Cyber-Physical Cloud Computing

Submitted by Raja Sengupta on Sun, 10/07/2012 - 9:32pm. Contributor:
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Abstract

The advent of cloud computing transformed the computer from a gadget to a utility. Servers in distant rooms dish out gigaflops to contracted virtual machine instances. Our research seeks to move the servers out of rooms and onto vehicles, such as aircraft, smartPhones, or cars to enable mobility as a service in a manner analogous to and augmenting computing as a service. To this cloud built of flying servers or roadway traffic one may say not just "do computation c" but "do computation c at location x". This idea requires a new virtualization - the virtual vehicle as the counterpart of the virtual machine instance of cloud computing. We discuss the research required to create cloud computing with flying servers, the hardware and software we have built, and show how sensing might be a service by experimental work on air quality, river mapping, pedestrian and ship search and tracking. Theoretical contributions include a model of computation for cyber--physical systems with changing structure and an a spatial extension of queuing theory we call Spatial Queuing Theory.

Award ID: 1136141

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