The Origins of Intelligent Data Research at MIT

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Last month's email advisor dealt with the idea of creating intelligent data as a means of improving data connections across the Internet. Though we feel that intelligent data and the development of the M Language are cutting-edge technology areas that will soon have practical applications in industry, it is also important to understand the origins of how this idea came to be a research program at MIT. By seeing the long-term direction of engineering advances, the practitioner will be better prepared to make business decisions about current computer technologies capable of increasing profits or reducing costs.

The story of the Laboratory for Manufacturing and Productivity – Data Center Program traces to about 15 years ago, when researchers began to think about the power of computer networks and the possible linkages to machines and physical objects. This genesis was the root of Auto-ID technology and the Electronic Product Code (EPC), currently being implemented by EPCglobal Network, inc., in addition to the Data Center Program and the fundamental idea of creating intelligent data.

Usually with most technology, the path to commercial application has its beginnings in loosely related research that offers an important fundamental insight. According to Dr. David L. Brock, a cofounder and former Director of the MIT Auto-ID Center, the roots of the EPCglobal Network trace to the idea of using the Internet as a means of controlling machines such as robots. Commonly termed "Internet devices" the first was the Trojan Room Coffee Machine, which researchers implemented in 1992 at the University of Cambridge. In this early example, a video card captured an image of a coffee pot every second and made this data available on a network, allowing researchers to see the status of the coffee without an unnecessary trip to the machine.

At about the same time engineers were exploring the use of Internet devices, computer scientists were working on a parallel track involving the development of standards for improved internet communication. The first was the Gopher protocol, introduced in 1991. Gopher grew rapidly as academics placed news and research information on the network. However, by the mid 1990s, Gopher had nearly disappeared. It was replaced by the World Wide Web, which featured an improved user interface and a freeform markup language.

Building on these advances in engineering and computer science, Dr. Brock founded the “Virtual Worlds Project” at the MIT Artificial Intelligence Lab in 1994. This was an early effort to link networked devices, such as robots and home appliances, with mathematical models located on a network. The models provided various instructions to operate theses devices automatically.

With these improvements in Internet control there remained a single, fundamental problem, the lack of unique identification for physical objects. Initial research efforts experimented with bar codes as a means of object identification. These efforts failed because bar codes required object manipulation to acquire a clear line-of-sight for a scan. At the time, the bar code also did not provide the unique identification needed for automated processes.

To solve this problem, Dr. Brock acquired some radio frequency security tags from a small company named Arizona Microchip. These tags operated at low frequency (135 kHz) and had 64-bits of raw data storage. The idea was to store all relevant data on a tag affixed to an object. Using a reader, the tagged object could be scanned to retrieve the data. With this approach, it quickly became clear that the amount of data associated with each object far exceeded the amount of storage available on the tag. The only viable alternative involved storing a minimum amount of data on the tag consisting of some sort of identifier, which could then be linked to larger amounts of data located on the Internet. This approach required the development of a globally unique identifier for RFID tags.

After initial contact with Thomas Brady, a senior scientist at the Uniform Code Council (UCC), it became clear that others were working on similar ideas involving electronic identification. Viewed as a potential replacement for the bar code, an initial research effort was formed at MIT called the Distributed Intelligent Systems Center (DISC) to develop unique identification methods needed for the automation of physical objects. Professor Sanjay Sarma, who held an assistant professorship appointment in the MIT Department of Mechanical Engineering, joined Dr. Brock and Professor Sunny Siu in this initial effort. Kevin Ashton, who worked at Proctor & Gamble and was thinking about applications of RFID to reduce stock-outs on retail shelves, met Brock, Sarma, and Siu during this time. About one year later, this led to the establishment of the MIT Auto-ID Center (1999) that focused on supply chain applications of unique identification. Alan Hamerman, who had previously played a pivotal role in the development of the bar code in the consumer goods industry, became interested and provided the necessary credibility and contacts to help establish the MIT Auto-ID Center as an industry sponsored research project with broad support.

In summary, it was through an interdisciplinary approach combined with various forms of communication, sometimes by chance, that several different parties came to the understanding that ideas intended for the improvement of automation and robotics, namely the use of RFID and unique identification, also applied to the identification of objects within the supply chain. This has led to the notion that physical objects could have the capability of “self identification.”

Taking this a step further, the work of the MIT Data Center Program examines the idea of self-identification as applied to non-physical objects, namely data, information, and mathematical models. Like the EPCglobal Network, this new approach has potential to create significant improvements in productivity.