Satellite Test Center (STC)

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DEFENCE AND SPACE

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Agenda - The Satellite Test Center (STC)

- STC use cases
- technical setup
- data links and connectivity
- implementation roadmap
- challenges during implementation

- Cyber attack vectors
- AIRBUS Defence and Space Security Framework
- STC security concept

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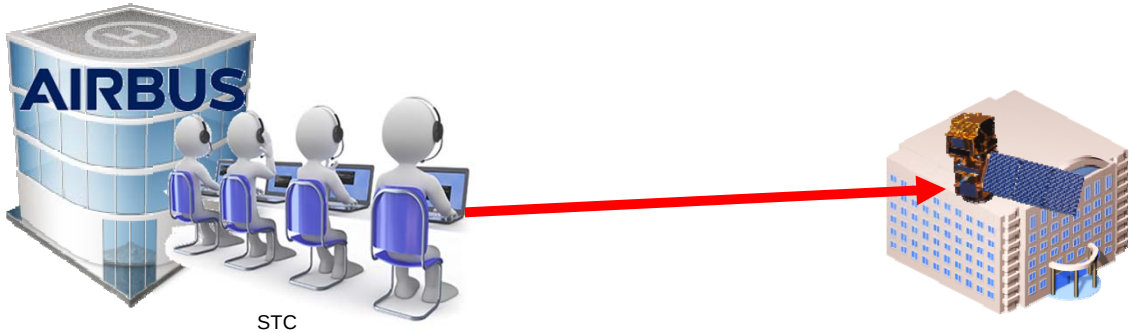
Use Case: remote testing of **spacecraft**



- the main operator team remains at home site while the spacecraft travels to a testing site
- only a limited hardware / backup team travels with the spacecraft
- full visibility of all relevant telemetry + environmental parameters at the STC
- full commanding ability to perform all relevant functional tests remotely
- the main control hardware (EGSE, Check-Out-System, SCOEs) remain at the spacecraft
- remote connections via remote desktop protocols are used for access
- collaboration tools (videoconferencing, WebEx, etc.) support the cooperative working mode
- this is basically an advanced model of the already in-use ESOC NDIU access for IGSTs / SVTs

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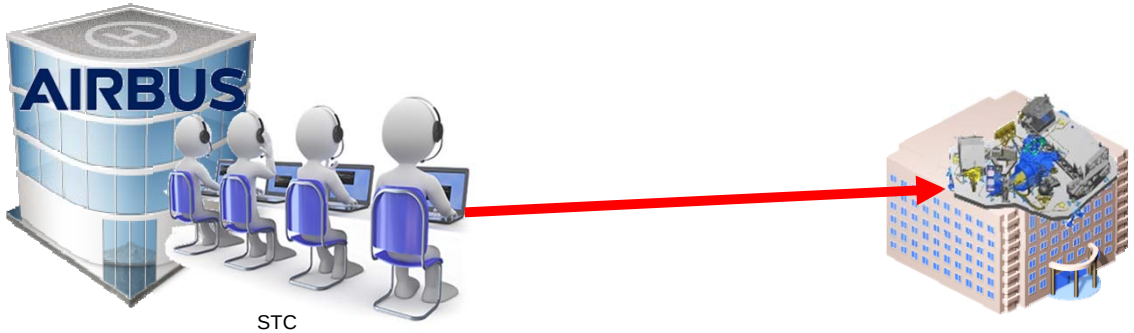
Use Case: remote testing of **instruments**



- the main operator team remains at home site while the instrument travels to a testing site
- the instrument is left autonomous, only emergency engineers remain for contingency procedures
- full visibility of all relevant telemetry + environmental parameters at the STC
- full commanding ability to perform all relevant functional tests remotely
- the main control hardware (EGSE, Check-Out-System, SCOEs) remain at the instrument
- remote connections via remote desktop protocols are used for access
- scientific data from the instrument can be transferred in real time to processing servers on home site via dedicated high-bandwidth lines

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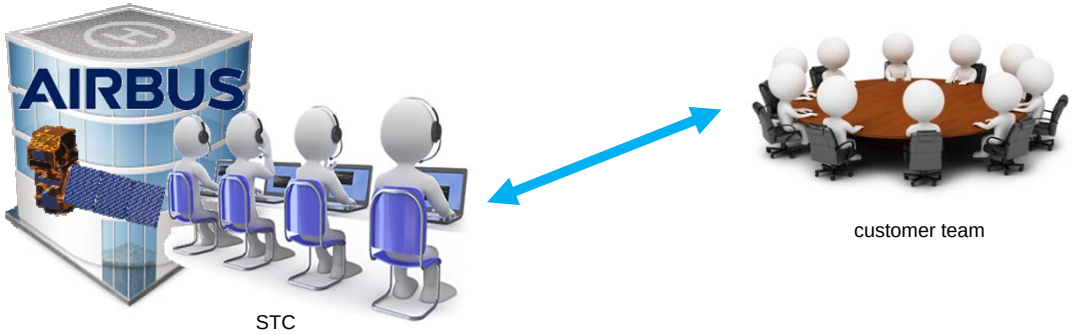
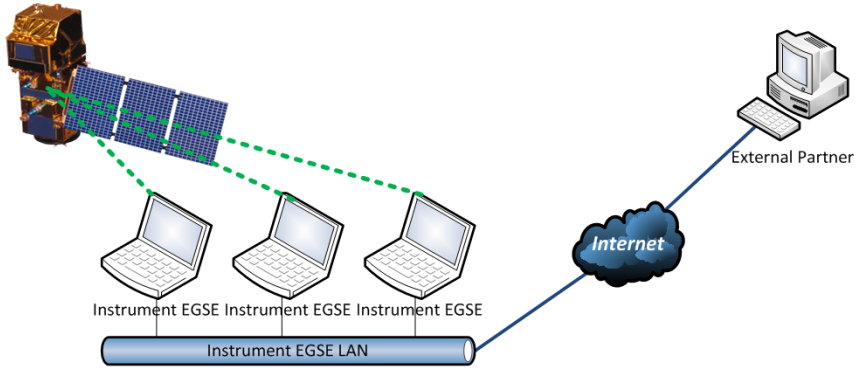
Use Case: **customer** participation at milestone tests



- the customer receives a dedicated STC-light installation to participate at specific tests
- access for the customer with monitoring capabilities is enabled from the STC
- observability of all relevant telemetry / synoptics at the customer premises
- results and findings are available at customer level immediately after the test based on the acquired telemetry
- the customer can select interesting telemetry, browse retrieved data or view relevant synoptics independently from the main test operator console

Use Case: scientific data retrieval + analysis for **PIs**



- science teams of the instrument / payload suppliers can access their own equipment located at the spacecraft's current location
- the science data is transmitted and stored on the computers located at the spacecraft site (EGSE / SCOE room)
- external instrument / payload partners get specific and secure access to these computers which they provided to the project
- instrument / payload supplier teams can work independently from their home sites, esp. without specific office hours requirements

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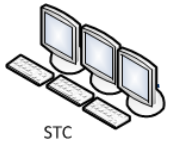
Use Case: remote **flexible workforce contribution** between AIRBUS sites

- peak workload situations at one AIRBUS site can be flexibly balanced by remote workforce contribution by other sites
- employees work remotely via a STC instance on their home site, no need to relocate personnel or change working contracts due to migration
- quick and efficient working mode, no need to wait for new employments and no need to lay off personnel if the workload normalizes again
- secure AIRBUS intersite-networks can be used for that approach, infrastructure is already in place

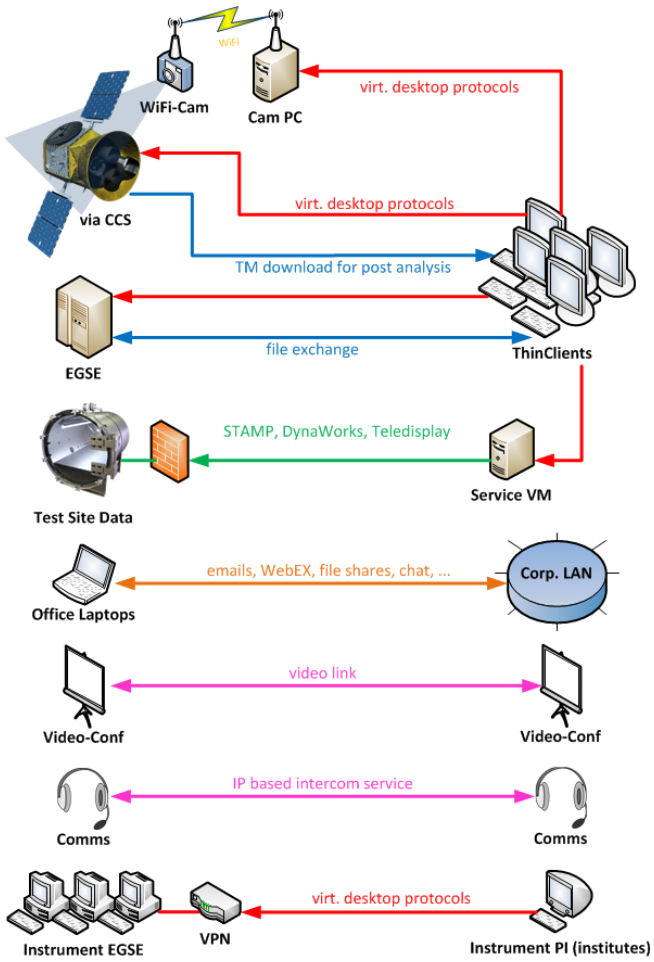
Technical setup



- secure remote desktop connection to the Central Checkout System
- the virtual display (desktop) of the CCS is transmitted remotely but no actual TC / TM data
- local operators can take over the spacecraft if necessary to maintain safety of hardware
- all critical infrastructure necessary to operate the spacecraft remains with it - same safety level as with the classic AIT approach

STC connectivity

- Live images of the S/C are transmitted via wired or WiFi-cams to a cam PC which is connected by RDP to the STC
- all CCS links are established via remote desktop sessions
- TM can be downloaded for post processing from the S/C
- TV facility status data (temp., pressure, lighting, etc.) are available at the STC in realtime
- office laptops of AIRBUS personnel have full corporate access inside the STC and remotely on campaign (e.g. Email, WebEx, file shares, internet)
- remote and STC teams communicate via permanent high-resolution videoconferencing systems
- clean-room communication (incl. ISO 5) via special intercom headsets with Matrix-VOIP
- specially secured VPN tunnel for PI access to their payload instrument EGSE



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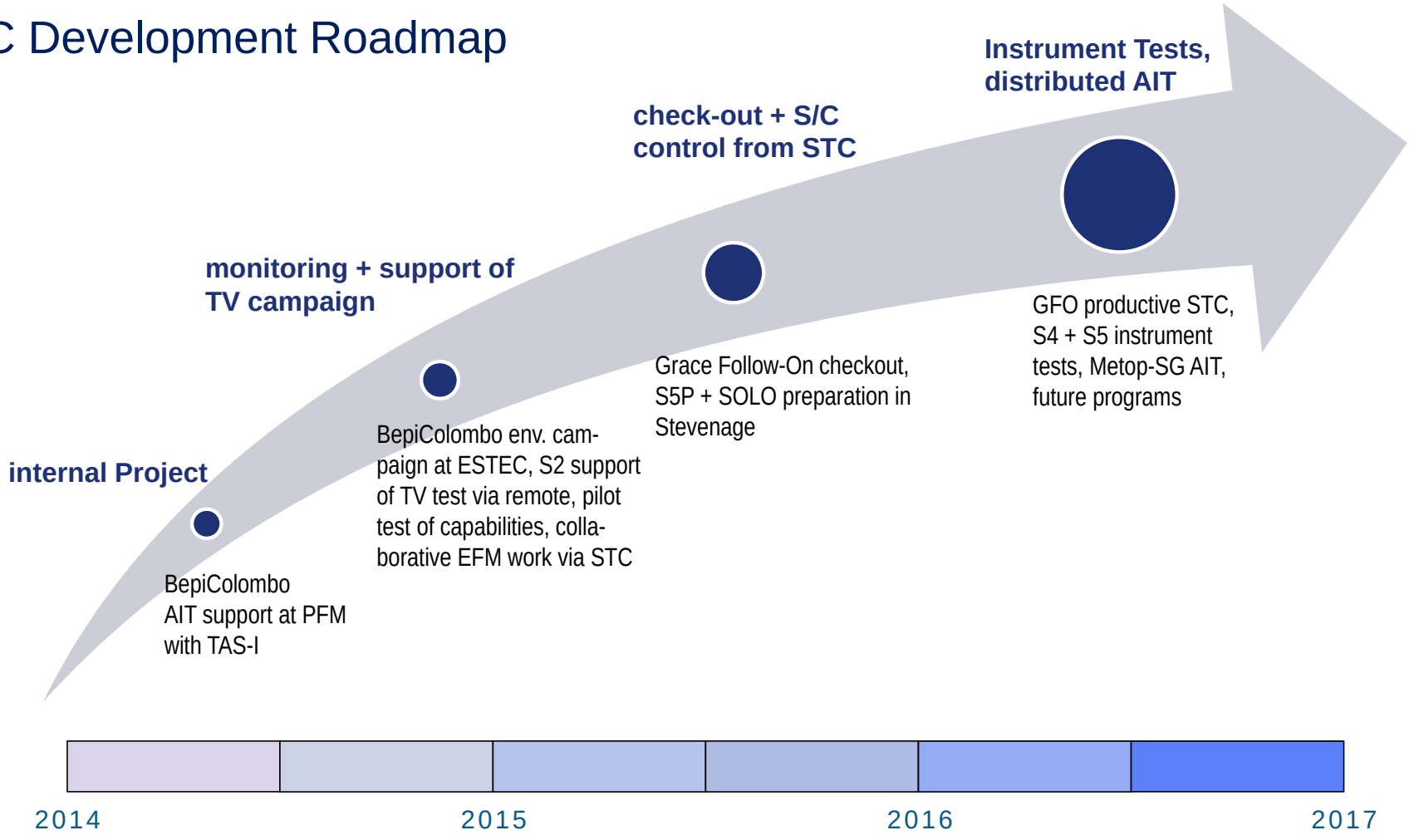
STC Development Roadmap



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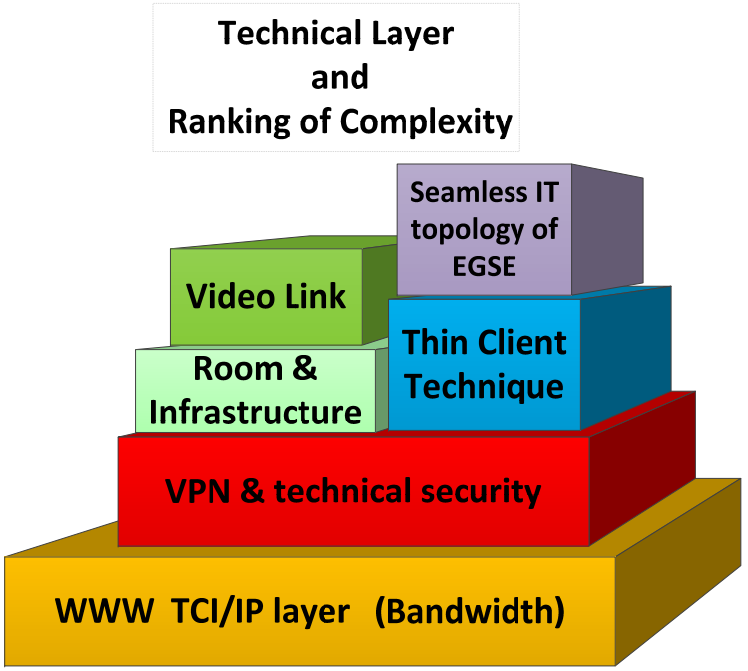
Complexity and challenges in the technical realisation

- **networking solutions** need to be foreseen to cover the performance (bandwidth, latency) requirements including reliability and redundancy
- **strong security** is essential to protect the service from malicious access and attacks and ensure sufficient protection to the knowledge and sensitivity of data
- live **video links** require compatibility with corporate videoconferencing standards
- the **Thin Client working mode** includes a change of work habits where all data remains on virtual servers and clients only are used to provide KVM accessibility
- **accommodation and infrastructure** need to cover the demands for comfort, effectiveness and security
- the **EGSE topology** need to be compatible with a remote operation approach and provide relevant interfaces



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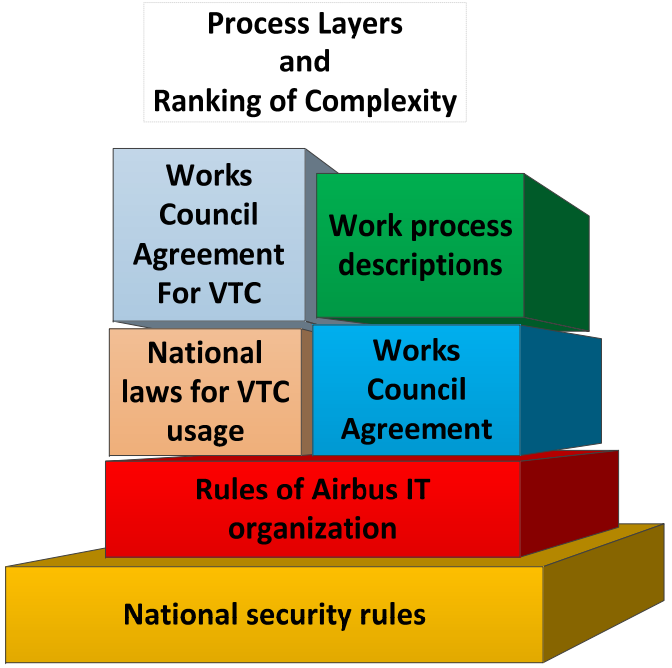
Complexity and challenges in the process implementations

- several **rules and regulations** are to be respected
  - national or European laws
  - company rules or site specific rules
  - labor regulations negotiated with working councils (including permit to use videoconferencing outside related video rooms)

- **work process descriptions** need to cover the applicable rules yet be efficient and compatible to the STC approach and furthermore applicable for other sites as well



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Complexity and challenges with mindsets and change-management

- **general skeptic attitude** towards remote operations needs to be addressed at different hierarchy levels
- confidence in a **reliable, (fail-)safe and performant operation** needs to be established
- **customer objectives and team objectives** need to be respected and balanced against each other
  - reducing the cost base
  - increasing transparency
  - raising effectiveness
  - improving flexibility
- opportunities to gain **savings** need to be addressed, evaluated, defined and chased

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STC pilot project: Sentinel-2

The first full-featured STC prototype

Remote operation with one spacecraft in

- IABG Muc. (environmental test)
- Kourou (launch prep)

The first milestone to achieve the distributed AIT scenario.

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STC productive implementation: GRACE Follow-On

The first productive STC implementation

Remote operation with two spacecraft in parallel.

- IABG Muc. (environmental test) currently

Later 2017 support of the launch campaign in Vandenberg / USA is foreseen.

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Cyber Security considerations

ensuring safety, security and mitigation of risks

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A few examples of how real cyber attacks are:

1982

Alleged **sabotage** of the Soviet Urengoy-Surgut-Chelyabinsk natural gas pipeline by the CIA.
How : Trojan horse injected via the Russian supply chain.
Consequence : Explosion of the pipeline.

2009

Operation Socialist: infiltration of Belgacom by NSA/GCHQ. Target : European cellphone comms.
How : targeted attack (engineers), internet traffic redirection, APT. Detected only in 2012/2013.
Consequence : Spying of European cellphone communications using Belgacom network.

2010

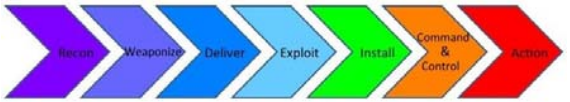
Operation Olympic Games / Stuxnet : attack on Iranian nuclear program (centrifuges used for uranium enrichment)
How : targeted attack (0 day), APT crafted specially for SCADA systems used in Natanz..
Consequence : estimated delay 5+ years to Iranian nuclear program. Origin : USA/Israel

2012

Nortel attack : Industrial espionage over a 12 year period (2000 – 2012)
How : password stolen from executives, rootkit, covert channels (encrypted data exfiltrated to China)
Consequence : espionage of top execs, R&T, finance, business plans. Direct contributor to company collapse

2013

"Target" attack : Payment information theft (point of sale)
How : via a subcontractor network (HVAC) connected to Target network
Consequence : Data from 70M credit/debitcards stolen



2014

Dragonfly/Havex : Industrial espionage on energy sector / pharmaceutical sector
How : waterhole attack / subco internet sites compromised (3 ICS vendors) to offer trojanized software.
Consequence : Targets critical Industrial Control Systems – Alleged origin : Russia – Target : Europe/US

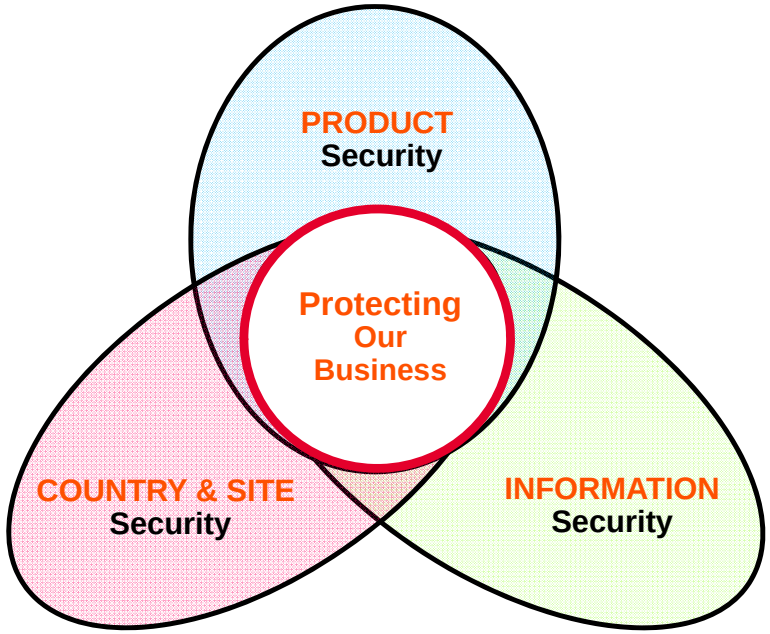
2014

German steel mill (BSI report 2014) : Manipulation of Industrial Control Systems
How : spear phishing ➔ corporate network ➔ production network
Consequence : Physical damage to the steel mill ("massive destruction")

2015

Equation group : espionage (allegedly developed by the same team that created Stuxnet)
How : attack via web exploits, USB, CD-ROM (conference proceedings)
Consequence : Exploit hides in hard drives firmware (impact 12 different vendors)

Airbus Defence and Space Security Framework



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Definition

PRODUCT SECURITY

Addresses the protection against **cyber threat** for the “products” we sell throughout their entire lifecycle, as well as ensuring all security requirements for the product’s **operational context** are appropriately specified and addressed.

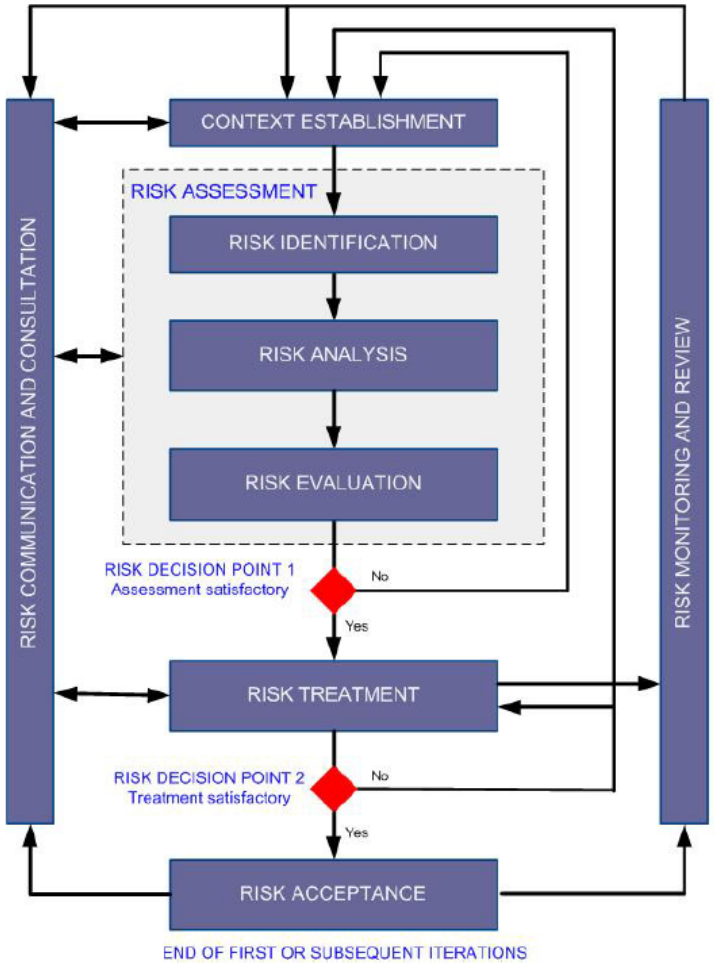
“PRODUCT” in the context of the Product Security initiative is:

Anything Airbus provides to a customer (internal or external) in any combination of:

- Tangible physical product (including but not limited to: component, LRI, platform, system, building, test equipment, spare parts, supplied COTS & MOTS, ….)
- Software/Firmware (including but not limited to: applications, updates, patches, configuration data, electronic service guides…)
- Managed Services (including but not limited to, NOC and SOC services, data services e.g. GEO Int, support centres, …)
- Documentation (user guides, instruction manuals, maintenance instructions…)

STC Risk Assessment ISO/IEC 27005

- Risk assessment based on the ISO/IEC 27005 Information Security Risk Management standard
- Three major cyber attack vectors to be considered:
  - Man-in-the-middle attack performed on the VPN link between the STC and the remote site(s)
  - Malware injection into the endpoints (both STC and remote sites)
  - Exfiltration and loss of intellectual property and/or sensitive data
- Risk Treatment / Security Concept defined, together with our collegues from Airbus CyberSecurity.



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STC Security Concept – Link Protection with Stormshield

The Airbus-developed high-performance **STORMSHIELD Network Security** (SNS) network appliance has been selected to protect the Internet-link between the STC and the remote sites.

STORMSHIELD is a next-generation Firewall and Unified Thread Management appliance with the following characteristics:

- Next Generation Firewall/UTM developed in Europe
- Advanced Security Qualification Engine (ASQ) as an integrative and intelligent combination of functions
- Low false-positive rate, high-performance, broad application support
- Integrated detection and mitigation of vulnerabilities in IT infrastructures
- VPN (IPSec, SSL)
- CC evaluation and certification
- Throughput up to 130 GBit/s, suitable for secure high-bandwith scientific payload data transfer from remote site

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STC Security Concept – Endpoint Protection by Airbus Cyber Defence Centres

The main axis of defence against the defined cyber risks is compulsive security monitoring and immediate reaction, provided by the three **Airbus Cyber Defence Centres** throughout Europe.

- Security monitoring includes the VPN links between STC & remote sites
- Non-intrusive monitoring of relevant Endpoints (eg. SCOE, CCS)
- Immediate notification of STC team in case of DDoS (Distributed Denial of Service) attacks, link termination and smooth handover of operations to remote team
- All cyber experts at one place for fast detection, analysis and incident response
- Cyber protection measures (prevention) are continuously updated in order to be able to meet the latest threats
- Using a combination of voluminous cyber threat intelligence, advanced analysis methods, own tools as well as real-time monitoring for fast detection

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Thank you

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