

Architecting optimal edge cloud systems

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Abstract. Distributed Complex Systems (DCS) correspond to decentralized systems made of sets of physical devices and software components, mostly creating an Internet of Things (IoT) ecosystems. There are different types of DCS, primarily pervasive systems and distributed information systems. In this research we focus on pervasive systems composed of a network of collaborative sensing, computational, actuating and reasoning components that are highly embedded in and actively interact with the environment.

DCS's nodes mostly run on a fully distributed cloud computing stack utilizing the central cloud and its Edge Computing (EC) extensions. EC includes mobile clouds, cloudlets, IOT gateways, and computing resources on the edge device. One of the main obstacles at the edge is that most DCS' nodes require many EC, while EC have limited resources on the edge. It is necessary to define an optimal architecture for implementing the DCS on the edge, taking into consideration the limits and constraints of EC. The assignment of each EC to a DCS node and the choice of the type of EC, is intended to provide the required functionality for the DCS.

The main goal of our research is to define a mathematical model embodying optimal architecture with best DCS value for an EC infrastructure implementation.

In order to architect the best EC DCS system, we need to evaluate it. The value of a system is determined by the match between its functions and the intent of its stakeholders. Value Engineering defined as an organized effort directed to analyze the functions of systems, to satisfy the required function at the lowest cost without reducing needed quality.

In this research, we use a mathematical model that optimizes a system value as a function of its architecture. The total value of the system is the summation of its values in the different scenarios. The contribution of each scenario to the overall value is weighted by its period of time. In each scenario, we calculated the value of the system by estimated benefit and cost. The main challenge was to design the optimal EC architecture that will provide the highest operational value.

A case study of autonomous vehicular edge was evaluated. It is a metropolitan traffic system designed to control the traffic flow and address major traffic events. This complex system comprises a traffic control center (CTC) system designed to control the traffic flow and address major traffic events. The operational architecture of this system consists of the CTC itself, and 3 types of autonomous vehicles: Heavy Air Vehicles (H), Mid Air Vehicles (M) and two families of drones: Sensor Drones (S) and Effector Drones (E).

The model supports the interrogation of different possible architectures in diverse scenarios and provides detailed information needed by decision makers. This information includes the best architectural choices, their benefit, cost and a sensitivity analysis. Results were presented to several decision-maker stakeholders who found them inspiring.

Biography

Dr. Miri Sitton ?" ???? ????? (CRG engineering Ltd.)

Miri Sitton holds a PhD in cross-enterprise systems engineering from Tel-Aviv University. She has 30 years of experience in systems development, systems engineering and enterprise architecture. She served in the Israeli Air-Force in various positions of software development and system engineering for 24 years and retired as a Lt. Col. Currently she serves as a founder and Co-CEO at CRG engineering Ltd. providing engineering and cyber services and solutions as well as enterprise processes design for information intensive enterprises. Dr. Sitton is a founder and a researcher in Tel Aviv University, Systems Engineering Research Initiative (TAU SERI).