

# Towards an Ecosystem of digital services: an empirical study on Internet of Things and Sensor as a Service

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## Abstract

Technology, in particular Internet of Things (IoT) has become the key driver for service design and innovations. We introduce the notion of Sensing as a Service (SenaaS), which would enable us to reconcile the technology service metaphor and the service notions. In this paper, we aim to examine SenaaS and then discuss its implications for IoT and data ecosystem, service ecosystem, smart offerings, and business ecosystems. IoT is enabled by a number of technologies for identification, sensing, actuators, internet connectivities and data storage/processing. IoT is composed of the “software side” and “physical side”. The ‘software side’ pushes towards a network oriented vision of IoT and the collection of the data, while the ‘physical side’ moves the focus on generic “objects” to be integrated into a common framework. The service metaphor is recently coined as SenaaS to combine both physical and virtual aspect of the sensor network, as well as to integrate sensing, data collection and actuation. SenaaS furthered IoT research more into the service domain as the potential of SenaaS to connect and communicate within social, environmental, and user contexts through things identities and virtual personalities operating in smart spaces using intelligent interfaces. We empirically apply IoT technology and the notion of SenaaS in a UK research council funded project - Hub of All Things (HAT), and developed an Ecosystem for services enabled by digital technologies. Leveraging on the cloud computing service oriented model (which comprises of IaaS - Infrastructure as a Service, PaaS - Platform as a Service, SaaS - Software as a Service, UCaaS - Universal Communication as a service), our new layered model extends service to the physical world by integrating SenaaS. We presented this from a supply chain and economic perspective from higher layer to lower: IaaS, PaaS, SaaS, SenaaS, with each offering their service to the business in the lower layer, and all receive service from the higher layer. And between any two layers, an UCaaS layer is suggested to facilitate the lower-layered service synchronisation and distribution to the higher layer. By combining the virtual (digital) services to the physical world and allowing users and the firms to co-produce the contextualised value propositions, this model clarifies the pathway for firms to serve contexts. For example, a smart mobility service provider is implementing SenaaS for users’ location and schedule for future 3 hours, to provide personalised recommendation on transportation, clothing and other relevant services. The ecosystem facilitated the firm to clarify its positioning and resource requirement to optimise its density of resources for value creation.