Smart Agriculture

Executive Summary

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Abstract. It has been known for some time that automated precision control of resources is a powerful tool for the development of agriculture. Such precision agriculture allows farmers to produce more crops, also in areas which were previously unsuitable for farming (such as the Atacama Desert in Chile, or desert agriculture in Israel). These technologies can be enhanced further, by complementing them with new methods and technologies developed for smart societies, in the IEEE 1451.99 IoT Harmonization working group.

Keywords: Internet, Smart City, Smart Society, Smart Agriculture, Monetization, Internet of Things, IoT.

1 Introduction

Smart City architectures exist today that help devices and services from different manufacturers to interoperate in a secure and open way, and in real-time. Standardization efforts in this field, such as IEEE 1451.99 IoT Harmonization working group, provides examples of how such technologies can be used to form a global backbone for IoT in smart societies. Key components of such an infrastructure include interoperable communication, Machine-to-Machine (M2M) and Human-to-Machine (H2M) interfaces, cybersecurity and privacy. The infrastructure also addresses key infrastructure components necessary for realizing a smart society, such as contracts and economic feedback models (instant payments) that will allow for an open and free market of sensor data and control operations.

2 Monetization

Monetization is recognized by many as the most effective method to optimize activities in a complex open society. By creating mechanisms where the exchange of goods and services can be made on the basis of supply and demand, the society automatically organizes itself in a self-optimizing manner over time. To compete, a preplanned society needs to anticipate all events and all needs, something that rapidly becomes too complex, even for very simple systems.

Digital infrastructure for Open Smart Societies mimics open free markets by introducing new types of digital edge services, allowing devices to trade information and goods (sensor data) and services (control operations) with each other, autonomously, securely, and in a legally binding manner. This is called *monetization*, the ability to put a monetary value very small pieces of information or actions, and then let parties trade. Monetization is especially important when optimizing activities across domain boundaries, where there is no clear master authority, or when distributing limited resources, where each unit of a resource needs to be utilized in the best manner possible.

3 Monetization in farming

Farming in areas where access to vital resources is limited, can be optimized by means of monetizing existing resources. Likewise, precision farming can be optimized, if monetization of very small amounts of a resource is possible. By monetizing a single drop of water (for instance), the farmer that can best convert the drop of water into valuable goods or services (for instance crops), will have a better chance to survive and even prosper.

4 Sustainability

When distributing limited resources, such as a common water resource, it is exceptionally important, from a societal point of view, that the resources are not needlessly wasted. Monetization also optimizes use by minimizing wasteful consumption. It is also important to share resources fairly, to allow for fair competition. Monetization assures that participants compete on a level playing field.

5 Example

Consider a river from the mountains running through an otherwise dry landscape. Farmers get their water from the river. Traditionally, farmers up-river can control access to the water, also for farmers down-river, in some cases even building dams, restricting access to water completely. In times of drought, farmers up-river have a better chance of survival, as they autocratically can take as much water as they want, leaving others without. Survival (or prosperity) is here not determined by which farmer is the best farmer, but which farmer resides closer to the source, something that might have been determined a long time ago by their ancestors. This system is not optimal, for the society at large.

Other systems that distribute equal amounts of resources among farmers are not optimal either. By giving equal amounts of water to farmers around the river, you give farmers not tending their farms as much water as farmers in desperate need of water.

As an alternative, the society can restrict access to the water at large, and monetize access to it. Water can then be traded autonomously in open auctions. Farmers trade water on their part, using rules they themselves define. Supply and demand control the price of water. In time of drought, price automatically increases, when raining, price automatically decreases. Framers may employ their own technologies and strategies to store and make best use of the water they buy, providing an efficient means for optimization and technological development. They can also resell stored resources autonomously, in times of high demand and poor supply, lessening stresses and additionally increasing the use of the limited resources. Today, technologies exist, such as the TAG Neuron, based on IEEE P1451.99 IoT Harmonization, that allows for autonomous trading of very small amounts of resources like water, all in an open, auditable and interoperable manner.

6 Summary

In a world that becomes more and more resource-constrained, and where sustainability is of vital concern, technologies developed for smart societies can be used to improve the performance of agriculture in resource-constrained areas, such as dry and desert areas. By monetizing resources, and providing an infrastructure for open, fair, auditable and free markets of resources, the society can put pressure on actors to optimize their use thereof, resulting in a more sustainable, and also a more productive farming environment.