St. Pölten University of Applied Sciences
Department Information Security

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Six Ways to Kill by Hacking

Critical Systems · Infrastructure

A murderous journey through Systems Security

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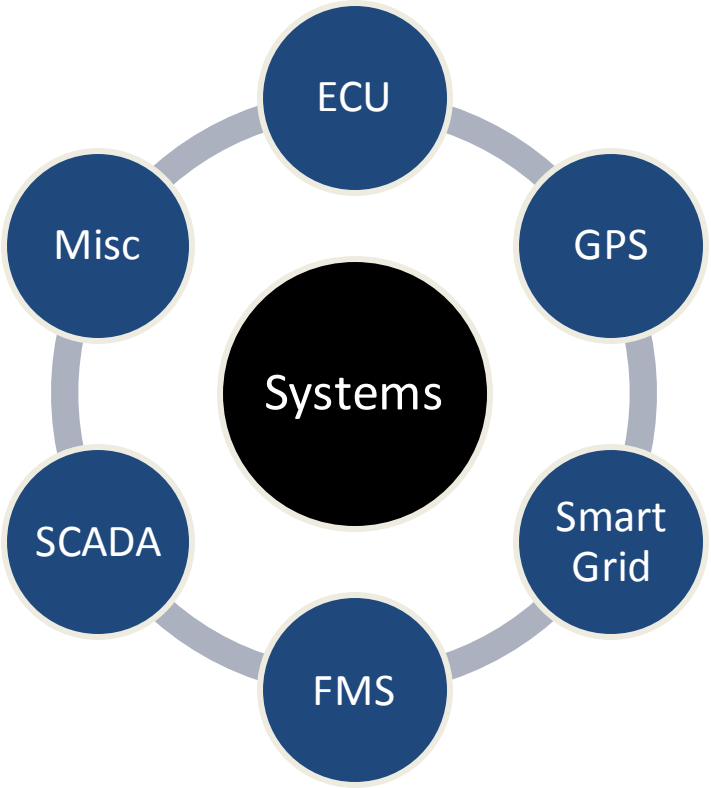
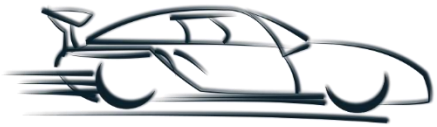
Introduction

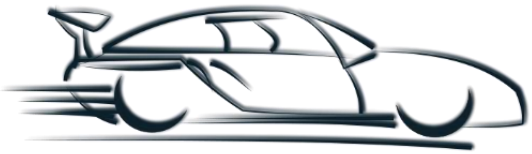
- Topic: Systems and Critical Infrastructure
  - Overview: Functionality, Security, Threats
- Potential for causing physical harm

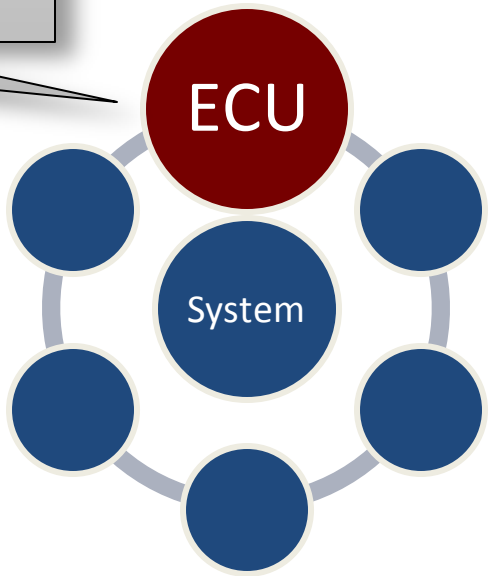




Case #1

- Car Computers
  - Electronic Control Unit (ECU)
  - 50-70 ECUs in a modern car
  - Responsible for almost all car functions
  - Communication via internal bus
  - Physical access via OBD-II
  - Wireless access via TPMS sensors, 3G, 802.11p,…)





ECU: Controller Area Network (CAN)

High-Speed Network

- Motor control (EMC)
- Brake control (EBCM)
- Transmission (TCM)

Low-Speed Network

- Heating and AC (HVAC)
- Door control (RCDLR)
- Airbag and seat belts (SDM)
- Dashboard (IPC)
- Radio
- Theft protection

Networks are connectioned via:
Diagnostics system (BCM), Telematics

ECU: Security

Flaws:

- Direct bus access
  - Manipulated (USB) device
  - On-Board Diagnostics Port (OBD-II) + Laptop
  - Wireless (via sensors, Telematics, GSM/UMTS,…)
- CAN Packets
  - Broadcast to all CAN nodes (ECUs)
  - Susceptible to DoS (disabled all ECU functions)
  - No authentication
  - Lacking access control
    - Diagnostics mode can be triggered
    - Weak key material (16 bit)

ECU Attacks (exemplary attack sequence)

Attack Status: CONFIRMED

Increase of motor RPM

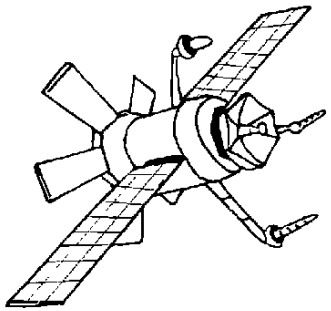
Locking doors

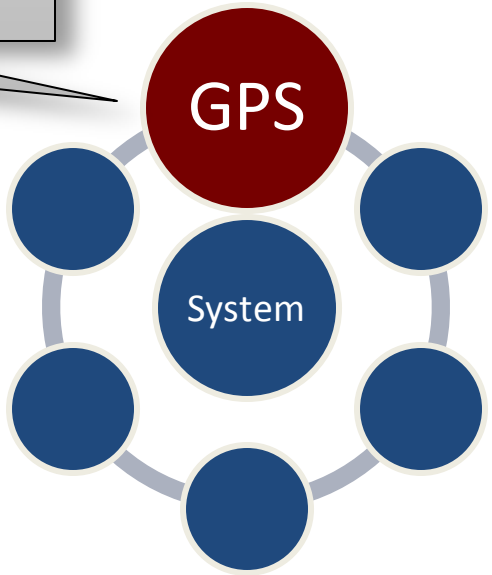
Falsification of dashboard

Disabling brakes

Case #2

- GPS
  - Global Positioning System (GPS)
  - Navigation und time provider
  - Operates with triangulation (measures distance to 4+ satellites using signal transit time)
  - Internal atomic clock provides accurate time





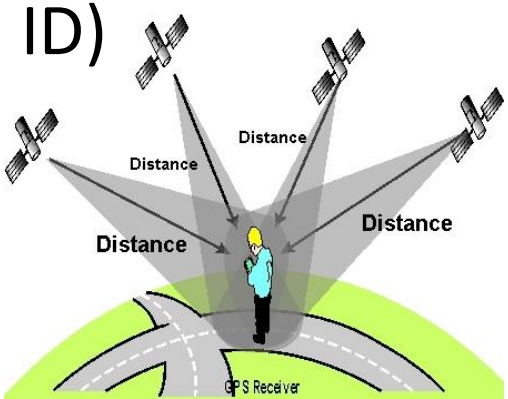
GPS: Use und Functionality

Applications (e.g.):

- Civilian and military navigation
- Frequency regulation in electricity and communication grids
- Time provider (also for Internet/NTP servers)
- Tracking systems
- Freight handling

Data transmission

- C/A Code (time, week, nav data, satellite ID)
- Signal strength approx. -160dBW (weak)



GPS: Security

Weaknesses/Threats:

- Signal encryption
  - Not implemented (civilian GPS)
- Jamming
  - Overriding the signal with a stronger one
- Spoofing
  - Falsification and retransmission of the signal
  - Pretends to be genuine (manipulated C/A code)
  - Denial of Service attack on receivers possible
- Receivers
  - Often conventional computers with lacking sec.
  - Missing integrity and plausability check

GPS Attacks

Attack Status: CONFIRMED/EXPERIMENTAL

Route manipulation

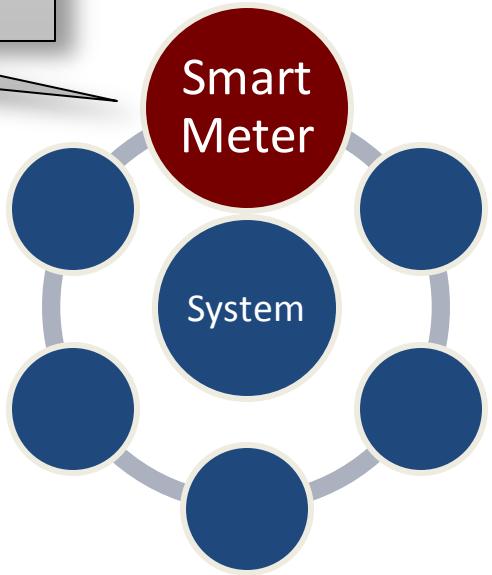
Disrupting traffic lights

Middle-of-Earth attack

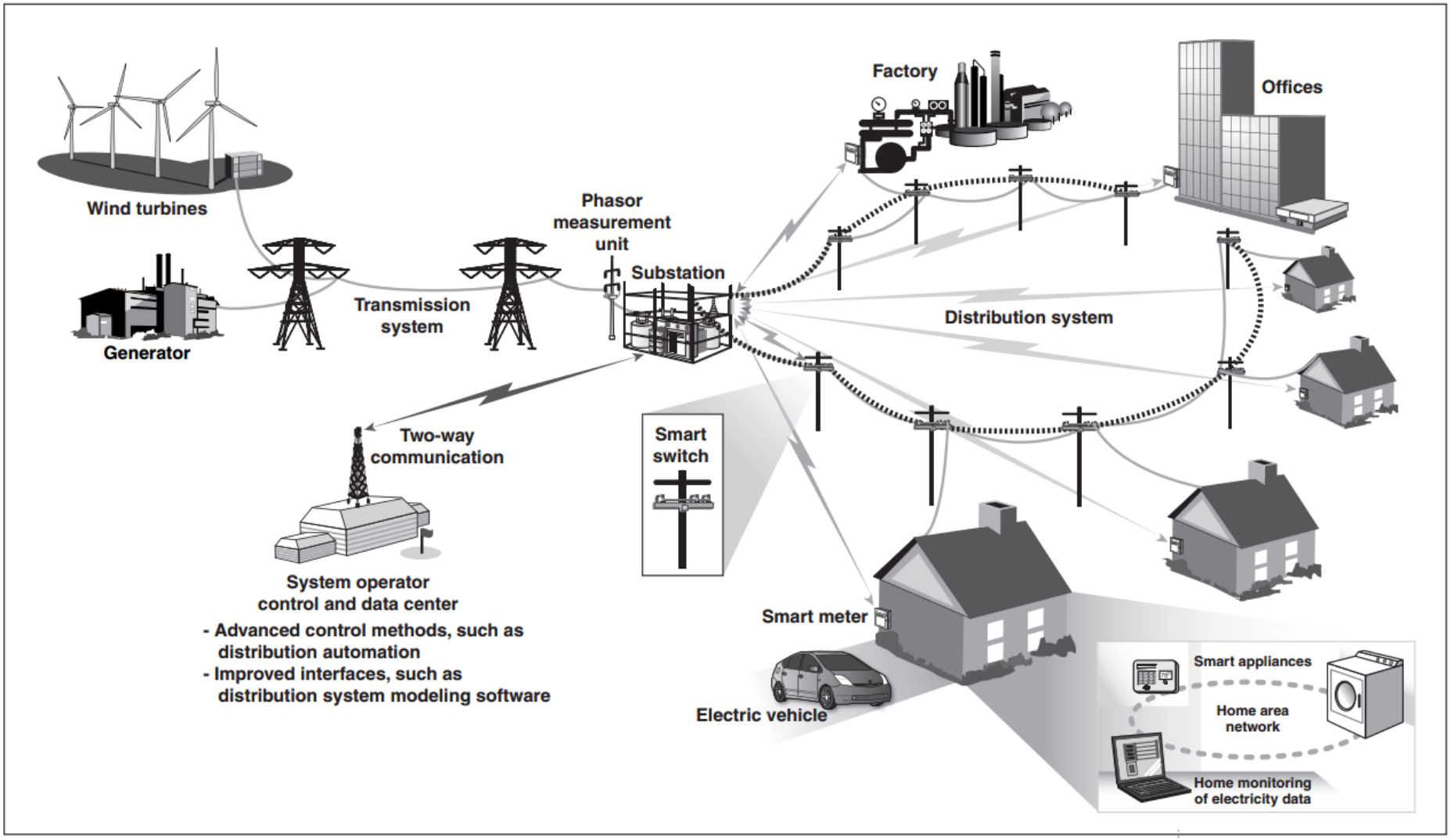
De-Sync of power grid

Case #3

- Smart Meter
  - Commodity metering and control device
  - Usually for metering of power, gas
  - Connects to the smart grid
  - Communicates with HAN/LAN, WAN
  - Wired (PLC) or wireless (RF mesh)
  - EU: Implementation until 2020



Smart Grid



Quelle: United States Government Accountability Office

Smart Grid: Security

Weaknesses/Threats:

- Weaknesses
  - Device IDs are not secret (printed on the face)
  - Password reuse
- Attack vectors
  - Memory: e.g.: Extracting admin passwords
  - RF signal: Interception, disruption, malware spread.
  - WAN: MITM attacks and more…
- Scenarios
  - Remote reading of consumption data
  - Service interruption
  - Energy theft

Smart Meter Attacks

Attack Status: EXPERIMENTAL

Activation of intelligent device

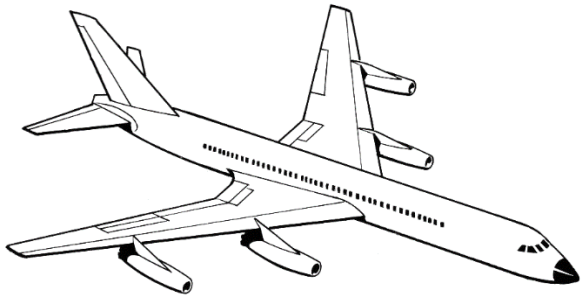
Regional power outage

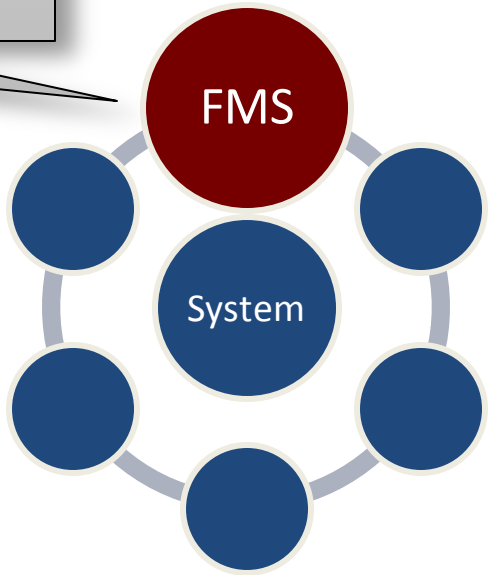
Chain reaction (see U.S., 2003)

Chaos

Case #4

- ADS-B/ACARS
  - Automatic Dependent Surveillance Broadcast (ADS-B)
    - Airplane tracking via radio
  - Aircraft Communications Addressing and Reporting (ACARS)
    - Ground <> Airplane communication
  - Flight Management System (FMS)





Airplane Communication: Functionality

ADS-B (Tracking)

- Radio transmission to and from the airplane
- U.S. commercial planes: Implementation until 2020

ACARS (Data exchange)

- Radio or satellite connection
- Arrival and departure information
- Weather data
- Engine information

FMS (On-board computer)

- Navigation database, flight plan
- Autopilot

Airplane Communication: Security

Weaknesses/Threats:

- ADS-B
  - No encryption
  - No authentication
- ACARS
  - Easy to eavesdrop; enables reverse engineering
- FMS
  - Computer system with weaknesses (like any other computer/OS)

FMS Attacks

Attack Status: EXPERIMENTAL/THEORETICAL

Setting a new waypoint

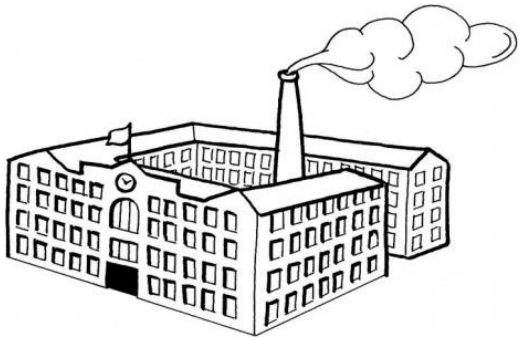
Changing positional data

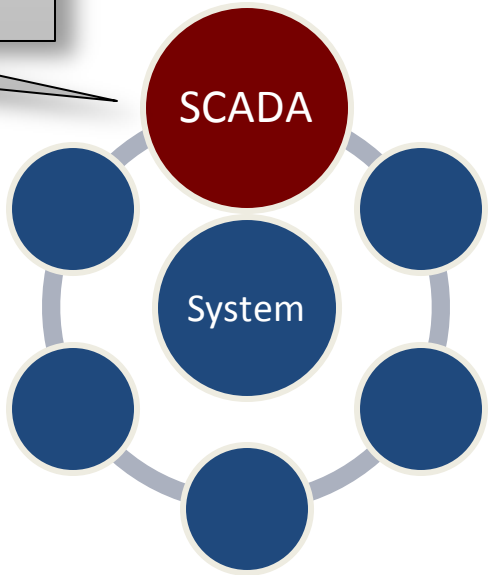
Disrupting internal systems

Forcing plane to “land”

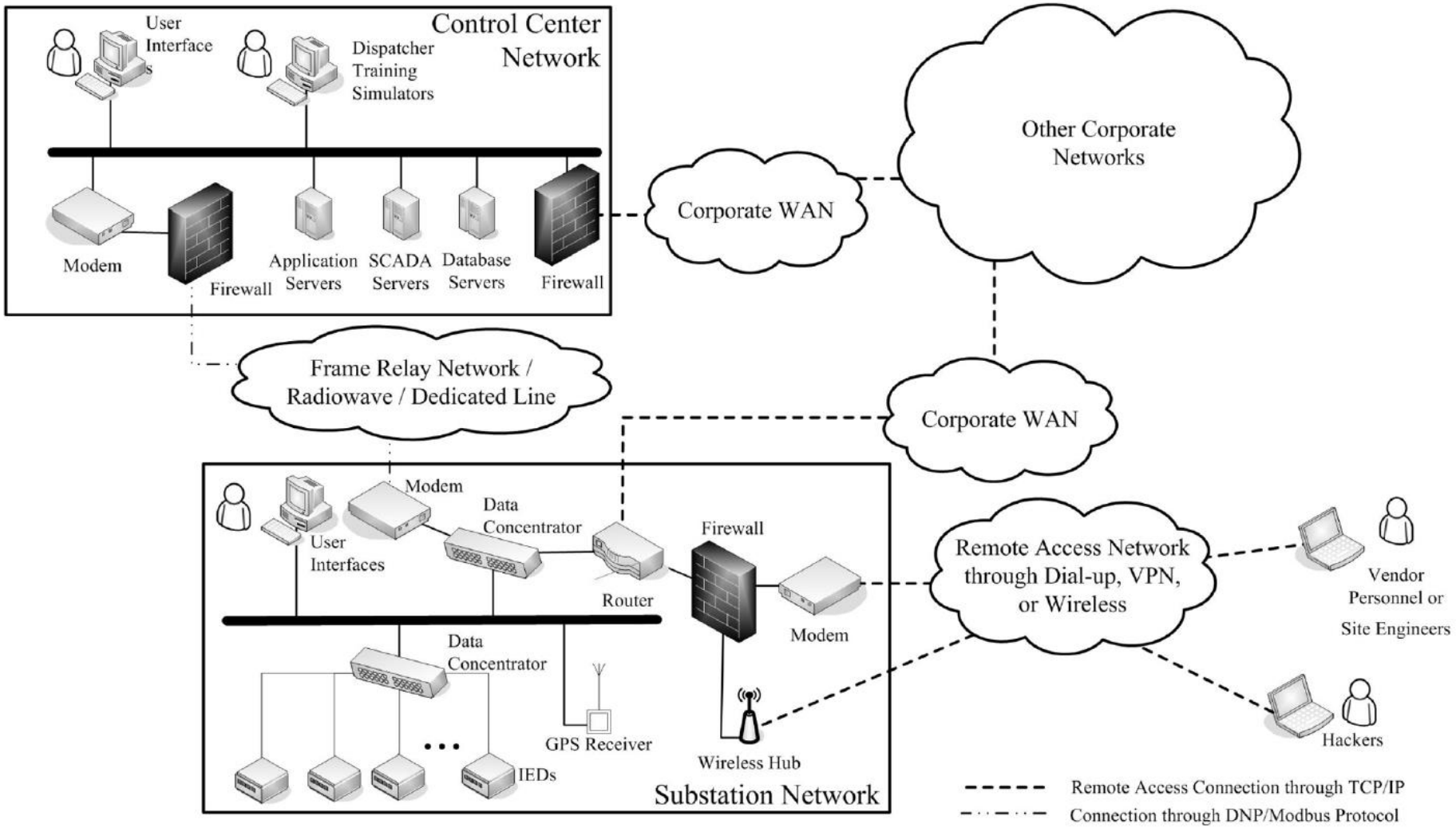
Case #5

- Industrial Control Systems
  - Supervisory control and data acquisition (SCADA) systems
  - Manufacturing, process control, automation, supply, transportation,…
  - Separate network
  - Remote access for service technicians
  - Logic is coded on Windows machines





SCADA System



SCADA: Security

Weaknesses/Threats:

- Security in industrial computers not a priority until recently
- Outdated technologies; low performance and small memory (although real-time capable)
- Attack vector: programming machine (conventional PC)
- Web server on-chip (e.g. current SIMATIC generation)
- Maintenance “backdoor”
- Internet connectivity; switch to IP-based systems
  - Links: Dial-up, VPN, wireless, satellite,…

Tatmittel SCADA

Attack Status: CONFIRMED/EXPERIMENTAL

Building:
Disable heating

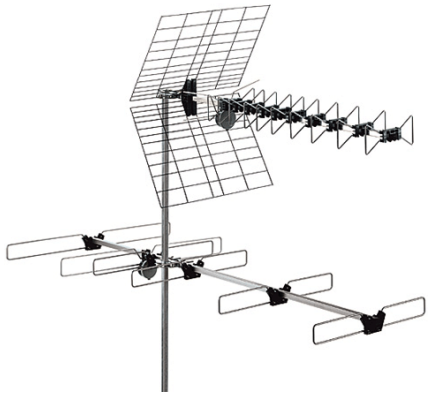
Sewers
overflow

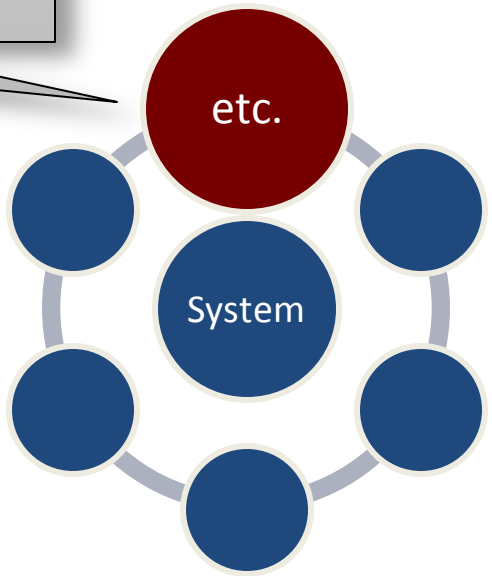
Pipeline burst

Hollywood
Scenario X

Case #6+

- Deadly jolt via pacemaker (remote hack, 10m range)
- Manipulation of medical devices (increasingly connected to the LAN)
- Many more radio hacks: Spoofing/Jamming using a 1500$ software radio and open source SW
- …





Conclusion

„Why make it simple, when you can use a computer?“

- Hi-Tech murder requires a lot of know-how
- Security flaws are often ancient…
- …or brand-new and barely researched

- Cybercrime is on the rise
- Internet penetration is increasing (IoT, etc.)
- Infrastructure attacks threaten national stability; constantly increase

Computer are more than just PCs and laptops!
Exotic systems will not always be exotic!
Security needs to keep pace!

It has begun…

Attack Status: PENDING

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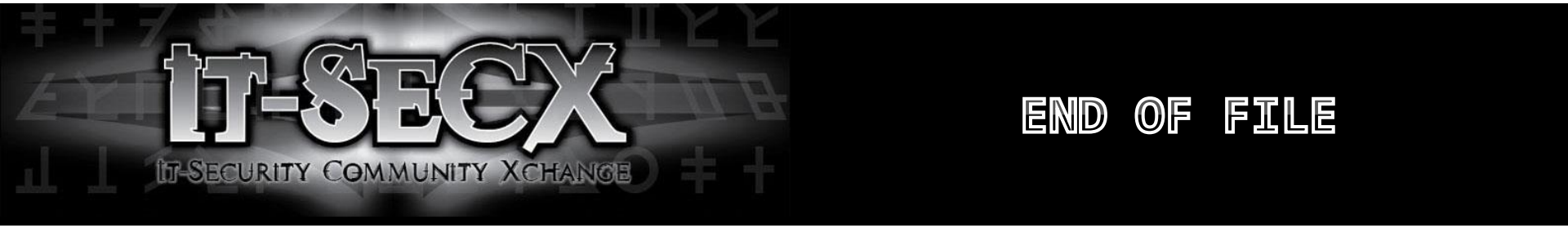

Thanks for your attention!
See you next time!

Questions?

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