9. APPENDIX B: Project positioning at the European level

Project	Project objectives	Differences with the M[5]HESTIA project
MiWEBA (FP7, 2013-2016)	**Project objective**: to optimise mm-wave overlay networks for 5G upon 2 scenarios: • Backhaul / Fronthaul links between elements in a Multi-Techno network • Mobile access links between the access point and the user equipment and Device-to-device links between user terminals • Target spectrum: V-band (57-64 GHz) and E-band (71-76 GHz, 81-86 GHz)	• No massive MIMO antenna and signal processing implementation
E3Networks (FP7, 2012-2015)	**Project objective**: to design of an energy-efficient and high-capacity transceiver for the backhaul infrastructure of future networks in E-band (with highly focused "pencil beam" transmissions and huge bandwidth)	• Access link not covered. • No propagation channel modelling. • No study on the access point
GREENTOUCH	Mission: to deliver the architecture, specifications and roadmap to increase network energy efficiency by a factor of 1000 compared to 2010 levels.	Does not cover higher spectrum No proof of concept
CROWD (FP7, 2013-2015)	The project targets very dense heterogeneous wireless access networks and integrated wireless-wired backhaul networks. **Project objective**: four key goals: • bringing density-proportional capacity where it is needed, • optimising MAC mechanisms operating in very dense deployments by explicitly accounting for density as a resource rather than as an impediment, • enabling traffic-proportional energy consumption, • guaranteeing mobile user's quality of experience by designing smarter connectivity management solutions.	• Focus on MAC and higher layers.
iJOIN (FP7, 2012-2015)	**Project objective**: novel concept RAN-as-a-Service (RANaaS), where RAN functionality is flexibly centralised through an open IT platform based on a cloud infrastructure. Joint design and optimisation of access and backhaul, operation and management algorithms, and architectural elements, integrating small-cells, heterogeneous backhaul and centralised processing. This solution will optimise the RAN system throughput and provide services instantly and efficiently in cost, energy, complexity and latency wherever and whenever the demand arises. Additionally to the development of technology candidates across PHY, MAC, and the network layer,	• mmWave considered for backhaul only. • No antenna design • No outdoor channel characterization • No M-MIMO on board. • No proof of concept.

	iJOIN will study the requirements, constraints and implications for existing mobile networks, specifically 3GPP LTE-A.	
5GNOW (FP7-2012-2015)	**Project objective**: PHY and MAC layer design of 5G cellular radio access architecture using asynchronous, non-orthogonal waveforms.	• Focus on waveforms. • No massive MIMO on board. Lower bands targeted.
METIS (FP7, 2012-2015)	**Project objective**: to lay the foundation for, and to generate a European consensus on the future global mobile and wireless communications system. *Overall technical objective*: to develop a concept for the future mobile and wireless communications system that supports the connected information society. Research focused on network topologies, radio links, multi-node, and spectrum usage techniques.	• No hardware implementation. • No specific work on higher bands (except identify-cation and prioritization of bands above 6GHz).
MiWaveS (FP7, 2014-2016)	**Project objective**: to develop key technologies for implementation of mmW wireless access and backhaul in future 5G heterogeneous mobile networks: • mobile access with up to 5 Gbps data rate and above 10 Gbps aggregate capacity for backhaul. • Reduction of the overall EMF exposure and power consumption per bit transmitted Target spectrum: V-band (57-64 GHz) and E-band (71-76 GHz, 81-86 GHz)	• Massive MIMO implementation not considered. • No channel modelling and characterization. • No Digital beamforming technique implemented (only analogue)
mm-Magic (H2020-ICT-2014-2 / July 2015- June 2017)	**Project objective**: to specify 5G in bands above 6 GHz: • Investigate suitable frequency bands • Conduct measurements and develop accurate channel models • Develop novel radio access technologies for 5G in bands > 6 GHz, demonstrate feasibility and robustness through simulation • Inputs to standardization and regulation	• No proof of concept planned. • 60-GHz is not the core band. • Waveforms considered: new waveforms (such as FBMC, GFDM, NCP-SC, FQAM etc.) and currently used 4G wave forms (such as OFDM, SC-FDMA), and variations (such as Windowed/Filtered OFDM, UF-OFDM, UW-OFDM).
MAMMOET (FP7 / January 2014 – December 2016)	The mission of MAMMOET is to advance the development of Massive MIMO, a new and highly promising trend in mobile access. MAMMOET will show the practical limitations of Massive MIMO and develop complete technological solutions leveraging on innovative low-cost and drastically more efficient and flexible hardware.	• Covers low bands <6GHz (namely 2.6GHz)
5Gex (5G PPP : 10/2015 - 03/2017)	**Project objective**: to support cross-domain service orchestration over multiple administrations or multi-domain single administrations.	(*)

	• Design and specify architecture, mechanisms, algorithms and enablers for automated and fast provisioning of infrastructure services in a multi-domain/multi-operator 5G environment • Define and validate the novel 5GEx business layer, including the business information model, economic and market mechanisms that promote efficiency of multi-domain services • Build a working end-to-end system and deploy a proof of concept prototype • Sandbox Exchange - validate by experimenting with selected use cases • Contribute to the relevant standard forums and Open Source communities	
5G NORMA (5G PPP : 07/2015 - 12/2017)	**Project objective**: to develop a conceptually novel, adaptive and future-proof 5G mobile network architecture with a clear roadmap towards 3GPP adoption. Innovations: "multi-service and context-aware adaptation of network functions" and "mobile network multi-tenancy" enabled by novel concepts of "adaptive (de)composition and allocation of mobile network functions", "software-defined mobile network control", as well as "joint optimisation of mobile access and core network functions."	(*)
FLEX5GWare (5G PPP : 07/2015 - 06/2017)	**Project objective**: to deliver highly reconfigurable hardware (HW) platforms together with HW-agnostic software (SW) platforms targeting both network elements and devices and taking into account increased capacity, reduced energy footprint, as well as scalability and modularity. Flex5Gware will evaluate and demonstrate the developed 5G technologies, in terms of proofs-of-concept, which will be showcased in a demonstration event where all the partners in the consortium will participate.	• Will deliver HW and SW platforms in order to host and support the 5G candidate technologies for 5G; not decided which 5G building blocks will be selected for demonstration purpose (and in which frequency bands).
METIS II	**Project objective**: to develop the overall 5G radio access network design and to provide the technical enablers needed for an efficient integration and use of the various 5G technologies and components currently developed. Innovation pillars: • a holistic spectrum management architecture addressing the spectrum crunch, • an air interface harmonisation	see FANTASTIC-5G and mmMAGIC for work on air interface.

	framework enabling an efficient integration of new and legacy air interfaces, • an agile Resource Management (RM) framework providing the dynamics required to efficiently adapt the integrated 5G air interfaces and radio concepts to the varying traffic demand and service requirements, • a cross-layer and cross-air-interface system access and mobility framework ensuring an ubiquitous access continuum, • and a common control and user plane framework providing the means for an efficient support of the broad versatility of services expected for 5G as well as a future-proof and cost-efficient implementation of the 5G integration.	
FANTASTIC-5G (5G PPP : 07/2015 - 06/2017)	**Project objective**: to develop a new multi-service Air Interface (AI) for below 6 GHz through a modular design. To allow the system to adapt to the anticipated heterogeneity, the pursued properties are: flexibility, scalability, versatility, efficiency, future-proofness. Development of the technical AI components (e.g. flexible waveform and frame design, scalable multiple access procedures, adaptive retransmission schemes, enhanced multi-antenna schemes with/without cooperation, advanced multi-user detection, interference coordination, support for ultra-dense cell layouts, multicell radio resource management, device-to-device) and integration of them into an overall AI framework where adaptation to the above described sources of heterogeneity will be accomplished.	• < 6GHz. • No proof of concept planned.
SELFNET (5G PPP : 07/2015 - 06/2018)	**Project objective**: to design and implement an autonomic network management framework to achieve self-organizing capabilities in managing network infrastructures by automatically detecting and mitigating a range of common network problems that are currently still being manually addressed by network operators, thereby significantly reducing operational costs and improving user experience. SELFNET explores a smart integration of state-of-the-art technologies in Software-Defined Networks (SDN), Network Function Virtualization (NFV), Self-Organizing Networks (SON), Cloud computing, Artificial intelligence, Quality of Experience (QoE) and Next-generation networking to provide	(*)

	a novel intelligent network management framework that is capable of assisting network operators.	
SESAME (5G PPP : 07/2015 - 12/2017)	SESAME targets innovations around three central elements in 5G: the placement of network intelligence and applications in the network edge through Network Functions Virtualisation (NFV) and Edge Cloud Computing; the substantial evolution of the Small Cell concept, already mainstream in 4G but expected to deliver its full potential in the challenging high dense 5G scenarios; and the consolidation of multi-tenancy in communications infrastructures, allowing several operators/service providers to engage in new sharing models of both access capacity and edge computing capabilities. SESAME proposes the Cloud-Enabled Small Cell (CESC) concept, a new multi-operator enabled Small Cell that integrates a virtualised execution platform (i.e., the Light DC) for deploying Virtual Network Functions (NVFs), supporting powerful self-x management and executing novel applications and services inside the access network infrastructure.	(*)
SONATA (5G PPP : 07/2015 - 12/2017)	SONATA provides service patterns and description techniques for composed services. A customised SDK is developed to boost the efficiency of developers of network functions and composed services, by integrating catalogue access, editing, debugging, and monitoring analysis tools with service packaging for shipment to an operator. For deployment, SONATA provides a novel service platform to manage service execution. The platform complements the SDK with functionality to validate service packages. Moreover, it improves on existing platforms by providing a flexible and extensible orchestration framework based on a plugin architecture.	(*)
SUPERFLUIDITY (5G PPP : 07/2015 - 12/2017)	Superfluidity is “a state in which matter behaves like a fluid with zero viscosity”. Project aiming at achieving superfluidity in the network: the ability to instantiate services on-the-fly, run them anywhere in the network (core, aggregation, edge) and shift them transparently to different locations. The SUPERFLUIDITY solution is based on: a	(*)

	decomposition of network components and services into elementary and reusable primitives; a native, converged cloud-based architecture; the virtualization of radio and network processing tasks; platform-independent abstractions, permitting reuse of network functions across heterogeneous hardware platforms, while catering to the vendors' need for closed platforms/implementations; and high performance software optimisations along with leveraging of hardware accelerators. Through these properties, SUPERFLUIDITY will provide a converged cloud-based 5G concept that will enable innovative use cases in the mobile edge, empower new business models, and reduce investment and operational costs.	
COMMINDOR (RNRT / 1999-2002)	Feasibility study of 60GHz wireless home network systems delivering more than 155Mbits/s	• Indoor only • No MIMO on board

(*) M^{5}HESTIA consortium is fully aware of these 5G oriented projects but they all have no direct relation with M5HESTIA as they do not cover air interface.