

# Energy efficient discontinuous mobile edge computing with quality of service guarantees.

## KEYWORDS

- ❑ MOBILE EDGE COMPUTING
  - ❑ GREEN NETWORKING
  - ❑ ENERGY EFFICIENCY
  - ❑ COMPUTATION OFFLOADING
  - ❑ NETWORKING
  - ❑ STOCHASTIC OPTIMIZATION
- ## AREA
- ❑ ELETTRICAL ELECTRONIC & ICT ENGINEERING

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## Priority Number

n. EP19306484,7\_19.11.2019.

## Patent Type

Patent for invention.

## Co-Ownership

Sapienza Università di Roma 33%, CEA 67%.

## Inventors

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## Industrial & Commercial Reference

The application sectors are the future fifth generation and beyond mobile networks (5G, 6G, etc.), and the consequent vertical sectors such as the industry 4.0, autonomous driving, etc. In the industry 4.0, the invention can bring benefits in the complex management of radio and computational resources to enable real-time analysis of data in an energy efficient way (including sensors, production machines and network elements such as access points necessary to transfer data), with guarantees on delays and reliability of the service.

## Time to Market

TRL\_3

## Availability

Research, Development and Experimentation.

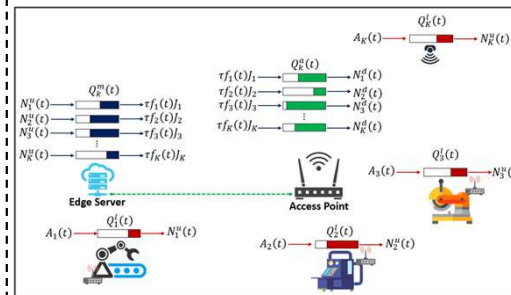


Fig. 1 General reference scenario for the Industry 4.0.

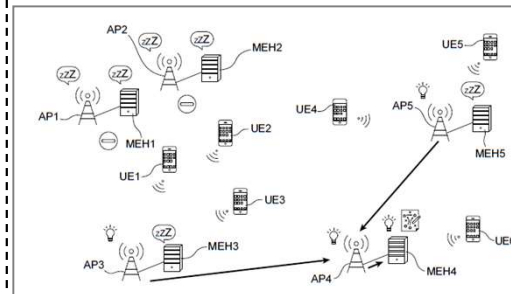


Fig. 2 Reference scenario with multiple network elements.

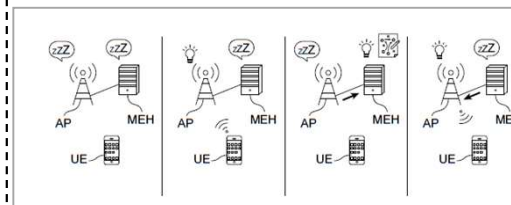


Fig. 3 Example of active and sleep modes for elements' energy saving

## Abstract

The invention relates to a multi-access edge computing method having a required Quality of Service, in a wireless network which includes at least one electronic device (UE) that offloads a computing task, at least one access point (AP) which can be switched between an active mode and a sleeping mode and at least one edge computation unit (MEH) which can compute tasks and be switched between an active mode and a sleep mode. The method allocates, by a computer-implemented scheduler, communication and computation resources by switching the at least one access terminal and the at least one edge computation unit between their respective active or sleeping modes. Said allocation is performed to minimize the network joint energy consumption.

## Pubblicazioni

❖ M. Merluzzi, N. di Pietro, P. Di Lorenzo, E. Calvanese Strinati and S. Barbarossa, "Network Energy Efficient Mobile Edge Computing with Reliability Guarantees," 2019 IEEE Global Communications Conference (GLOBECOM), Waikoloa, HI, USA, 2019, pp. 1-6, the authors consider a dynamic joint energy minimization under end-to-end latency guarantees, considering also the probability of exceeding a certain delay.



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# Energy efficient discontinuous mobile edge computing with quality of service guarantees.

## Technical Description

The present invention, which envisages the use of low energy cost states for all network elements, hinges on stochastic optimization tools as a method to define an optimal scheduler that dynamically allocates communication and computation resources, minimizing the overall system energy consumption under guaranteed service quality (latency).

In fact, the method has the ability to obtain an energy efficient solution, with a guaranteed quality of service, without assuming any prior knowledge of the context parameter statistics such as wireless channels and the arrival of data to be transferred for the calculation.

Thanks to stochastic optimization, the method works online and without knowledge of these parameters, except for their instantaneous values.

## Technologies & Advantages

The advantages of the proposed method, once the implementation phase has been reached, lie in its general application, which requires only ad-hoc tuning for the particular practical application. Therefore, the method is not restricted to particular applications or scenarios, but it can be adapted according to the individual needs. In the case of industry 4.0, the method would enable of real-time data analysis, coming from the factory machinery, in an energy efficient and therefore more sustainable way, reducing management costs and the consequent emissions of the ICT industry. In complex environments such as that of industrial plants, a flexible method that adapts to conditions such as network congestion and the availability of resources, would bring great advantages from an operational expenditure point of view (OPEX).

## Applications

As already mentioned, the scenarios such as the industry 4.0 and, in general, all vertical sectors that will benefit from future mobile networks, are the main application sectors of the invention.

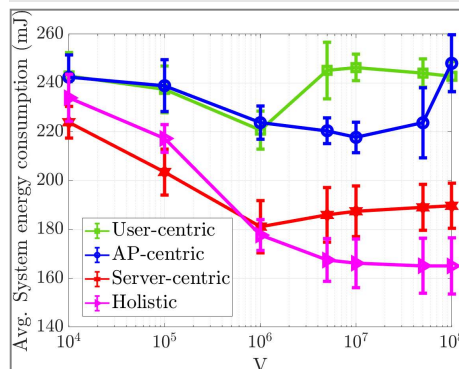
A fundamental application will be machine learning / artificial intelligence at the edge of the network to enable, in fact, real-time data analysis for process diagnosis, anomaly detection and predictive maintenance of industrial processes, in complex environments of industrial plants.

Other fields of application are that of autonomous driving, and in general the Internet of Things (IoT).

## CONTACTS

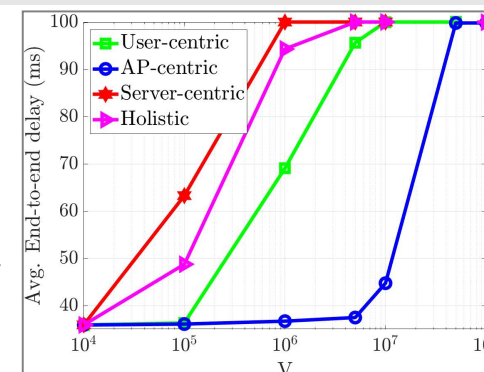
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**Fig. 4** Example of network energy consumption reduction thanks to Lyapunov stochastic optimization parameter tuning (Holistic refers to the joint optimization of all network elements)

**Fig. 5** Example of average delay, meeting the constraint imposed by the quality of service



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