



Providing Resilient & secure networks (Operated on trusted Equipment) to Critical infrastructures

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Partners:

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 Fraunhofer-Institut für Angewandte Informationstechnik FIT
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Project Websites

www.celticnext.eu/project-ai-net-protect
 https://protect.ai-net.tech

AI-NET-PROTECT is one of three sub-projects of the CELTIC Flagship project AI-NET (Accelerating Digital Transformation in Europe by Intelligent NETWORK Automation), which brings together three technology fields: communication networks and technologies for 5G and 6G, user-centric data centres, and artificial intelligence (AI). Under the umbrella of the industry-led AI-NET project, researchers from seven European countries came together in three sub-projects to research novel solutions for the automation of optical communication networks and bring them to application maturity.

The AI-NET-PROTECT sub-project provides critical infrastructures and enterprises with automated, resilient, and secure networks operated on trusted equipment. To achieve this goal, the project developed a scalable transport network infrastructure with network telemetry, intent-based software-defined network control, and strong security utilizing artificial intelligence solutions.

Main focus

Digital transformation is ongoing in many areas of today's society, and it will impact many aspects of people's lives via means such as smart cities, robotics, transportation, and next-generation industries. At the same time, the current centralized cloud infrastructure is inadequate to serve the transformation's requirements. We believe three technologies can come together to shape a new secure service and application platform: 5G/6G, edge-centric computing, and artificial intelligence. In this context, the European industry has a good

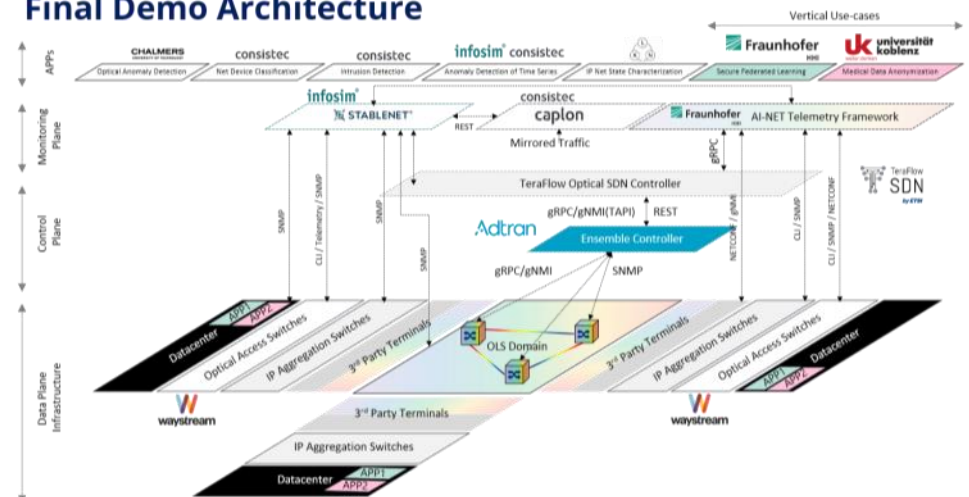
position in 5G/6G networks, transportation, and industrial applications. Still, it must strengthen its position in secure cloud, data centre, and artificial intelligence technologies to be at the forefront of development.

Approach

The AI-NET-PROTECT subproject (Providing Resilient and Secure Networks Operating on Trusted Equipment to Critical Infrastructures) investigated and developed concepts, network architectures, and methods for automated and secure network operation in critical infrastructures and the economy. The focus was on protecting sensitive and security-relevant data and on the high robustness of the network infrastructure. Strong security is ensured by approaches such as proactive anomaly detection, complex cryptographic methods, and quantum-safe algorithms - algorithms that quantum computers cannot decrypt. The high-performance and robust network operation is based, among other things, on an easily expandable network architecture, a separation of software and hardware, and artificial intelligence (AI). This enables automated resource allocation and control in the network as well as remote commissioning and maintenance of network devices. The main targets of the project were:

- ◆ Development of a scalable network & node architecture
- ◆ Integration of network telemetry and intelligent control
- ◆ Development of artificial intelligence (AI) based network automation

Final Demo Architecture



- ◆ Ensuring strong automated and quantum-safe security
- ◆ Validation of the developed solutions with proof-of-concept demonstrators and testbeds

New AI methods and solutions are developed that provide robust and reliable automation, which is not sufficiently supported in current solutions. Most of today's AI algorithms are developed for other domains, and AI-NET-PROTECT provides algorithms tailored to the needs of carrier-grade edge, metro, and core networks.

Achieved results

AI-NET-PROTECT provides solutions and new technologies for automating network infrastructure and edge computing to enable better runtime operation, optimized resource utilization, and lower operational costs. As a result, we will enable new and better services running on top of the base infrastructure, taking full advantage of 5G capabilities.

Intellectual property rights and new or improved products resulting from the project are clear evidence of the economic importance of AI-NET and AI-NET-PROTECT. It is expected that the novel solutions developed in AI-NET-PROTECT will, in a few years' time, form core functions of network and network management solutions, without which they will no longer be competitive. For SMEs, AI-NET-PROTECT offers, among other things, the potential to develop new software solutions and services and to constantly expand their customer base through new contacts.

The project achieved outstanding progress with excellent scientific results based on the good collaboration of all AI-NET-PROTECT partners. This resulted in **170 publications and presentations**, including **135 conference papers** and **32 journal papers**, and in total, **14 standardization contributions and implementations** and **17 open source contributions**. In total, AI-NET-PROTECT gave **7 Keynote talks** at conferences. In total, **10 AI-NET-PROTECT workshops** were organized by project partners.

A major effort and achievement of the project is the development of a **final demonstration with 9 integrated use cases and prototypes** from all WPs onto the OTB-5G+/6G-RIC testbed at HHI, Berlin, and **6 additional stand-alone demos**. Use cases include optical network automation, ML-based service optimization, anomaly and malicious attack detection, and medical data anonymization. All demos were integrated into the federated streaming telemetry and data analytics framework, and dashboards were generated to visualize the key performance indices. The AI-NET-PROTECT network architecture was successfully applied and verified in the final demo with these integrated use cases. The network KPIs were also collected in the final demo infrastructure and use cases. The final demonstration and stand-alone demonstrations were shown during the Final Review in June 2024 and in the AI-NET booth during the Closing Event on 2 July 2024.

A key outcome of the Swedish consortium is a field trial with Wa-

ystream, Lunet, Savantic, and RISE on "AI/ML-based analysis of telemetry data for fibre access systems". The work is conducted in the Lunet open access network, where telemetry data is collected from over 500 Waystream access switches. Analysis of the data is ongoing, with a focus on traffic characteristics and predictability by RISE and multi-variate analysis by Savantic.

Impact

The ambitious objectives of the AI-NET-PROTECT sub-project enable a new class of applications that live at the edge, creating truly smart cities and industries for the benefit of European citizens, e.g., improved transportation systems, healthcare and wellness support, and factory and critical infrastructure automation.

The project developed end-to-end automation at the network and service level using AI in the European framework with reference to national funding priorities for securing the location using previous project results (especially SENDATE, EU Horizon 2020) in coordination or cooperation with other national projects (BMBF OTB-5G+, 6G-RIC). The work in AI-NET-PROTECT allows the European IT and telecommunications industry to gain more market share with new network solutions and IT services in a market currently dominated by few non-European players.

- ◆ 26 / 22 prototypes, technology demonstrators, and proof of concepts (PoC)
- ◆ 167 / 128 scientific papers in leading journals and conferences
- ◆ 7 / 6 Keynotes at conferences and industry events
- ◆ 32 / 34 PhDs contributing to and using project results
- ◆ 50 / 42 MSc theses contributing to and using project results
- ◆ 32 / 32 hirings
- ◆ 21 / 20 patent applications and contributions to standards and open source projects
- ◆ 35 / 30 new or improved products/services
- ◆ 60 / 12 dissemination activities towards a wider technical audience and the general public (i.e., outside the core scientific community)

About CELTIC-NEXT

CELTIC-NEXT is the EUREKA Cluster for next-generation communications enabling the digital society. CELTIC-NEXT stimulates and orchestrates international collaborative projects in the Information and Communications Technology (ICT) domain.

The CELTIC-NEXT programme includes a wide scope of ICT topics based on new high-performance communications networks supporting data-rich applications and advanced services, both in the ICT sector and across all vertical sectors.

CELTIC-NEXT is an industry-driven initiative, involving all the major ICT industry players as well as many SMEs, service providers, and research institutions. The CELTIC-NEXT activities are open to all organisations that share the CELTIC-NEXT vision

of an inclusive digital society and are willing to collaborate to their own benefit, aligned with their national priorities, to advance the development and uptake of advanced ICT solutions.

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