



Next Generation IoT as part of Next Generation Internet

Impact Creation and Outreach

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IoT-NGIN Consortium

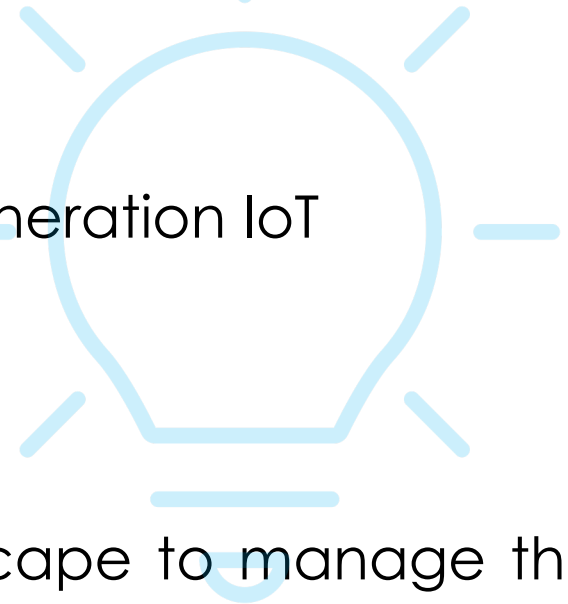


	Logo	Participant organisation name	Short name	Country	
01		Capgemini Technology Services	CAP	France	Industry
02		Atos Spain S.A.	ATOS	Spain	
03		ERICSSON GmbH	EDD	Germany	
04		ABB Oy	ABB	Finland	
05		INTRASOFT International S.A.	INTRA	Luxemburg	
06		Engineering-Ingegneria Informatica SPA	ENG	Italy	Living Labs
07		Robert Bosch Espana Fabrica Aranjuez SA *	BOSCH	Spain	
08		ASM Terni SpA	ASM	Italy	
09		Forum Virium Helsinki	FVH	Finland	SME
10		Optimum Technologies Piroforikis S.A.	OPT	Greece	
11		eBOS Technologies Ltd	EBOS	Cyprus	
12		Privanova SAS	PRI	France	
13		Synelixis Solutions S.A.	SYN	Greece	
14		CUMUCORE Oy	CMC	Finland	Research
15		Emotion s.r.l.	EMOT	Italy	
16		AALTO-Korkeakouluosaatio	AALTO	Finland	
17		i2CAT Foundation	I2CAT	Spain	
18		Rheinisch-Westfälische Technische Hochschule Aachen	RWTH	Germany	
19		Sorbonne Université	SU	France	

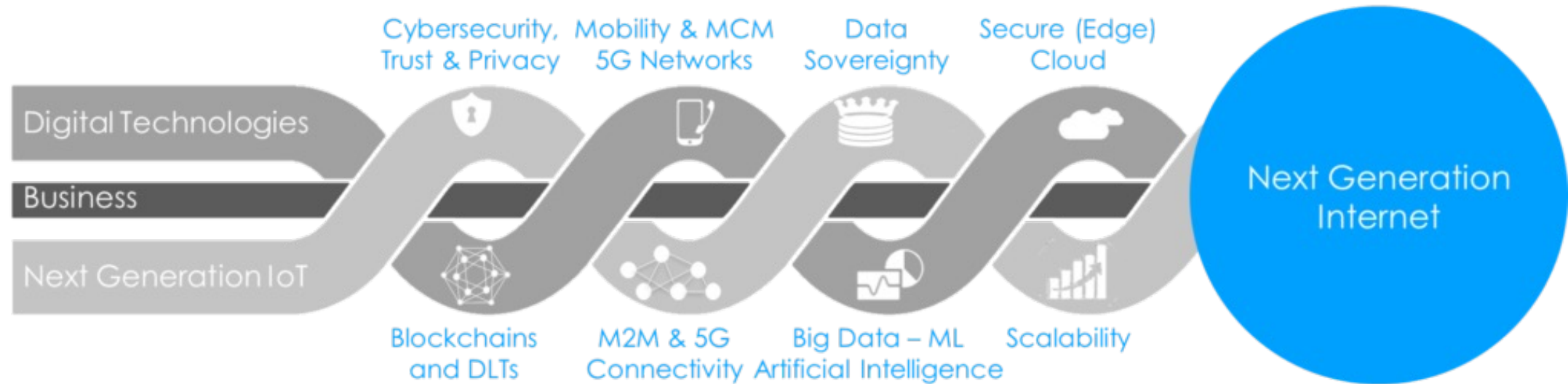
IoT-NGIN in one slide



- Our goal:
 - *Bringing the IoT and modern technologies (5G, AI, DLT...) together in an optimal way, towards a sustainable ecosystem of European Technology and System providers*
- Our way:
 - Offer new tools and ecosystem to enable next-generation IoT
 - New services to existing platforms
 - New platform opportunities
 - New collaboration paradigms
 - New business potential
 - Prepare the technology & standardization landscape to manage the demands posed by large-scale IoT deployments



IoT-NGIN building blocks



IoT-NGIN Technical Achievements



WP1



- **Next Generation IoT Requirements & Meta-Architecture**

- IoT-NGIN meta-architecture as a reference architecture for next-generation IoT systems
- D1.3 - IoT meta-architecture alignment and continuous technology watch
- D1.4 - Continuous technology watch and alignment

WP2

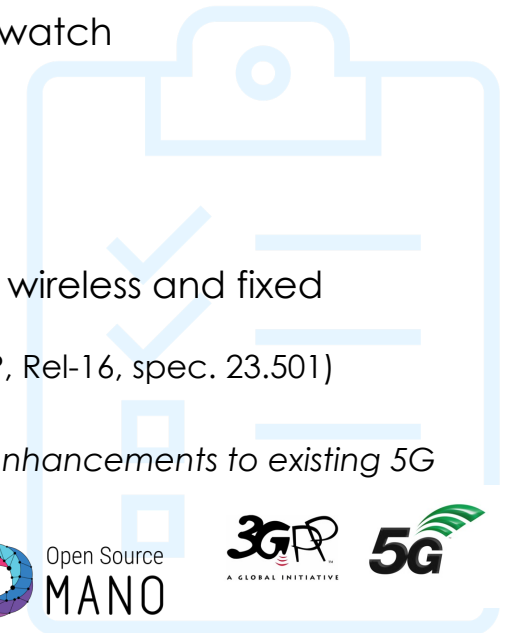


- **Enhancing IoT Underlying Technology**

- Enhanced 5G coverage through D2D communications and TSN
 - TSN for 5G networks for deterministic communication between both wireless and fixed connections
 - **First 5G core prototype in Europe with Ethernet PDU**, supporting TSN (3GPP, Rel-16, spec. 23.501)
 - 5G-resource-management API for simplified access to 5G services
 - 5G Connectivity and Device Management, contributions accepted as enhancements to existing 5G standards
 - μservice LCM
 - Network Slice Management *integrating ETSI OSM as the NFV MANO*
 - Flexible & secure edge-cloud framework, based on unikernels
- D2.2 - Enhancing IoT Underlying Technology
 - D2.3 - Enhanced IoT Underlying Technology (Final Version)



Open Source
MANO



IoT-NGIN Technical Achievements



WP3



- **Enhancing IoT Intelligence**

- [MLaaS platform](#) offering MLOps functionality across ML design and development lifecycle, integrating edge and cloud resources and Digital Twins
- Analysis of [Privacy-preserving Federated Learning](#) for secure FL training for diverse applications
- IoT-NGIN [FedPATE](#) increasing [privacy for knowledge aggregation and sharing](#)
- Simplified access to PPFL training via a common [PPFL API](#)
- [XAI Online Learning framework](#) for dynamic training of ML models and model serving for IoT applications
- [Reinforcement Learning \(RL\)](#) based implementation for electric grids' optimization
- [DLT-enabled Polyglot Model Sharing](#), enforcing for reusing immutable ML models across ML architectures

-  D3.3 - Enhanced IoT federated deep learning/ reinforcement ML
-  D3.4 - ML models sharing and Transfer learning implementation

IoT-NGIN Technical Achievements




WP4

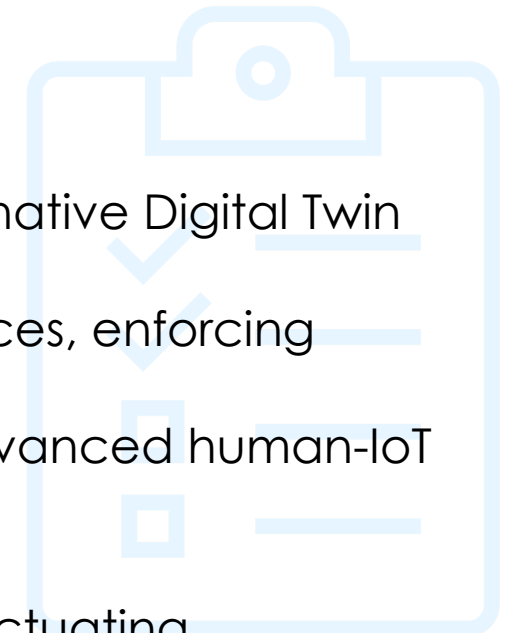


- **Enhancing IoT Tactile & Contextual Sensing/Actuating**

- Advanced lightweight **Device Discovery** techniques
 - **Computer Vision** for image recognition
 - **Visual Light Positioning**
 - **Ultra-Wide Band localization**
- **Context-aware data brokering** as enabler for edge-native Digital Twin services
- Multi-criteria access control for IoT devices and services, enforcing **ZeroTrust privileged access** for pervasive security
- **User-centric AR interfaces** with diverse sensors for advanced human-IoT interactions

 D4.3 - Enhancing IoT Tactile & Contextual Sensing/ Actuating

 D4.4 - Enhanced IoT Tactile & Contextual Sensing/ Actuating (Final Version)



IoT-NGIN Technical Achievements



WP5



• **Enhancing IoT Cybersecurity & Data Privacy**

- ML-based **cybersecurity** auditing and active protection in IoT
 - [GAN-based dataset generator](#) enhancing preparedness towards IoT/FL attack detection
 - Modular [IoT vulnerability crawler](#), covering WASC threat classification & MITRE CWE
 - [ML-based Malicious Attack detector](#), addressing both network and sophisticated membership attacks
 - [Moving-Target Defense Honeypots](#)' framework using system polymorphism to hide IoT application targets from adversaries
- Enforce **data sovereignty** through trusted, auditable and controlled data sharing
 - Simplifying access to IoT device and Digital Twin data through [interoperable Semantic Twins](#) based on SAREF ontologies
 - Secure & trusted data sharing through the [Decentralized Interledger Bridge](#)
 - [Privacy-preserving Verifiable Credentials](#) based decentralised on-device access control for constrained IoT Devices

- ⚙️ D5.2 - Enhancing IoT Cybersecurity (Update)
- ⚙️ D5.4 - Enhancing IoT Data Privacy & Trust (Update)
- ⚙️ D5.5 - Enhanced IoT Cybersecurity & Data Privacy/Trust

IoT-NGIN Technical Achievements



WP6



- **IoT-NGIN Integration & Laboratory evaluation**

- Active enforcement of **DevSecOps** methodologies for the entire software lifecycle
- Instantiation of **IoT-NGIN architecture** in 10 LL UCs
- Development of **business-specific logic**, for using IoT-NGIN tools across use cases
- IoT-NGIN **integrated edge/cloud-native** platform
- **Easy & Flexible deployment**: *One-command Kubernetes-based deployment and configuration* of the IoT-NGIN platform
- **5G optimization tests** validating
 - data performance for IoT-NGIN use cases
 - RWTH's 5G EdgePMU in a private standard 5G deployment
 - CMC's 5G Core with TSN in industrial setup
- **Laboratory testing & evaluation** of IoT-NGIN functionality

⚙️ D6.2 - Integrated IoT-NGIN platform & laboratory testing results

⚙️ D6.3 - Interoperable IoT-NGIN meta-architecture & laboratory evaluation



IoT-NGIN Technical Achievements



WP7



- **IoT-NGIN Living Labs Validation & 3rd Party Support**

- **Validation** of the IoT-NGIN enhancements **through diverse use cases**

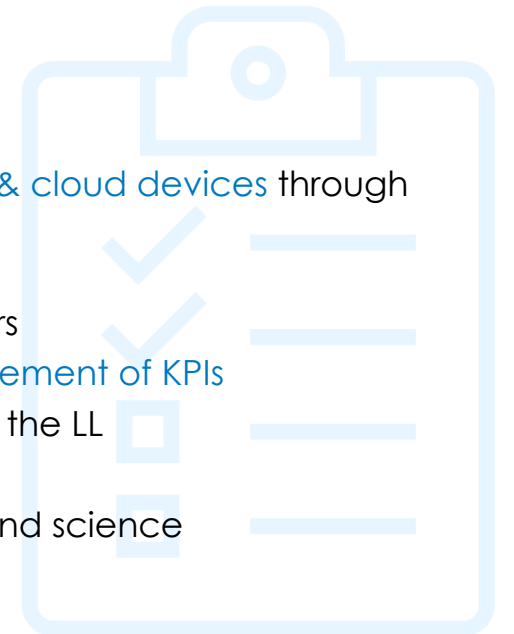
- Analysis & refinement of **10 use cases** in 4 Living Labs
- Coordination with and support of **8 use cases** from the Open Calls

- **For all LLs**, IoT-NGIN has delivered

- Comprehensive **validation** of the IoT-NGIN capabilities **in IoT, edge & cloud devices** through well-defined pilot scenarios
- Detailed **analysis of the pilot results**
- Evaluation of **QoS and QoE** of using IoT-NGIN by Living Lab end users
- Detailed **assessment** of the obtained outcomes towards the **achievement of KPIs**
- Identification of **deviations** from the originally planned execution of the LL
- Determination of **limitations** and potential **design optimizations**
- Development of **replication guidelines**, supporting open research and science

⚙️ D7.3 - IoT-NGIN Living Labs use cases intermediate results

⚙️ D7.4 - IoT-NGIN Living Labs use cases Assessment and Replication guidelines



Standardization / Exploitation outlook



- Contribution to standardization bodies / clusters
 - 3GPP, 5GPPP, 5G IA, AIOTI, BDVA/DAIRO, GAIA-X, etc.



- **3GPP SA6:** 3 contributions accepted & published
- **EUTC contributions to 3GPP SA5:** 11 contributions accepted and published as global standards
- **CIGRE:** contributions to the new WG on sub-station automation
- **Twinbase startup** exploiting IoT-NGIN results
- Strong industry interest on the project topics
 - Many **collaborations emerged** among the project partners and **opportunities for new ones** have been identified

Interactions with 49 targeted clusters & associations in the 2nd reporting period!



Contributions to 6 standardisation organisations

- 3GPP SA6 and SA5
- CIGRE
- IEEE Smart Agrifood Electronics SIG
- ISO
- ENISA
- GAIA-X

9 Communication clusters

- NetworldEurope
- 5G- and 6G-PPP and -IA's, DG CONNECT
- NGI
- EUTC
- ISO
- ENISA
- 3GPP

11 Vertical Sector Clusters & orgs.

- Madrid Automotive Cluster
- Automotive Cluster Catalonia
- Open Urban Platform
- OASC
- BRIDGE
- IEEE Agrifood Elec. SIG, CIGRE, ISO, EUTC, GAIA-X

7 other clusters

- NG-IoT/Now EU-IoT
- DIH
- Spaces.Funding
- ENoLL
- Living-In.EU
- Crowdhelix
- Bosnian Future Forum

6 Open-Source clusters

- FIWARE Foundation
- ONF
- OSM
- Linux Foundation
- ECLIPSE Foundation
- GAIA-X

4 Software clusters

- BDVA (Now ADRA)
- AI4EU,
- INATBA
- NESSI

4 Security organisations

- INTERPOL
- United Nations General Assembly
- ISF Int. Sec. Forum)
- ENISA (EU Agency for Cybersecurity)

5 IoT clusters

- AIOTI
- ECS
- ECISO
- 5G-ACIA
- EFFRA

Standardization bodies followed by partners



Partner	Standardisation bodies
AALTO	GAIA-X, IDSA, ITU Smart City (industry-led de-facto standardization)
ABB	Platform Industry 4.0 & IEC/TC 65/WG 24 Asset Administration Shell, GAIA-X
BOSCH	5G-ACIA (Alliance for connected industries and automation)
CMC	ONF
EDD	3GPP, CIGRE
FVH	OGC Point of Interest SWG (W3C POI, ISO 19112, ISO 19155)
PRI	NIST, ENISA, ISO
eBOS	IEEE circuits and systems society SIG on AgriFood Electronics

IOT-NGIN



<https://iot-ngin.eu>



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#iotngin, #iot, #ai