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Information systems based on nano-technologies: the development of a dynamic synapse molecular device

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ABSTRACT OF THE TALK

In 1959 at the conference of the American Physical Society Richard Feynman pronounced his well-known sentence: "There is plenty of room at the bottom". He meant that the laws of physics are not counter indicative to the realization of electronic circuits or machines at the molecular scale. The appearance of new structures named nano-objects such as carbon nanotubes makes this vision conceivable. However, such nano-objects may possess properties very different from the ones of commonly used computational devices such as MOS transistors. As a consequence, novel design methodologies or architectural approaches are necessary.

In my thesis research I tried to tackle this problem. The project was completed at the Embedded Computing Laboratory at CEA (Gif-sur-Yvette, France) and at the "Molecular, Nanostructures and devices" group at IEMN-CNRS (Villeneuve d'Ascq, France). During this seminar I will present main results of this work.

I will start with a brief review of current computational architectures based on nano-objects. By defining the qualitative requirements for such computational architectures I will justify our choice of a spiking neural network architecture. Next, I will describe a design of dynamic synapse implemented with nano-objects. An Organic Field Effect Transistor (OFET) with gold nanoparticles included in its active layer and functioning

as a transistor-memory device will be proposed as a model of a synapse that exhibit the properties of synaptic plasticity. Influence of nanoparticles on the transistor properties will be characterized and a memory effect induced by these nanoparticles will be demonstrated. Finally I will present evidence that such features of synaptic plasticity as facilitation/ depression and Short-Term memory can be reproduced with the proposed device.