



A Holistic, Innovative Framework for the Design,
Development and Orchestration of 5G-ready
Applications and Network Services over Sliced
Programmable Infrastructure

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MATILDA is an H2020 project that aims to design and implement a **holistic 5G end-to-end services operational framework** that tackles the lifecycle of design, development and orchestration of **5G-ready applications** as well as **5G network services** running over a programmable infrastructure, while following a unified programmability model and a set of control abstractions.

The MATILDA unified programmability model aims to realize a **radical shift** in the development of 5G-ready applications, as well as virtual and physical network functions and network services. MATILDA will define proper abstractions and create an **open development environment** for use by both applications' and network functions' developers.



MATILDA will utilize intelligent and coordinated **orchestration mechanisms** to automate the placement of 5G-ready applications, as well as the creation and maintenance of their required network slices. Deployment and runtime policies enforcement is provided through a set of **optimization mechanisms** supporting runtime adaptation of the application components.

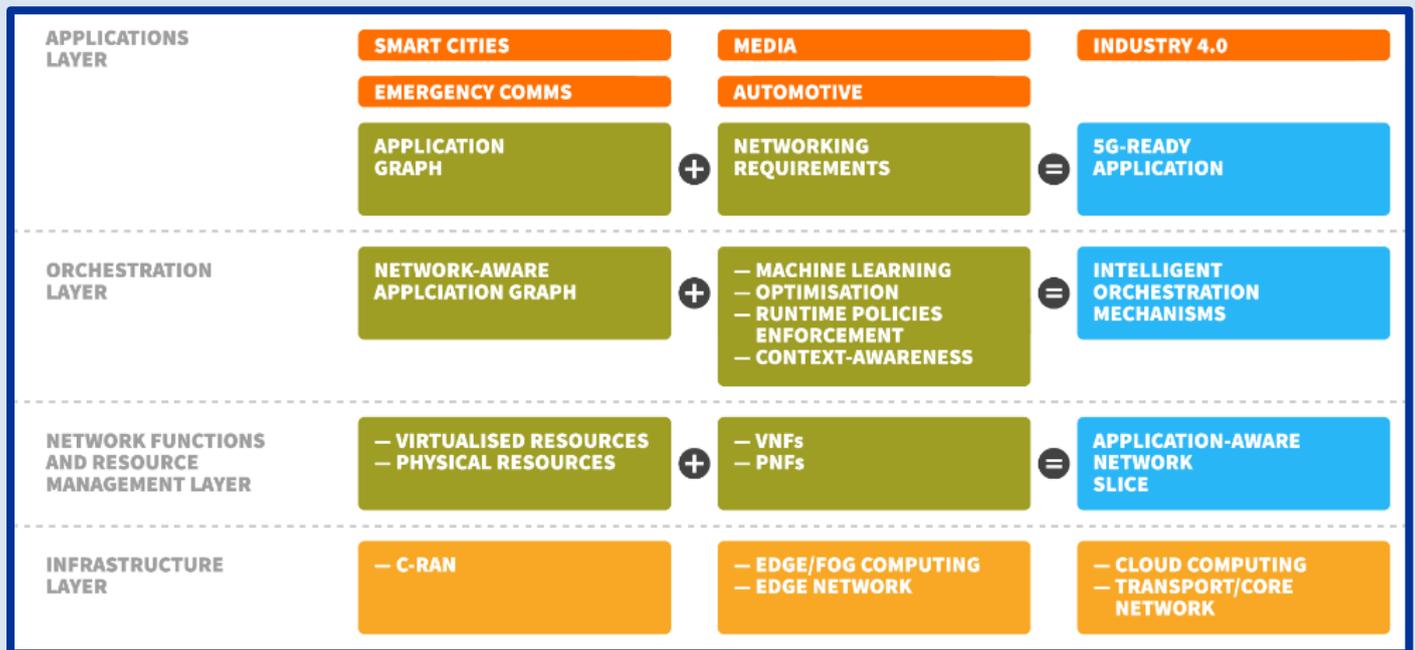
MATILDA will also offer a platform to deploy and operate **network and computing slices**, which will be composed of a set of extended Telecom Service Provider OSS/BSS functionalities, of a **multi-site NFVO** supporting the lifecycle management of the network services, as well as of the functionalities needed to support and integrate **multi-site Edge Computing** operations. Network and application-oriented **analytics and profiling mechanisms** are also supported based on real-time as well as a posteriori processing of the collected data from a set of monitoring streams. Finally, the developed 5G-ready application is made available for **open-source or commercial purposes** through a 5G marketplace.



MATILDA envisions designing and developing a **holistic framework** that supports:

1. tight interconnection among the development of 5G-ready applications,
2. the creation of on-demand application-aware network slices and
3. the activation of appropriate networking mechanisms for the support of vertical industry applications.

To actualize this vision, MATILDA follows a **layered approach** in its conceptual high-level architecture reflecting the main technological areas as contained in the framework.



The **Applications Layer** corresponds to the design and development of the 5G-ready applications per industry vertical, along with the specification of the associated networking requirements.

The **Orchestration Layer** corresponds to both the application components and the attached virtual network functions and includes a set of intelligent mechanisms for optimal deployment, runtime policies enforcement, data mining and analysis and context awareness support.

The **Network Functions and Resource Management Layer** corresponds to the implementation of the resource management functionalities over programmable infrastructure, as well as the lifecycle management of the activated VNFs.

The **Infrastructure Layer** comprises the physical infrastructure facilitating data communication and spanning a set of cloud computing and storage resources.

MATILDA is structured around the following **6 key objectives**:

Objective I: to facilitate vertical industries in exploiting the full potentials of the 5G ecosystem, by enabling the development of network-aware applications and their deployment and orchestration over dynamically created network slices.

Objective II: to provide an open-source development and application/services composition environment along with a critical mass of VNFs/PNFs and network-aware application components made available to application developers, service providers and operators for developing and verifying appropriate development of network-aware applications through the MATILDA marketplace.

Objective III: to provide a network-aware applications orchestrator able to deploy applications over dynamically created network slices that support a set of intelligent orchestration mechanisms, including deployment and runtime policies enforcement, data monitoring, fusion and analysis and a context awareness engine for inference of knowledge based on the collected information.

Objective IV: to provide dynamic and efficient management of resources constituting an application-aware network slice including the mechanisms for managing the required VNF-FGs, based on the requests provided by the deployment manager of the Orchestrator.

Objective V: to prove the applicability, usability, effectiveness and value of the MATILDA framework for vertical industries, demonstrating and stress-testing the developed MATILDA artefacts under pragmatic conditions against a pre-defined set of use cases over the available 5G testbeds.

Objective VI: to ensure scientific dissemination of the innovative MATILDA results to the 5G industry verticals, businesses, research and international communities, in order to exploit the MATILDA software development paradigm and orchestrator and identify end-users and potential customers, as well as to contribute specific project results to relevant standardization bodies and the 5G PPP community.

MATILDA has **17 consortium partners**, each of which is strategically positioned within the EU nations. They are:

CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI		
ATOS SPAIN SA		
ERICSSON TELECOMUNICAZIONI		
INTRASOFT INTERNATIONAL SA		
COSMOTE KINITES TILEPIKOINONIES AE		
ORANGE ROMANIA SA		
EXXPERTSYSTEMS GMBH		
GIOUMPITEK MELETI SCHEDIASMOΣ YLOPOIISI KAI POLISI ERGON PLIROFORIKIS ETAIREIA PERIORISMENIS EFTHYNIS		
INTERNET INSTITUTE, COMMUNICATIONS SOLUTIONS AND CONSULTING LTD		
INCELLIGENT IDIOTIKI KEFALAIOUCHIKI ETAIREIA		
SUITE5 DATA INTELLIGENCE SOLUTIONS LIMITED		
NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"		
UNIVERSITY OF BRISTOL		
AALTO KORKEAKOULUSAATIO		
UNIVERSITY OF PIRAEUS RESEARCH CENTER		
ITALTEL SPA		
BIBA – BREMER INSTITUT FUER PRODUKTION UND LOGISTIK GMBH		



MATILDA has defined a total of **7 work packages** in order to actualize all of the objectives set forth in the project. They are:

WP 1: MATILDA Reference Architecture, Conceptualization and Use Cases

- T 1.1. End-to-end 5G-ready Applications, Network Services and Vertical Requirements
- T 1.2. MATILDA Framework Reference Architecture
- T 1.3. Chainable Application Components & 5G-ready Application Graph Metamodel
- T 1.4. VNF/PNF & VNF Forwarding Graph Metamodel
- T 1.5. Network-aware Application Graph Metamodel
- T 1.6. Deployment and Runtime Policy Metamodel

WP 2: 5G-Ready Applications and Network Services Development Environment and Marketplace

- T 2.1. Chainable Application Components and VNF/PNF Development & Verification Environment
- T 2.2. 5G-ready Application and Network-aware Application Graph Composer
- T 2.3. Deployment and Runtime Policy Editor
- T 2.4. 5G-ready Applications and Network Functions Marketplace
- T 2.5. 5G-ready Applications and Network Functions Profiling

WP 3: Intelligent Orchestration Mechanisms

- T 3.1. Deployment Manager and Optimization Engine
- T 3.2. Active/Passive Monitoring and QoS/QoE Evidence Collection
- T 3.3. Data Fusion, Real-time Profiling and Analytics Toolkit
- T 3.4. Context Awareness Engine

WP 4: Multi-site Resource Management and Execution Mechanisms

- T 4.1. Multi-site Virtual Infrastructure Manager
- T 4.2. Multi-site NFV Orchestrator
- T 4.3. Application Graph Execution Manager
- T 4.4. VNFs and PNFs Implementation

WP 5: MATILDA Orchestrator, Testing and Refinement

- T 5.1. Technical Integration Points and Testing Plan
- T 5.2. Code Maintenance and Continuous Integration
- T 5.3. Integrated MATILDA Orchestrator and Development Environment
- T 5.4. Software Quality Assurance

WP 6: MATILDA Industrial Demonstrators and Performance Evaluation

- T 6.1. Demonstrators Planning and Validation Scenarios
- T 6.2. Evaluation Framework Definition
- T 6.3. 5G Testbeds Preparation and Operation
- T 6.4. Emergency Infrastructure with SLA Enforcement Vertical
- T 6.5. High Resolution Media On-demand Vertical
- T 6.6. Smart City Intelligent Lighting System Vertical
- T 6.7. Industry 4.0 Smart Factory Vertical
- T 6.8. Automobile Electrical Systems Remote Control Vertical
- T 6.9. Validation, Performance Evaluation and Adoption Guidelines

WP 7: Dissemination, Communication, Exploitation and Business Planning

- T 7.1. Dissemination Clustering and Standardization Activities
- T 7.2. 5G-PPP Program Interaction
- T 7.3. Communication Activities and Data Management
- T 7.4. IPR Handling and Innovation Management
- T 7.5. Market Analysis and Exploitation, Business and Sustainability Planning
- T 7.6. Project's Impact Assessment

MATILDA has defined the following five awesome use cases:

High Resolution Media on Demand

This use case describes a scenario whereby a network provider offers high-resolution media on-demand service especially for flash events, based on the CDN technology, which is adapted to the screen resolutions of different end users' UEs for best user experience within a specific timeframe.

Distributed System Testing

FastWAN is a distributed interconnection technology with Real Time, Interoperable, High QoS, Guaranteed Data Delivery with High Data Volume Capabilities, Plug and Play, Support for both Industrial Signals and Network Data that enables M2M communication over the internet with capabilities of realizing early systems integration and functional testing.

5G Emergency Infrastructure

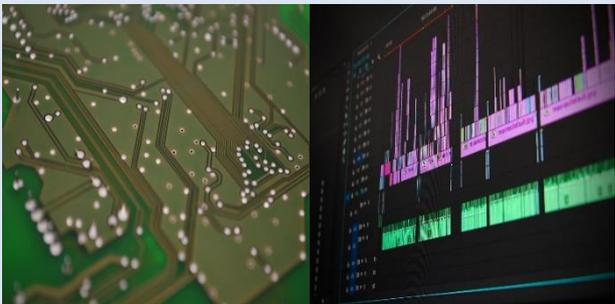
This use case leverages the E2E SDN and NFV capabilities to build a 5G-enabled emergency response pilot for real time intervention monitoring and critical infrastructure protection integrated with advanced operation, administration and management (OAM) capabilities for supporting SLA, designed for first responders and public safety services.

Industry 4.0 Smart Factory

Tailored towards enabling both inter-enterprise and intra-enterprise integration where collaborative manufacturing takes place between product owners and manufacturers who are running on different technologies and management solutions and have to be connected for the purpose of tracking, co-designing, task planning during the production phase.

Smart City Intelligent Lighting System

Tailored to provide smart city service based on the developed middleware that offers lighting controllers, middleware platform and management interface running over a LoRaWAN network that enables the lighting company to easily manage and maintain all the lighting poles with a reduction in energy consumption.



MATILDA has been kicked off with the plenary meeting that took place in **Athens**, Greece, on 5-6 July 2017. The project has had two more face-to-face meetings after the kick off meeting in Athens: the second MATILDA plenary meeting took place in **Genoa**, Italy, on 29-30 November 2017, while three months later, on 13-14 February 2018, another plenary meeting has been organized in **Athens**, the Greek capital.

The consortium members were duly represented in all the events: a number of members participated in **fruitful discussions** that took place in the course of the meetings, which had been organized with quite intensive and sometimes parallel sessions.

During the meetings, the different Work Packages (WPs) were presented and their respective related objectives discussed. A significant amount of time was dedicated to discussing different aspects of WP1, which is the key WP devoted to accurately define the reference architecture, the conceptualization and the use cases of the MATILDA proposal. All the remaining technical WPs (WP2-7) were also presented and thoroughly analyzed, and their status and objectives carefully discussed, also in the light of the goals of the whole project.



Kick off meeting, 5-6 July 2017, Athens, Greece



2nd Plenary meeting, 29-30 November 2017, Genoa, Italy



3rd Plenary meeting, 13-14 February 2017, Athens, Greece





As to March 2018, MATILDA has submitted **6 deliverables** to the European Commission:

D1.1: MATILDA Framework Reference Architecture

D1.2: Chainable Application Components & 5G-ready Application Graph Metamodel

D1.3: VNF_PNF & VNF Forwarding Graph Metamodel

D1.4: Network-aware Application Graph Metamodel

D1.5: Deployment and Runtime Policy Metamodel

D7.1: Communication Roadmap

Within the dissemination activities, the MATILDA partners have already produced a total of **7 scientific papers**, 2 of them published in scientific journals, the remaining 5 submitted to international conferences or workshops.

Still in March 2018, MATILDA has had its **first technical review** meeting. The review meeting took place on 9 March 2018 in Brussels, Belgium. During the meeting, plenty of important matters were ironed out. Mainly, the overviews of all the work packages were discussed including their status, achievements and produced deliverables. Relevant topics to be included in an amendment request to be filed in April-May 2018 were discussed and will be summarized in the next newsletter.

Really soon, it will be time for yet **another plenary meeting** which will take place in Madrid, Spain, on 23-25 May 2018. As usual, we expect the meeting to be very intensive and productive, with a lot of fruitful discussions and status updates regarding all the ongoing tasks in the project.