SOVEREIGN Online Course on

"Blockchain: Fundamentals and Security"

Tuesday 18th – Wednesday 19th of February 2025

Organized by

MSCA-SE-SOVEREIGN (G.A. 101131481)

distributed ledger technologies and user-driven automation towards self-SOVEREIGN mobile data access in beyond 5G networks

MSCA-DN-ELIXIRION (G.A. 101120135)

rEaLIzing healthcare 4.0 eXploIting the 6G netwoRk evolution

Technical Coordination by

Dr. Dionysis Xenakis, Assistant Professor NKUA, Department of Digital Industry Technologies
Project Coordinator, MSCA-SE-SOVEREIGN programme

The Course is under the auspices of

The Master's Program of the National and Kapodistrian University of Athens in "Business Administration"

The Master's Program of the National and Kapodistrian University of Athens in "Financial Technology/ FINTECH

Technically co-sponsored by the following EU-funded actions:

Fostering a Human-Centered, Trustworthy and Sustainable Internet	Critical infrastructure High accuracy and Robustness increase Integrated Synchronization Solutions	AI-ASsisted cybersecurity platform empowering SMEs to defend against adversarial AI attacks	Secure management of IoT devices lifecycle through identities, trust and distributed ledgers
GA 101093274	GA 101082440	GA 101131292	GA 101020416

1st Day: Tuesday 18th of February 2025

Time	Speaker	Title	Syllabus
8:30 - 10:15	**NKUA** Prof. Thanasis Papaioannou Sponsoring Project: NGI TrustChain	Blockchain Fundamentals (1/2)	• Introduction to Blockchain Technology • Definition, key characteristics (decentralization, transparency, immutability). • Historical evolution (from Bitcoin to modern systems). • Components of a Blockchain • Nodes, transactions, blocks, consensus mechanisms. • Public vs. Private Blockchains • Differences, examples, and use cases. • Blockchain trilemma
10:15 - 10:45	**Coffee Break**		

10:45 - 12:30	**NKUA**
	Prof. Thanasis Papaioannou
		Blockchain Platforms and Ecosystems	• Bitcoin
			  – Key features, scripting language.
			• Ethereum
			  – Smart contracts, ERC standards, Ethereum Virtual Machine (EVM).
			• Other Platforms
			  – Hyperledger Fabric, Solana, Cardano.
			• Blockchain Interoperability
			  – Cross-chain solutions and bridges.
			• Advanced operations
			• Sharding, state channels, oracles

12:30 -13:30	**Lunch Break**		

13:30 - 15:15	**University of Piraeus**
	Mr. Aggelos Sideris
	
	Sponsoring Project CHRISS
		Blockchain Fundamentals (2/2)	• Introduction to Blockchain Technology
			• Definition, key characteristics (decentralization, transparency, immutability).
			• Historical evolution (from Bitcoin to modern systems).
			• Components of a Blockchain
			• Nodes, transactions, blocks, consensus mechanisms.
			• Public vs. Private Blockchains
			  – Differences, examples, and use cases.
			  ○ Blockchain trilemma

15:15- 15:45	**Coffee Break**		

15:45 - 17:30	**University of Piraeus**
	Mr. Anastasios Voudouris
	
	Sponsoring Project ERATOSTHENES
		Cryptographic Foundations	• Core Cryptographic Concepts
			  – Hashing
			  – Public and private key cryptography.
			  – Digital signatures.
			• Merkle Trees
			  – Structure, purpose in blockchains.
			  – Security Challenges

2nd Day: Wednesday 19th of February 2025

Time	Speaker	Title	Syllabus
8:30 - 10:15	**NKUA** Prof. Thanasis Papaioannou & Prof. Dionysis Xenakis	Consensus Mechanisms	• Proof of Work (PoW) – Mechanism, energy concerns, and mining. • Proof of Stake (PoS) and Variants – Staking mechanics, – Delegated PoS, Practical Byzantine Fault Tolerance (PBFT). • Emerging Consensus Mechanisms – Proof of Authority (PoA), Proof of Space and Time, etc. • Comparative Analysis – Strengths, weaknesses, and use-case suitability.
10:15 - 10:45	**Coffee Break**		
10:45 - 12:30	**NKUA** Prof. Thanasis Papaioannou	Smart Contracts (1/2)	• What are Smart Contracts? – Definition, characteristics, execution. • Smart Contract Development – Tools: Solidity. – Hands-on: Write and deploy a basic contract. • Common Vulnerabilities - Reentrancy, integer overflow, gas limit issues
12:30 -13:30	**Lunch Break**		
13:30 - 15:15	**University of Piraeus** Mr. Aggelos Sideris Sponsoring Project: CHRISS	Smart Contracts (2/2)	• What are Smart Contracts? – Definition, characteristics, execution. • Smart Contract Development – Tools: Solidity. – Hands-on: Write and deploy a basic contract. • Common Vulnerabilities – Reentrancy, integer overflow, gas limit issues
15:15- 15:45	**Coffee Break**		
15:45 - 17:30	**NKUA** Prof. Thanasis Papaioannou & Prof. Dionysis Xenakis	Blockchain Applications	• Healthcare • Supply Chain • Decentralized Finance • Telecoms / Content Sharing • Other applications
17:45 -18:15	**Coffee Break**		
18:15 - 19:30	**University of Piraeus** Mr. Anastasios Voudouris Sponsoring Project: AIAS	Blockchain and Research	• State-of-the-Art Research Topics – Privacy-preserving technologies (zk-SNARKs, zk-STARKs). – Multiparty computation – Game theory • Open Challenges • Opportunities for Innovation • Identifying gaps for academic contributions

Need further details | Having connectivity issues? Please mail to: nio@uoa.gr

SOVEREIGN: distributed ledger technologies and user-driven automation towards self-SOVEREIGN mobile data access in beyond 5G networks

SOVEREIGN
Grant agreement ID: 101131481

DOI
10.3030/101131481

EC signature date
24 August 2023

Start date 1 January 2024 — **End date** 31 December 2027

Funded under
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Total cost
€ 0,00

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€ 1 656 000,00

Coordinated by
ETHNIKO KAI KAPODISTRIAKO PANEPISTIMIO ATHINON
Greece

https://cordis.europa.eu/project/id/101131481

SOVEREIGN aims to fuel artificial intelligence (AI) with DLT-backed data in order to innovate the B5G service chain and the B5G protocol stack towards the support of fully decentralized, instantaneous, and anonymous resource trading across the B5G network ecosystem (end terminals, infrastructure, OTT service providers, etc.). SOVEREIGN aims to empower intelligent end points in B5G networks, to gain full control of their identities, connectivity, sessions, service terms, and shared data upon accessing B5G spectrum, antennas, network slices and services.

Self-sovereign identity (SSI) is a model for managing digital identities in which individuals or businesses have sole ownership over the ability to control their accounts and personal data.

8 Partners
6 Countries

Measurable Performance Objectives (MPOs)

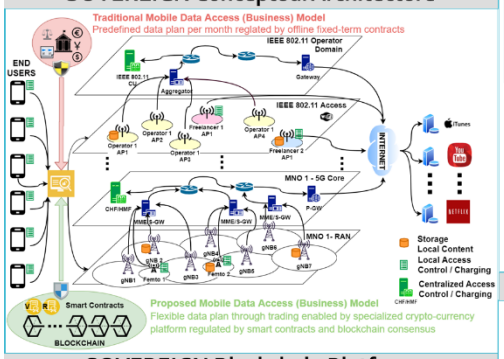
MPO1. *Setup new mobile data services and negotiate new service terms in sub-minute scales*
MPO2. Self-sovereign mobile data access of 20B peers using the DLT-backed B5G service platform
MPO3. Design a DLT-backed B5G service platform supporting 20M transactions per second
MPO4. Sustain 99.99999% availability of the SOVEREIGN anonymity services in B5G systems
MPO5. Demonstrate 99.99% service reliability with partial network-assistance and 99.99999% service reliability with full network-assistance

Research and Innovation Objectives (RIOs)

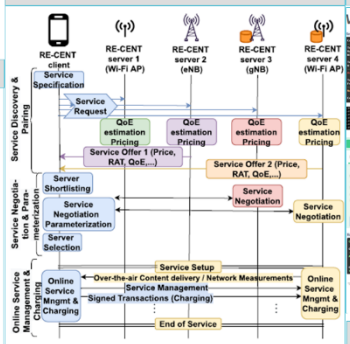
RIO1. *Conceptualize and develop a modular end-to-end service architecture integrating DLT-empowered service provisioning towards self-sovereign mobile data access in B5G networks*
RIO2. Design and implement a fully decentralized DLT-backed authentication, authorization, and accounting (AAA) platform tailored to self-sovereign connected intelligence in B5G networks
RIO3. Design and implement forward-thinking protocols for self-sovereign identity management and anonymity/data privacy preservation over joint DLT/B5G system infrastructures
RIO4. Design, implement, and assess the performance of user-controlled AI-enabled service discovery, pairing, mobility management and resource provisioning for the B5G network protocol stack

WHITE PAPER: D. Xenakis, C. Koulis, A. Tsiota, N. Passas, C. Xenakis, «Contract-less Mobile Data Access Beyond 5G: Fully-decentralized, high-throughput and anonymous asset trading over the Blockchain», *IEEE Access*, vol. 9, pp. 73963-74016, 2021, https://doi.org/10.1109/ACCESS.2021.3079625.

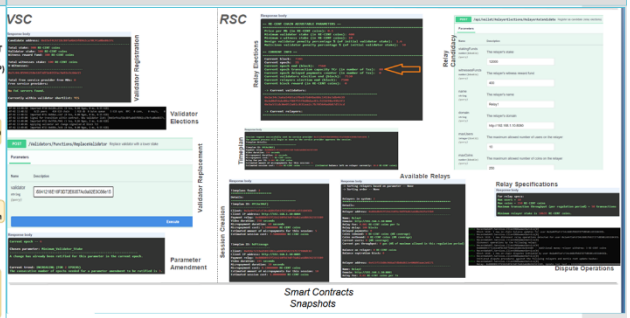
SOVEREIGN Conceptual Architecture



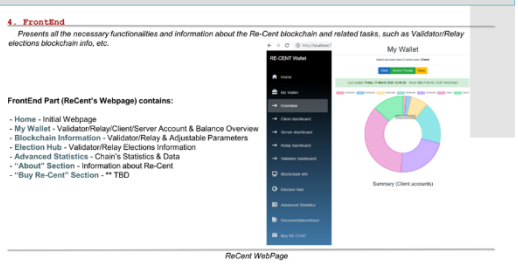
SOVEREIGN Service Flow



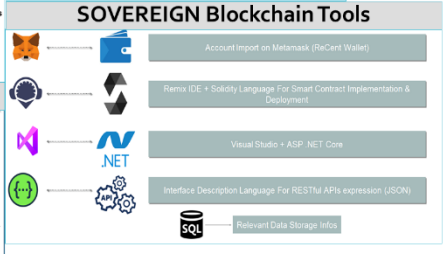
Back-end Infrastructure



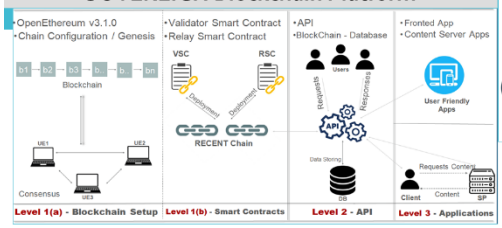
Front-end



SOVEREIGN Blockchain Tools



SOVEREIGN Blockchain Platform



Project Coordinator: Prof. Dionysis Xenakis, *National and Kapodistrian University of Athens*
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HORIZON EUROPE

MARIE CURIE ACTIONS

ELIXIRION

ELIXIRION: rEaLIzing healthcare 4.0 eXploIting the 6G netwoRk evolutION

Project Information

ELIXIRION
Grant agreement ID: 101120135

DOI
10.3030/101120135

EC signature date
6 July 2023

Start date 1 November 2023
End date 31 October 2027

Funded under
Marie Skłodowska-Curie Actions (MSCA)

Total cost
€ 0,00

EU contribution
€ 2 536 970,40

Coordinated by
ARISTOTELIO PANEPISTIMIO T
Greece

https://cordis.europa.eu/project/id/101120135

Ind.	Target KPIs	WP	DCs
A1	Reliability: up to 99.99999%, 100% Coverage	1	LU-1
A2	Capacity: up to 1 Tbps, Energy/Cost-efficiency: 75% higher than SoA	1	AUTH-1
A3	Increased 6x battery lifetime/energy efficiency compared to SoA	1	MCS-1
B1	Service placement latency: down to sub-ms, Service continuity: 99.99999%	2	NBC-1
B2	30% develop./deploym. Time reduction, 30% workflow exec. time reduction	2	BSC-1
B3	50% more info shown to patients on EMR access, 50% manual work decrease for data collection	3	AMC-1
C1	E2E latency: down to sub-ms, Energy/Costefficiency: 50% higher than SoA	3	ORAN-1
C2	Transaction throughput: 100K transactions per second (TPS)	3	FOG-1
C3	>75% higher energy/cost-efficiency, 100% uninformative information reduction	3	LIU-1
C4	20% increased analytics performance, 80% increased output understanding	2	SUIT-1

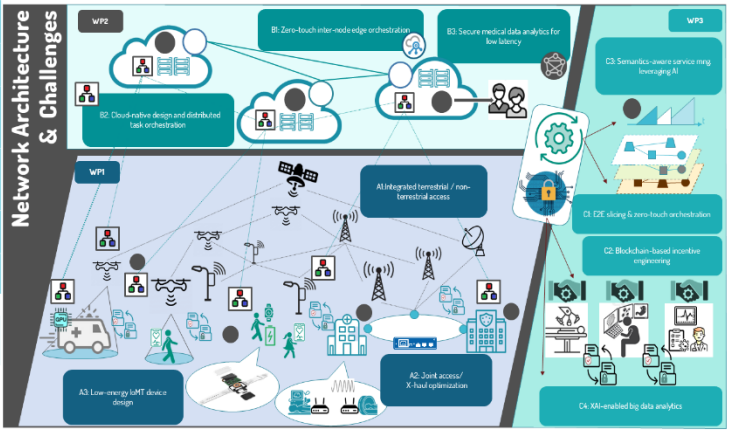
Project Coordinator: Prof. Amalia Miliou (AUTH)
UOA PI: Prof. Dionysis Xenakis (nio@uoa.gr)
WWW: https://elixirion-mc.eu/

ELIXIRION aims to set the foundations of the emerging Healthcare 4.0 paradigm by leveraging 6G technologies targeting to: i) provide all citizens/patients with a wide range of services of different requirements, such as ultra-low latency for latency-critical applications, high speed for data hungry services and ubiquitous secure access to healthcare resources, anytime, anywhere, respecting all privacy aspects, and ii) ensure a secure, efficient, and profitable healthcare ecosystem to all involved stakeholders, while creating a sustainable open market easing access to new players

8 Countries

Healthcare 4.0 promotes the digitization of healthcare through the use of advanced technologies. Such technologies provide patients with greater reliability, convenience, satisfaction, and transparency.

14 Partners



Research Area 1: High reliability and high capacity green 6G infrastructures, focusing on technologies such as i) **NTNs** (Unmanned Aerial Vehicles (UAVs), satellites and High Altitude Platform Stations (HAPS)), ii) **joint access and X-haul**, and iii) **multi-GHz bands** (mmWave, sub-THz, THz), to complement the TN services.

Research Area 2: Fully-distributed compute continuum for low latency healthcare applications.

Research Area 3: AI-driven E2E Healthcare service provisioning over 6G.