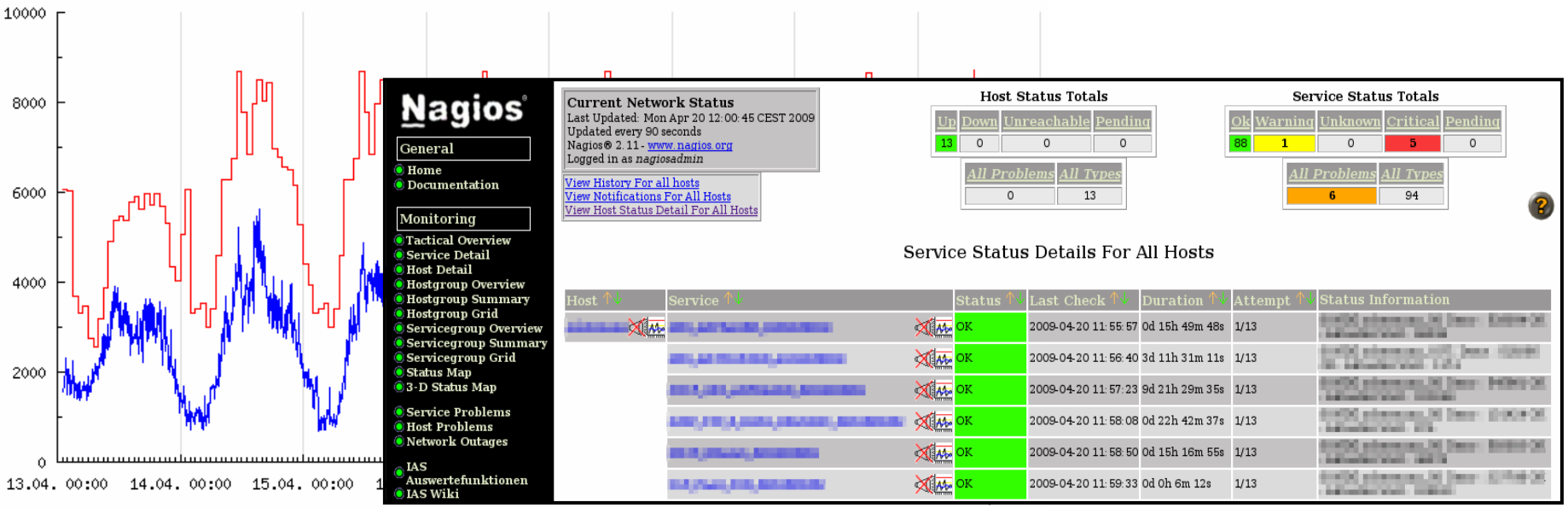
IAS anomaly detection

Profile generation, checking thresholds



- Calculate ■ upper bound of ■ normal behavior periodically.
- This is done for a subset of the descriptor-set: important attributes like ICMP-ping, DNS-queries, TCP-SYN, SMTP-RCPT…
- Permanent checks: compare ‘fresh’ IAS-data with precalculated thresholds → NAGIOS http://www.nagios.org/

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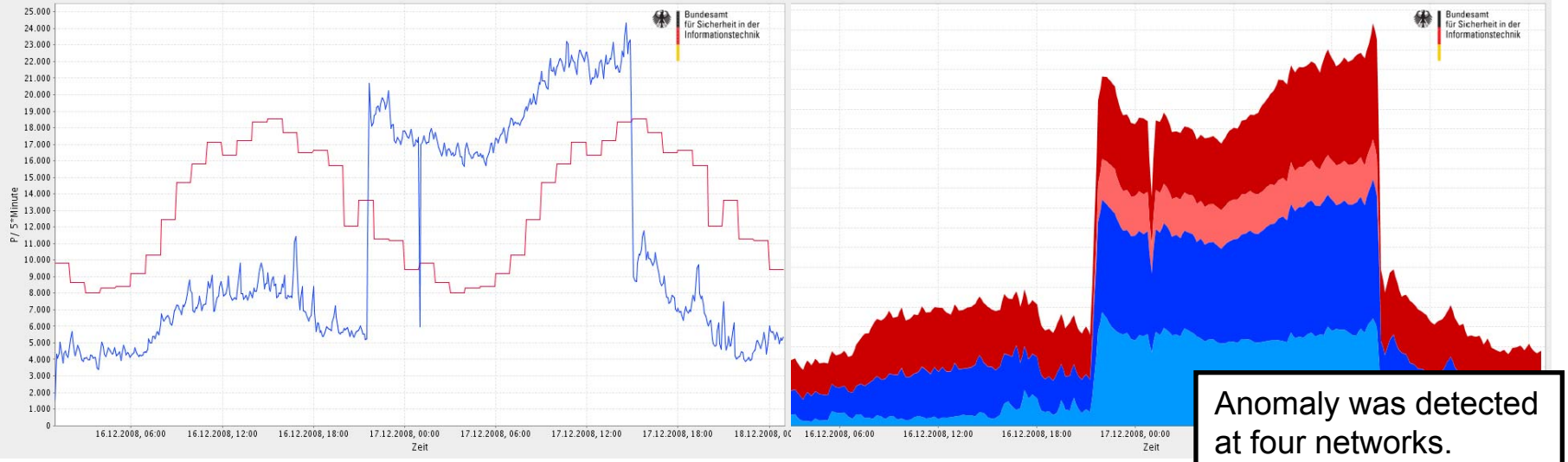
IAS-detected anomalies

Example: DNS anomaly, 12/2008

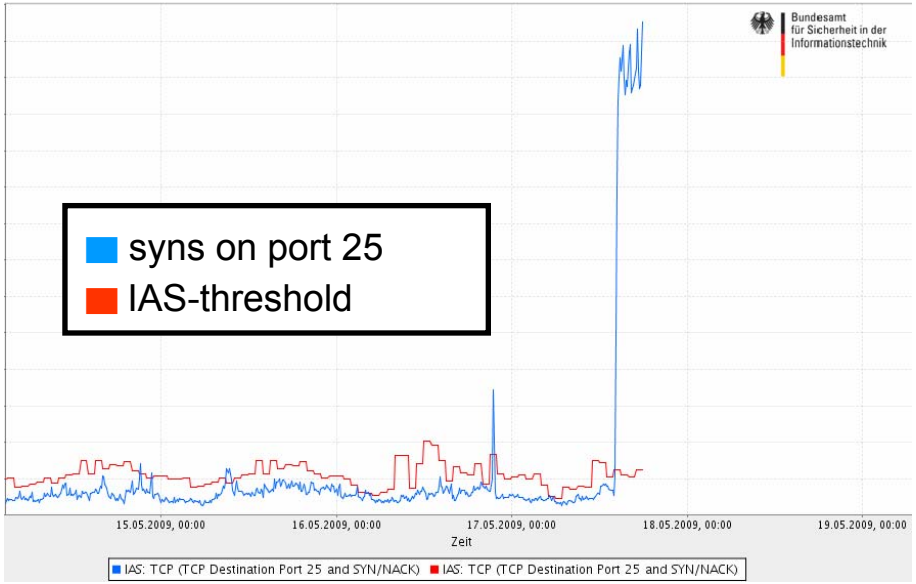


- Long-lasting peak in incoming DNS-queries, seen by several networks.
- IAS-analysis showed, that all queries asked for NS records.
  Some servers refused the queries.
- Calling operators & partners, asking for NetFlow & further info.
- Result: Queries for NS record ".", two source IPs in eastern Europe.
  Obviously source IPs had been spoofed, reflected DDoS-attack.
- ISC SANS, 2009-01-18: *DNS queries for "."*.

IAS-detected anomalies

Example: SMTP anomaly, 05/2009 1/2

- Spam…Have seen spam for many years now, have upgraded to bigger hardware, have deployed anti-spam-clusters…
- But in this case, operators said: “We are under attack, a DDoS!”



- Ratio of mails per SMTP session was very small, compared to ‘normal waves’.
  - More than 64.000 sessions at one MTA, 500 new per second.
  - Response-ratio of MTA dropped to ~60%, later on to ~30%.

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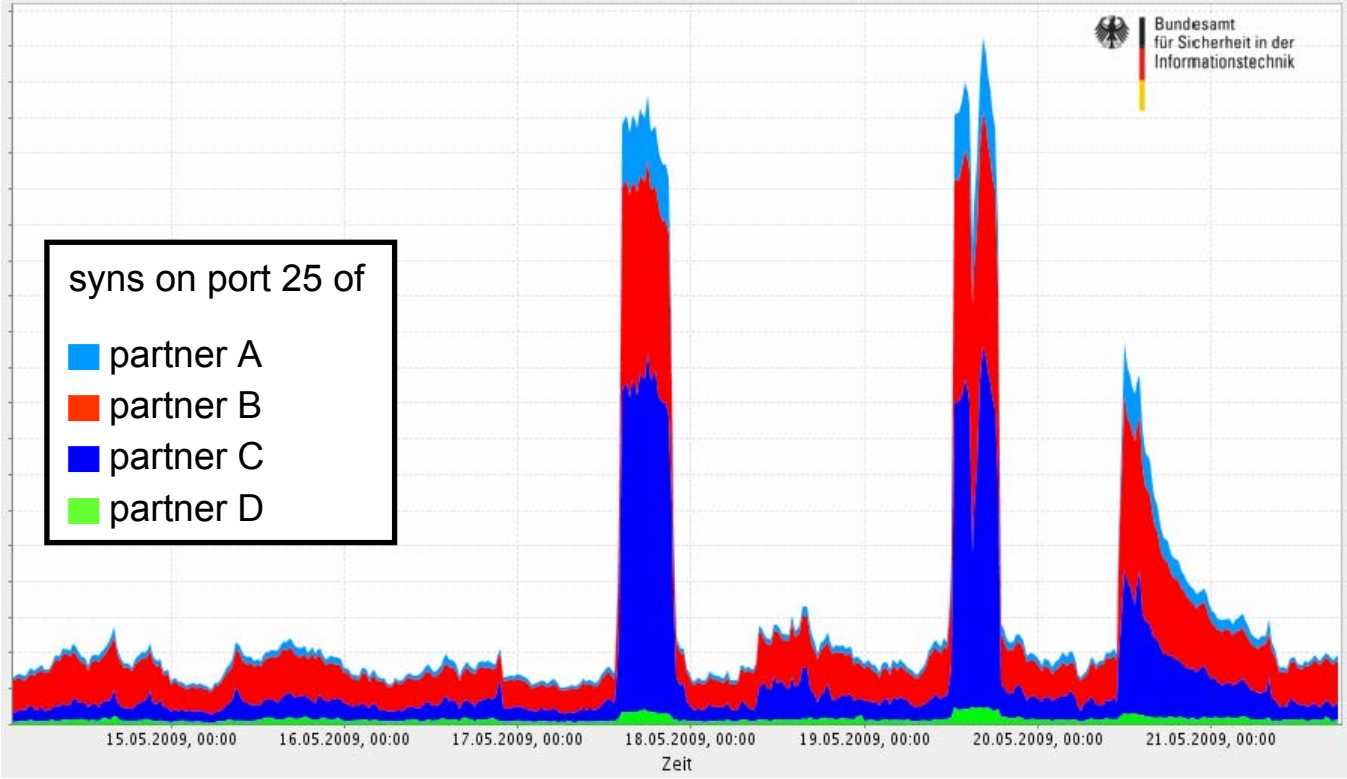
IAS-detected anomalies

Example: SMTP anomaly, 05/2009 2/2



- IAS data analysis: all monitored networks saw the same behaviour.
  → No targeted DDoS-attack but rather a mass phenomena.
- EVAA showed: not a DDoS, transmission of a ‘regular’ mail with a casino-ad. → MTA had problems with large number of sessions.

Conclusion

Distinction from other systems

- IAS sensors
  - do not monitor data with personal reference,
  - do not reassemble TCP flows,
  - are independent of intrusion detection signatures,
  - revoke context of a packet after building its counters,
  - work passively, no impact on original network traffic.
- IAS cannot
  - detect targeted attacks or individual exploits,
  - protect networks actively like a firewall or an IPS,
  - provide attacker byte code,
  - give info for identifying source-IP or even targeted machine.

Conclusion
Benefits

- A sensor network of IAS-monitored authorities gives valuable information in terms of IT security.
- Aggregated data extends the perspective of individual networks.
- Manual analysis provides security-related trends.
- Anomaly detection shows indications of incidents.
- In case of incidents (detected by IAS or other sources), IAS provides nearly real-time monitoring of network traffic.
- ➢ Helpful to develop and evaluate counter measures.

Prospect:

- Automatic correlation with other systems.
- Deploy additional sensors.

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Thank you! - Questions?

Contact

Federal Office for Information Security (BSI)
Godesberger Alle 185-189
53175 Bonn, Germany

www.bsi.bund.de

Martin.Bierwirth@bsi.bund.de
Andre.Vorbach@bsi.bund.de

Tel: +49 (0)228 99 9582-5119
-5830