Security challenges and trusted computing in the Smart Satellites domain

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SPACE Hellas S.A.

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Facts Sheet

ASSURED

Presence

- HQ located in Athens
- Branches in Athens, Thessaloniki, Patra, Heraklion-Crete, Ioannina, Farsala and Nicosia-Cyprus
- Subsidiaries in Cyprus, Romania, Serbia, Malta & Jordan
- Activities in Europe and the Middle East

Human Capital

- Over 750 Specialized Employees
- Over 700 Certifications
- Accreditations: National . EU . NATO Secret
- Certified according to:
  ISO9001:2015 . ISO27001:2013
  SO14001:2015 . ISO20000:2018
  ISO22301:2019 . ISO27701:2019
  ISO45001:2018

Growth & Stability

- Over 35 Years of Operations and Sustainable Growth
- Turnover: € 128.6 million (2022)
- Listed on the Athens Stock Exchange since 2000

Investments

Space Hellas Holds:

- **18.1%** of Mobics (Greece)
- **32.2%** of WEB-IQ (Netherlands)
- **35%** of AgroApps (Greece)
- **60%*** of SingularLogic (Greece)
- **40%** of Epsilon SingularLogic (Greece)
- **100%** of SenseOne (Greece)

Space Hellas is the leading Digital Integrator and Service Provider in South Europe

Key R&D Domains

Ongoing R&D projects

ASSURED

PANDORA
- Integrated Cyberdefence platform

SEPTON
- Cybersecurity for medical devices

Ainception
- AI for Cyberdefence

PRIVATEER
- 6G security

Space 4.0
- Environmental monitoring

DEGREES
- Satellite Networks security

OCTANT
- Monitoring for merchant fleets

SafeCity
- Collaborative urban security

BSFS
- Urban security and safety

OASEES
- Distributed intelligence for IoT

PISTIS
- Data sharing, federation and trading

NEMO
- Next-generation edge computing

5G COMPAD
- Miltary 5G

CO-PROTECT
- Disaster resilience

ACTING
- Cyberdefence training and exercises

6G-BRICKS
- 6G experimenta-tion platform

ASSURED
- Distributed verification and trust

PALANTIR
- Cybersecurity as-a-service for SMEs

HellasQCI
- Quantum Key Distribution (QKD) piloting

TENACITY
- OSINT for border control

ENTRUST
- Networked medical devices security

Space Hellas main role in R&D projects

CubeSats – what is it ?

- Low earth orbit satellites that enable resource-limited organizations to operate in space
- They are deployed usually in constellations and many satellites are collaborating to perform a specific task.
- Typically, the software ecosystem of a CubeSat includes:
  - the Operating System (OS),
  - telemetry navigation apps and other vertical apps deployed.
  - One of the most prominent Real Time OS in the community is KUBOS.

Space Market and Cybersecurity Trends

1. The space market presents positive prospects for future development and with growing investments from private sources.
2. The satellite services market accounted for revenue of $126.5 billion in 2018 and is anticipated to generate $144.5 billion by 2026.
3. The CubeSat market size was valued at 210.1$ million in 2019 and is projected to reach 491.3 $ million by 2027.
4. Cyber-attacks towards satellite systems can cause huge financial impact, with global cybercrime costs expected to reach $10.5 trillion USD annually by 2025.
5. CubeSats are becoming increasingly popular due to their lower cost and ease of deployment compared to traditional satellites.
6. ASSURED outcomes can contribute to mitigate the risk from cyber-threats in various sectors, including the Space one.
7. ASSURED functionalities can contribute to enhance the security of the designed solutions and make them more resilient against a variety of attacks.

Day-to-day operations of a CubeSat

Communication in order to receive commands and execute mission applications from the ground stations.

Periodic communication for the automatic exchange of health and status information.

Querying the telemetry database.

Downloading payload data files.

Secure satellites – needs and challenges

Need to:

1. **Enable the performance of remote security attestation** confirming the integrity of all modules cooperating to execute mission critical functions.
2. **Enhance the confidentiality and integrity** of the exchanged data.
3. **Provide resiliency of the Operating System** and Software Modules against multiple vector attacks.

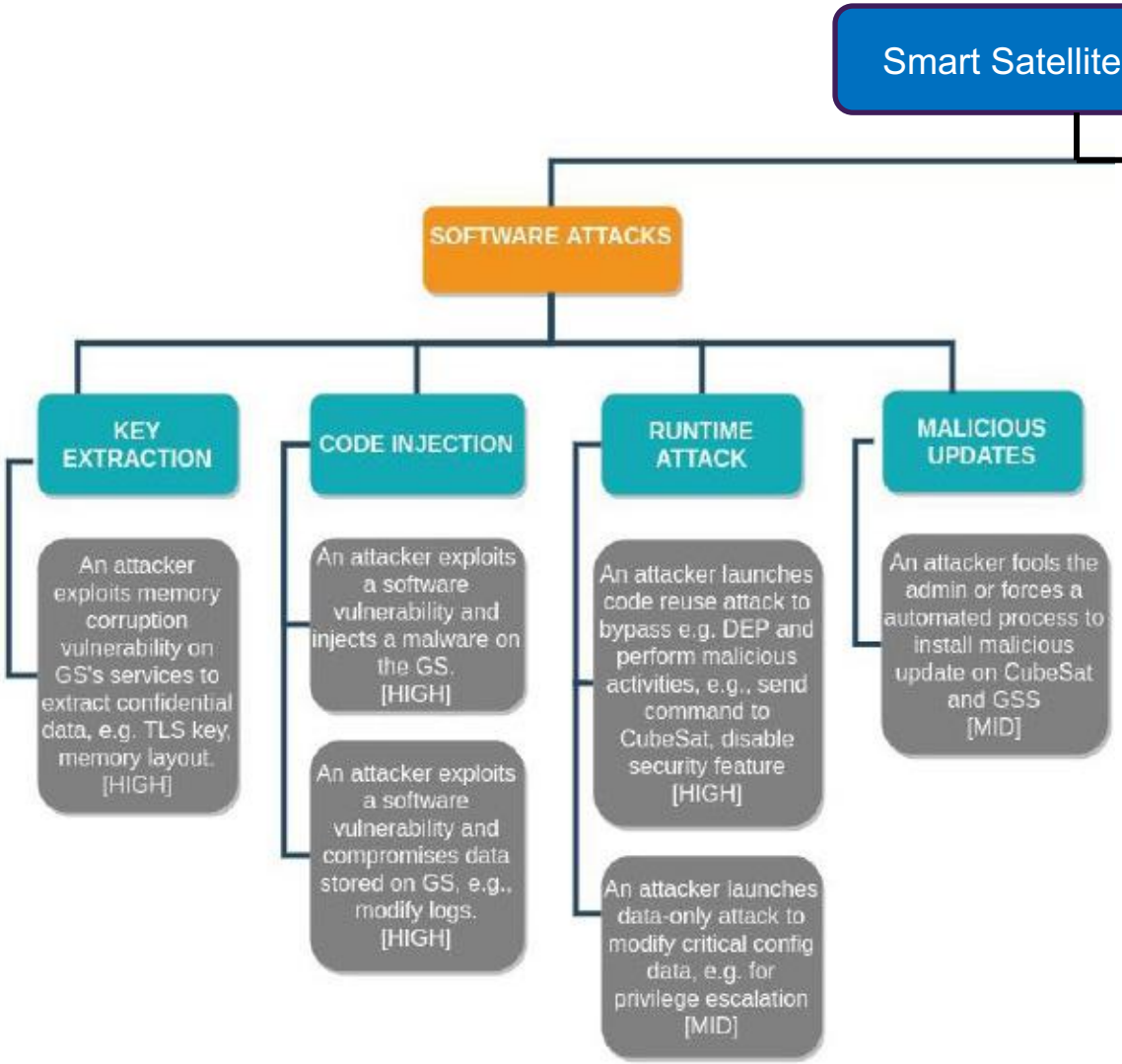


FIGURE 19: ATTACK TREE GRAPH FOR SMART SATELLITES USE C

Cause that data exchanged are transmitted in open air are exposed to Man-In-the-Middle attacks. In that way an attacker can:

1. **Inject unauthorized or malicious code** during system upgrade/release.
2. **Intercept exchanged data** or infiltrate data into the system.
3. **Take advantage of obsolete design methods** that fail to consider risk assessment information and correct security mechanisms mapping.

Security and trust in the context of ASSURED

- Software **security attestation** mapped at the device level respecting aerospace regulations.
- **Device identification.**
- **Run-time protection** against cyber-attacks.
- **Software integrity.**
- System upgradability and **data integrity protection** through Blockchain technology.

Space Hellas main role in ASSURED

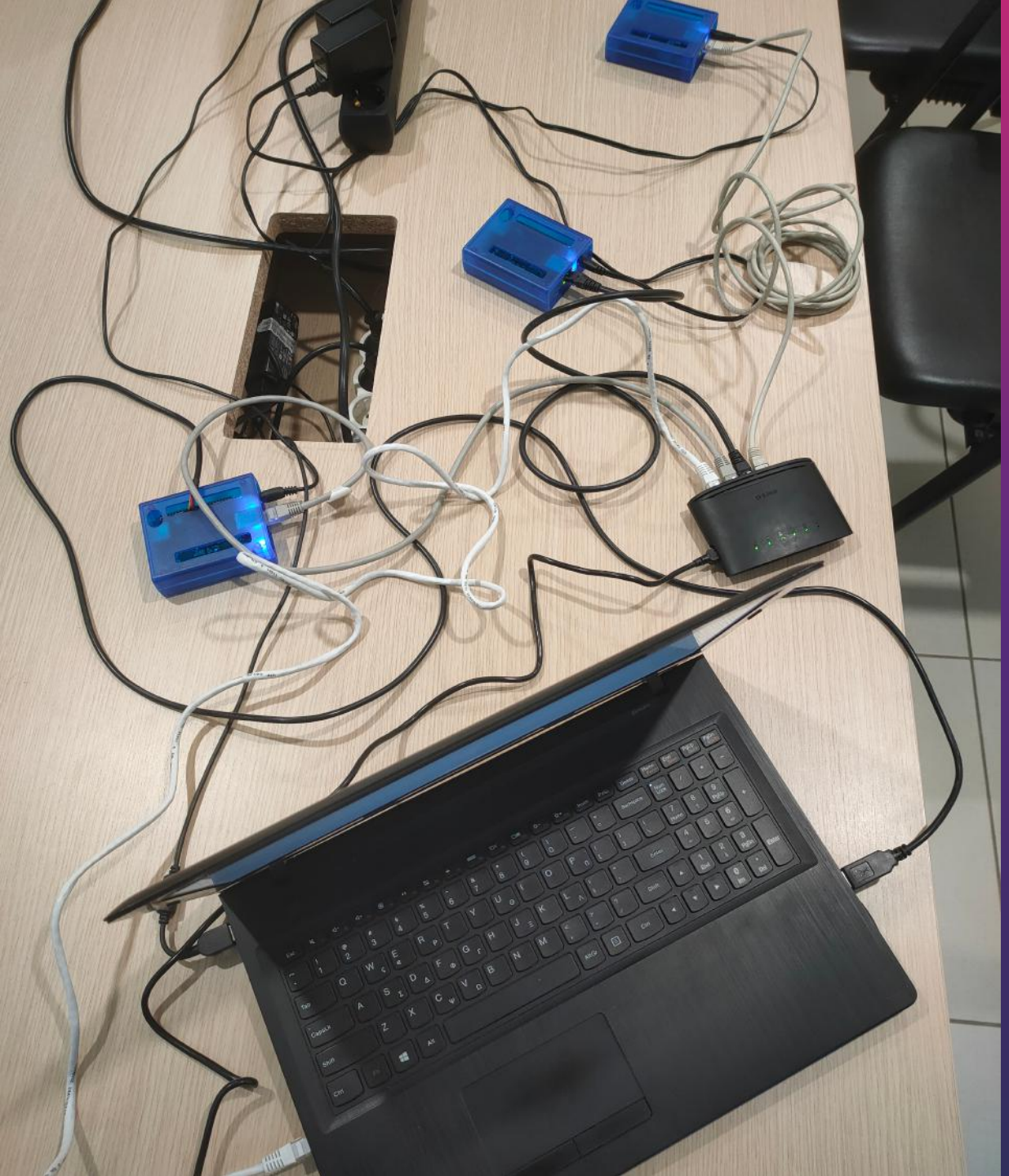
Space Hellas within ASSURED is leading the UCs Demonstrators

Implementing the demonstrator focusing on Digital Security of Smart Satellite Communications

Integrating ASSURED Framework in a lab-based demonstrator

Space Hellas is interested in:

- hardening embedded devices (sensors, smart meters etc.)
- inclusion of remote device attestation in the company's Managed Security Services



Lab

- CubeSats are demonstrated using OBCs Beagle Bone Black (BBB)
- BBB are running the KubOS operating system
- Demonstrating the constellation of CubeSats
- Laptop is the Ground Station
- Ground station and BBB boards have the tested components of ASSURED Framework

User stories – What we do

User story 1 : **As an Internal Operator (CubeSat Operator), I want to ensure that the transmitted data are protected against attacks targeting the devices involved (trying to compromise the key distribution), in order to ensure data confidentiality and integrity.**

User Story Confirmations:

- ✓ *Ground Station and CubeSats can successfully perform Secure Registration and Enrolment.*
- ✓ *CubeSat Operator can receive data from the CubeSats in a secure way.*
- ✓ *Key Exchange Binary can be successfully attested, including the performance of Key Exchange Protocol and Symmetric Key is accepted.*

User story 2 : **As an Internal Operator (CubeSat Operator), I want to execute critical mission functions in a secure way, in order to improve the health state information of the entire data value chain.**

User Story Confirmations:

- ✓ The CubeSat Operator verifies that CubeSat is in the right state, and it is successfully updated.
- ✓ Valid attestations (Integrity Verification and Control Flow Attestation) are performed for the CubeSat to be updated and for the services involved.
- ✓ Software Update for mission application performed and attested.

User stories – What we do

User story 3 : **As an Internal Operator (CubeSat Operator), I want to share data collected and received from the CubeSats with External Member(s) (including users of external organizations), in order to update them about the status of the CubeSats and Mission in a secure, accountable and in efficient manner.**

User Story Confirmations:

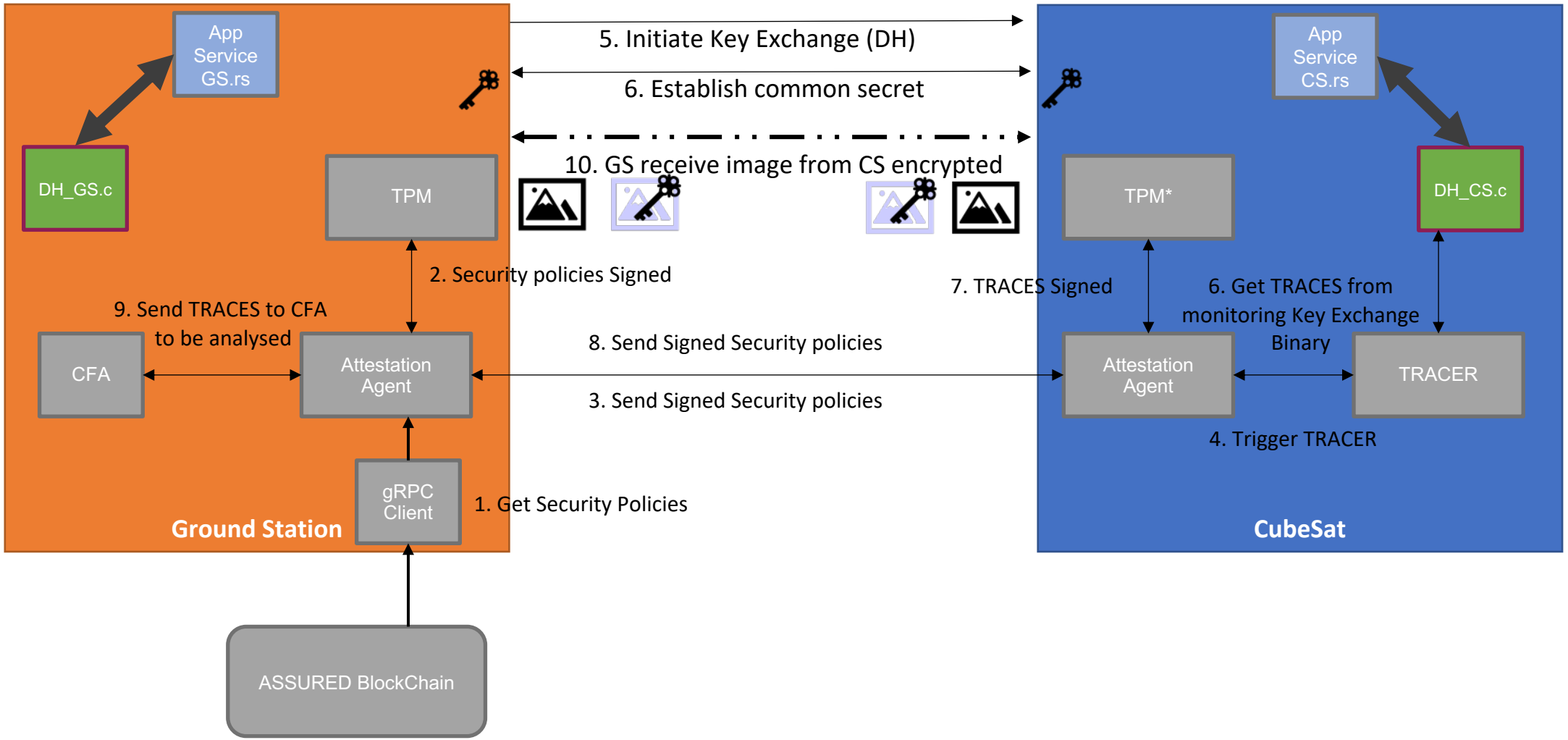
- ✓ *Successful store of Attestation Result(s) on the Blockchain*
- ✓ *Successful store of Raw Traces at Storage*
- ✓ *Successful update of respective Attestation Results at Blockchain with pointer reference.*
- ✓ *Successful query and access to results from external members.*

User story 4: **As an Internal Operator (CubeSat Operator), I want to securely and efficiently communicate with CubeSats and collect data, in order to check the health state of the entire chain of communicating satellites.**

User Story Confirmations:

- ✓ *The CubeSat operator can successfully check the health state of the entire chain of communicating satellites.*
- ✓ *Successful store of Swarm Attestation Results on the Blockchain*
- ✓ *Authorized External Members can get access to the Attestation Results.*

Technical flow and Assured components demonstrated in the User story 1



So, what are the benefits from ASSURED?

CubeSat is :

- Communicating with a ground station and send useful data
- Executes critical mission functions necessary for the operation of the CubeSat
- Communicate with other CubeSats in a constellation to achieve a specific mission
- Downloading payload data files

ASSURED :

- Establishes a secure channel between CubeSat and Ground Station
- Ensure that all the devices involving in the communication are in a secure state and not compromised
- Create attestation report stored in the blockchain for external members to get useful info about the security of the System of Systems
- Protect during run-time against cyber-attacks.

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