NG-IoT Workshop on Standardization

TERMINET: nexT gEneRation sMart INterconnectEd ioT

Presenter: Prof. Armir Bujari

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Project Identity & Consortium
Project Identity & Consortium

- **Call:** H2020-ICT-2018-20
- **Topic:** ICT-56-2020
- **Type of action:** RIA
- **Total Budget:** € 8,000,000.00
- **Active period:** 1 Nov 2020 – 31 Jan 2024

### Consortium (26)

<table>
<thead>
<tr>
<th>3 Industries</th>
<th>5 Universities</th>
<th>3 Research Centers</th>
<th>15 SMEs</th>
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<tbody>
<tr>
<td>ERICSSON</td>
<td>CERTH</td>
<td>TRSC</td>
<td>Schneider Electric</td>
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<td>MEBGAAL</td>
<td>TECONIA</td>
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<td>SIROCO</td>
<td>SIDERIA</td>
<td>LOGOSRI</td>
<td>AMERICAN FARM SCHOOL Thessaloniki - Greece</td>
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<td>Gemelli</td>
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**Note:** The consortium consists of 3 industries, 5 universities, 3 research centers, and 15 SMEs.
Motivation, Challenges and Objectives
Motivation

Traditional cloud computing is not able to support real time applications.

A new cost effective approach is needed
- New IoT systems could be closer to the data source
- Low latency services and applications are viable
- Data privacy could be increased

Traditional manual configuration and device management is no longer viable.

Need for enhancing IoT
- Heterogeneous technologies, devices, and platforms
- Pervasive interconnection of people, services, and devices
- Embedded intelligence, connectivity and processing capabilities at the edge of the IoT network

Combination of Smart Technologies
TERMINET Challenges

- 10 primary challenges

Challenge #1
NG IoT reference model

Challenge #2
Complexity reduction and interoperability increase

Challenge #3
Employment of cost effective distributed edge solutions

Challenge #4
Combination of AI with the IoT

Challenge #5
Design of novel, intelligent IoT devices

Challenge #6
Application of vertical security, privacy and trust

Challenge #7
Fostering AR/VR contextual computing

Challenge #8
Tactile IoT Support

Challenge #9
Utilization of digital twins

Challenge #10
Novel disruptive business models
# TERMINET Objectives

## Six Objectives

<table>
<thead>
<tr>
<th>Objective #1</th>
<th>Objective #2</th>
<th>Objective #3</th>
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<tr>
<td>Flexible, open, and decentralised next generation IoT reference architecture for new real-time capable solutions.</td>
<td>SDN-enabled multiple-access edge computing environment for IoT and mission-critical and vertical solutions.</td>
<td>Moving AI to the edge by using cutting-edge ML technologies.</td>
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<tr>
<th>Objective #4</th>
<th>Objective #5</th>
<th>Objective #6</th>
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<tbody>
<tr>
<td>Security by design based on attestation modelling, distributed and decentralised blockchain, and enterprise-level privacy.</td>
<td>Tactile IoT model by adding human-centric perspective and sensing/actuating capabilities.</td>
<td>Design intelligent IoT devices for new generation IoT use cases, by fostering digital business development.</td>
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TERMINET Business Logic & Architecture
TERMINET Business Logic

- Combined SDN and NFV networking architecture, utilizing containerization
- Federated Learning Framework: FLF-DMLC, FLF-DMOS and FLF-DMP
- AR/VR Contextual Framework, Digital Twins, IoT Devices Inventory, Haptic devices
- AR/VR, Digital Twins, IoT Inventory
- IoT Network Framework (SV-IoT-NF): Trust, privacy and authentication among the various entities, using Blockchain
- Security, Privacy & Trust

TERMINET Integrated Platform
**TERMINET Architecture**

### Application Layer – APP-L
This layer is implemented in the cloud to offer a wide coverage.

### Platform Layer – PLA-L
Platform Controller; virtualization enhancement; NFV Orchestrator; Global AI models; Data Management/Storage

### Intelligence Layer – INT-L
Fed by filtered IoT data streams for applying the TERMINET advanced federated learning approach.

### Middleware Layer – MID-L
Intermediate layer which collects and processes the various data coming from the IoT devices at the physical layer.

### Security & Privacy Vertical Layer – SPV-L
It aims to ensure the security and privacy for all layers.
Multiple IoT testbeds

Collection of IoT data through software-defined gateways

Compute resources (CPU/GPU/FPGA, RAM, Storage)

Distributed AI-based IoT vertical applications

Distributed Federated Learning Framework

Software-defined Network Fabric

Streaming Analytics for IoT Data

Heterogenous IoT Hardware support

IoT to Edge to Core Cloud continuum

Infrastructure

Platform

Stakeholders
TERMINET Use Cases
Use Cases

**UC #1**: User-Centric Devices in Smart Farming
Multi-collected and heterogeneous data coming from crops, livestock, and mixed farming systems are coupled with AI capabilities to enhance agriculture systems’ sustainability.

**UC #2**: Pathway of Personalized Healthcare
Higher level of medical education to health practitioners, leverage diagnosis and improve patient satisfaction and safety.

**UC #3**: Smart, Sustainable and Efficient Buildings
Transform buildings into smart buildings and optimize their energy consumption and harvesting.

**UC #4**: Prediction and Forecasting System for Optimizing the Supply Chain in Dairy Products
Provide efficient supply chain forecasting, based on different types of production and sales data.

**UC #5**: Group Training Surgery Using VR enabled IoT Technologies
Enhance the understanding of treatment by efficiently providing a virtual training environment for medical personnel.

**UC #6**: Mixed Reality and ML Supported Maintenance and Fault Prediction of IoT based Critical Infrastructure
Reduce the operational costs of the end user and the burden of maintenance engineers.
TERMINET Identified Results for Standardization
Relevant Standards Developing Organisations

- INTERNATIONAL ORGANISATION FOR STANDARDISATION (ISO)
- INTERNATIONAL TELECOMMUNICATION UNION (ITU)
- EUROPEAN COMMITTEE FOR STANDARDISATION (CEN) AND THE EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDISATION (CENELEC)
- EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI)
- IEEE
- IEC
- DIN
- OASIS OPEN
- INTERNET ENGINEERING TASK FORCE (IETF) AND INTERNET RESEARCH TASK FORCE (IRTF)
- WORLD WIDE WEB CONSORTIUM (W3C)
- ALLIANCE FOR INTERNET OF THINGS INNOVATION (AIOTI)
- INTERNATIONAL DATA SPACES ASSOCIATION (IDSA)
- GAIA-X
- IOT ACCELERATION CONSORTIUM
- OMA SPECWORKS
- THE OBJECT MANAGEMENT GROUP (OMG) AND INDUSTRY IOT CONSORTIUM (IIC)
- THE OPEN CONNECTIVITY FOUNDATION (OFC) AND IOTIVITY
- THE IOT SECURITY FOUNDATION (IOTSF)
- BVDA/DAIRO
• Following:
  • Full traceability at all stages of production and implements
    • Certified quality management systems (ISO 9001: 2008)
    • Food safety management (ISO 22000: 2005)
    • Environmental management (ISO 14001: 2004)

• Opportunities for Standardisation:
  • Agri-food Partnership of the Region of Central Macedonia ([http://agromacedonia.gr/](http://agromacedonia.gr/))
  • AGROTECHEXPORT cluster coordinated by the Exporters’ Federation of Northern Greece ([https://atecluster.gr/en/](https://atecluster.gr/en/))
  • The newly established “Mediterranean Agrofood Competence Centre” of Crete coordinated by the Chamber of Irakleion Prefecture ([http://www.macc.gr/](http://www.macc.gr/))
  • The nation-wide “Internet of Food Alliance” cluster ([https://inofa.gr/](https://inofa.gr/)) with over 70 members coordinated by AFS.
UC2 Standardisation Efforts

• Following:
  • EUCROF New Technologies WG (on how technology - like ML - can improve clinical trials)
  • AI4Belgium (AI approaches for multiple industries in Belgium)
  • EUCROF AI/ML Task Force of New Technologies WG

• Opportunities for Standardisation:
  • The joint Task Force on AI/ML by EUCROF NTWG and eClinical Forum has the purpose to monitor the evolution of AI/ML technologies in the Life Sciences domain and address relevant topics that are of major interest for clinical research.
  • In this task force we are driving efforts in the use of data for learning models to be used in clinical studies.
UC3 Standardisation Efforts

• Following:
  • [EN IEC 62443-2-4:2019](#) Security for industrial automation and control systems - Part 2-4: Security program requirements for IACS service providers
  • [EN IEC 62443-3-3:2019](#) Industrial communication networks - Network and system security - Part 3-3: System security requirements and security levels
  • [EN IEC 62443-4-1:2018](#) Security for industrial automation and control systems - Part 4-1: Secure product development lifecycle requirements
  • [EN IEC 62443-4-2:2019](#) Security for industrial automation and control systems - Part 4-2: Technical security requirements for IACS components
  • [prEN IEC 62443-2-1:2019](#) Security for industrial automation and control systems - Part 2-1: Security program requirements for IACS asset owners
  • [prEN 62443-3-2:2018](#) Security for industrial automation and control systems - Part 3-2: Security risk assessment and system design

• Opportunities for Standardisation:
  • [IEC TC 65 Industrial-process measurement, control and automation](#): For industrial-process measurement.
  • [CENELEC TC 65X Industrial-process measurement, control and automation](#): Target equipment and systems operating with electrical, hydraulic, mechanical or other mechanisms of measurement and control.
  • [ISO/TC 184 Automation systems and integration](#): Automation and control systems, information systems and integration processes.
  • [IEC TC 56 Dependability](#): Performance of reliability, maintainability and support of maintenance processes
  • [ISO/TC 69 Applications of statistical methods](#): Collection (planning and design) of data, their analysis and finally, the presentation and interpretation of results.
  • [ISO/IEC JTC 1/SC 7 Software and systems engineering](#): Good practices for the processes of software development and system engineering.
  • [ISO/IEC JTC 1/SC 27 IT Security techniques](#)
  • [ISO/IEC JTC 1/SC 38 Cloud Computing and Distributed Platforms](#)
  • [ISO/IEC JTC 1/WG 9 Big Data](#)
UC4 Standardisation Efforts

• Following:
  • ISO 9001:2015: Organisational goals and aspirations, policies, processes, documented information, and resources needed.

• Opportunities for Standardisation:
  • ISO 9001:2015
    • Establishment of federated learning models for the extraction of sales/production to forecast the data that are also going to be used for ISO 9001:2015.
    • The sales/production forecast value that is going to be generated automatically in the dedicated files thus making them part of the ISO 9000:2015 standard.
UC5 Standardisation Efforts

• Following:
  • Proprietary protocols and Standardised open protocols.
    • The open ones are: Opus, WebRTC, UDP over IP, TCP, HTTP over TCP and HTTPS.

• Opportunities for Standardisation:
  • Team training in virtual reality
    • Object interactions suited for physical controller interaction or non haptic hand interaction, using inside out tracking for mobile consumer level virtual reality equipment, like the Oculus Quest.
    • Natural interaction technique. It is a control mechanism, where fingers individually can control, grasp and manipulate virtual objects in VR.
UC6 Standardisation Efforts

• Following:
    • MQTT interfaces will be developed for the Remote Terminal Units (RTUs) of SCHN, allowing easier integration of RTUs with information systems for diagnosis and maintenance
  • RFC 6241: Network Configuration Protocol (NETCONF).
    • NETCONF data adapters collect measurements by fronthaul optical switches in order to be utilised for diagnosis and maintenance processes.

• Opportunities for Standardisation:
  • IEEE 1232-2010: Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE) specifies formal data models to facilitate and converge the exchange of diagnostic information.
  • IEEE 1636-2018: An implementation-independent specification for interfacing information systems containing data related to the diagnosis and maintenance of other systems.
  • ISO 13374: Converge data exchange and communication for condition monitoring and diagnostics (CM&D) systems
Abstraction layer for digital twins, device inventories and discovery, with harmonisation across SDOs, e.g., OMG, ETSI and W3C, to reduce fragmentation and costs for integration.

Orchestration across the computing continuum, building upon Kubernetes and providing support for time sensitive and best-effort communication flows.

Remote attestation for establishing trust and security in devices and software components.
## TERMINET- Key Identified Standardization Gaps

<table>
<thead>
<tr>
<th>Topic</th>
<th>Details</th>
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<tbody>
<tr>
<td>Unified standards for Digital Twins to counter fragmentation across SDOs</td>
<td>In communication with the Edge Computing Task Force concerning the RFC “A Framework for QoS-Enabled Semantic Routing in Industrial Networks” which is in draft status but public. <a href="https://datatracker.ietf.org/doc/draft-bellavista-semantic-sdn-mom/">https://datatracker.ietf.org/doc/draft-bellavista-semantic-sdn-mom/</a></td>
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<tr>
<td>Open standards for designing, developing, deploying, and testing accelerated ML algorithms to FPGA based edge or cloud systems to counter dominance by proprietary siloed solutions</td>
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<td>Open standards relating to the gateway concept for remotely testing device</td>
<td>i2CAT is developing a RINA library (RINAsense) implementation for FreeRTOS, <a href="https://github.com/Fundacio-i2CAT/rinasense">https://github.com/Fundacio-i2CAT/rinasense</a></td>
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<td>Open standards for federated machine learning</td>
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<td>TERMINET patent on MPP’s attestation technique of the (AG)</td>
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<td>SHCN’s New Generation of RTU device – Prototype</td>
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TERMINET
Implementation to existing frameworks of 3rd parties

- Participate to the ETSI TeraFlowSDN open-source project for aligning the TERMINET SDN activities with this software development group.

- Orchestration of Intelligent UAVs Swarm: https://github.com/wcipAUTH/UAV-orchestrator

- Incorporating NGSI-LD in the set of protocols and formats supported by the Web of Things. NGSI-LD is a RESTful API for accessing IoT context information expressed as property graphs.

- Contributing IoT security support for logging and authorization to Hyperledger


TERMINET Achievements & Datasets & Scientific Publications


37. A. Liatifis et al., “Evaluating SDN applicability in the Edge,” in ICC 2023,

38. I. Siniosoglou et al., “Applying Federated Learning on Decentralized Smart Farming: A Case Study,” in ICC 2023,


CHERRY TREE DISEASE DETECTION DATASET

https://ieee-dataport.org/documents/cherry-tree-disease-detection-dataset
DNP3 INTRUSION DETECTION DATASET

Datasets

DNP3 INTRUSION DETECTION DATASET

Citation Author(s):
Panagiotis Redologou-Grammatikos
Vasiliki Kelli
Thomas Lagkis
Vasileios Argyriou
Panagiotis Sargoanidis

Submitted by:
Panagiotis Sarl

Last updated:
Tue, 11/23/2022 - 13:03

DOI:
10.21227/th9-b0b1

Data Format:
* csv

Link to Paper:
Risk Analysis of DNP3 Attacks

License:
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ABSTRACT

In the digital era of the Industrial Internet of Things (IIoT), the conventional Critical Infrastructures (CI) are transformed into smart environments with multiple benefits, such as pervasive control, self-monitoring and self-healing. However, this evolution is characterized by several cyberthreats due to the necessary presence of insecure technologies. DNP3 is an industrial communication protocol which is widely adopted in the CIs of the US. In particular, DNP3 allows the remote communication between Industrial Control Systems (ICS) and Supervisory Control and Data Acquisition (SCADA). It can support various topologies, such as Master-Slave, Multi-Drop, Hierarchical and Multiple-Server. Initially, the architectural model of DNP3 consists of three layers: (a) Application Layer, (b) Transport Layer and (c) Data Link Layer. However, DNP3 can be now incorporated into the Transmission Control Protocol/Internet Protocol (TCP/IP) stack as an application-layer protocol. However, similarly to other industrial protocols (e.g., Modbus and IEC 60870-5-104), DNP3 is characterised by severe security issues since it does not include any authentication or authorisation mechanisms. This dataset contains labelled Transmission Control Protocol (TCP) / Internet Protocol (IP) network flow statistics (Common Separated Values - CSV format) and DNP3 flow statistics (CSV format) related to 9 DNP3 cyberattacks. These cyberattacks are focused on DNP3 unauthorised commands and Denial of Service (Dos). The network traffic data are provided through Packet Capture (PCAP) files. Consequently, this dataset can be used to implement Artificial Intelligence (AI)-powered Intrusion Detection and Prevention (IDP) systems that rely on Machine Learning (ML) and Deep Learning (DL) techniques.

TERMINET EHEALTH POST-OPERATION COMPLICATIONS SYNTHETIC DATASET

https://zenodo.org/record/7886727
SMART HOUSE MEASUREMENTS

Load Forecasting Dataset

Readme File

Authors: Chrysovalantis-Kostoulis, Georgios Stavropoulos, Dimotethis Ioannidis

Publication Date: February 10, 2023

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreements No. 957406 (TERMINET).

1 Introduction
This dataset features information from a smart home located at Greece, which features the Mediterranean climate. The building is utilized as a modern workplace that is being used for various every day activities. It is equipped with numerous smart devices and appliances, from smart lights to smart a elevator, while also featuring PV/T.

https://zenodo.org/record/7628298
DAIRY SUPPLY CHAIN SALES DATASET

Datasets

DAIRY SUPPLY CHAIN SALES DATASET

Abstract

Sales data collection is a crucial aspect of any manufacturing industry as it provides valuable insights about the performance of products, customer behaviour, and market trends. By gathering and analysing this data, manufacturers can make informed decisions about product development, pricing, and marketing strategies in Internet of Things (IoT) business environments like the dairy supply chain.

One of the most important benefits of the sales data collection process is that it allows manufacturers to identify their most successful products and target their efforts towards those areas. For example, if a manufacturer notices that a particular product is selling well in a certain region, this information could be utilized to develop new products, optimize the supply chain, or improve existing ones to meet the changing needs of customers.

This dataset includes information about 70% of the products. According to the above information, the data published will help manufacturers to understand the dynamics of the dairy market and its consumption patterns, which is creating fertile grounds for synergies between academia and industry and eventually, help the industry in making informed decisions regarding product development, pricing and market strategies in the IoT environment. The use of this dataset could also aim to understand the impact of various external factors on the dairy market such as the economic, environmental and technological factors. It could help in understanding the current state of the dairy industry and identifying potential opportunities for growth and development.

Instructions:

Citation

https://iee-dataport.org/documents/dairy-supply-chain-sales-dataset
VIRTUAL REALITY GESTURE RECOGNITION DATASET

Thank you for your attention!

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