iJOE Special Focus Issue "'Wireless Sensor Networks and Cloud Instruments for Web Based Measurements"

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"Anyone who has never made a mistake has Never tried anything new" Albert Einstein

The last few years have witnessed an almost explosive growth in the development and deployment of wireless systems with fixed-mobile convergence, Wi-Fi, Wi-Fi Mesh, WiMAX, 3G evolutions, Mobile-Fi, etc.

This growth in wirelessly connected devices shows no signs of slowing down. On the contrary, with new services and new technologies waiting in the wings, the future use of wireless measurement and communication devices looks set to continue increasing even more rapidly. However, radio spectrum is a finite resource and in a wirelessly connected future, new approaches to ensure connectivity, security and quality of service are going to be needed. Radio resource management has an important part to play in ensuring that the greatest benefit is obtained from the finite resources available for radio communications in the future. Emerging technologies have a significant impact on the efficient use of the spectrum, the minimization of costs related to establishing new wireless networks, the optimization of service quality, and the realization of transparent operation across multi-technology wireless networks.

Wireless LANS may prove less expensive to support than traditional networks for employees who need to connect to corporate resources from multiple office locations. Large hotel chains, airlines, convention centers, Internet cafes, etc., view providing wireless Internet connectivity to their customers as an additional revenue opportunity. Wireless connectivity is a more affordable and logistically acceptable alternative to wired LANs for these organizations.

A basic Wi-Fi wireless network can be assembled fairly quickly. However, many users are not aware of the options available to maintain and optimize their wireless networks over time to meet the increased demands for improving the capability, performance and security.

Wireless sensor networks and communication networks placed on the grid will help utilities monitor and control the flow of energy better and more effectively address power outages. At the edge of the grid, consumers will use wireless networks to better manage their energy consumption. Wireless devices bring new resources to distributed computing. In addition to traditional computational resources such as processing power, disk space, and applications, wireless devices will increasingly employ cameras, microphones, GPS receivers, and accelerometers, as well as an assortment of network interfaces (cell, radio, Wi-Fi, and Bluetooth). One important class of devices is sensors, which can supply information regarding temperature, health, or pollution levels, to name just a few.

Wireless Sensor Networks have motivated consumers to adopt this technology when having to measure variables that affect them on a daily basis (things like garden sensors, environmental factors, electricity, building automation, grid applications, biomedical, etc.).

We have been unable to create sufficiently powerful instruments to study large and very distributed physical phenomenon like climate, pollution, animal life, the spreading of diseases, viruses, shortage of water, etc., primarily because our measurement technology is still primarily PC-based. I have been waiting for years to catch a wave of technology that can carry us into creating new types of instruments to tackle these problems. The adoption of Cloud Computing and the work done in the area of Internet of Things may qualify as technological waves that can push us to create this new type of instrumentation.

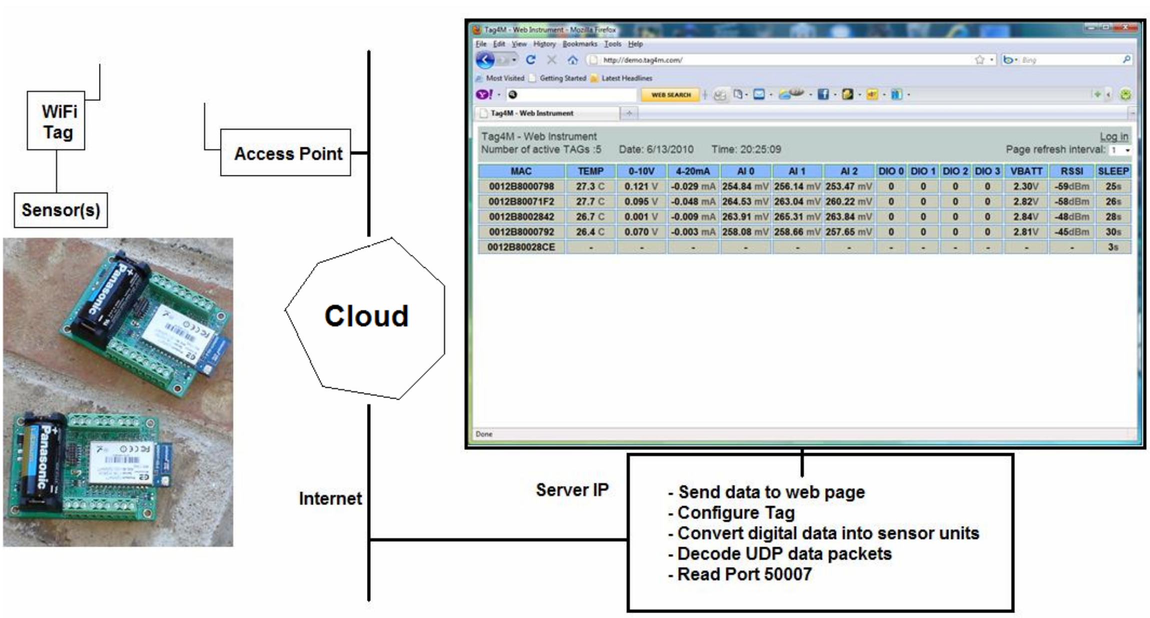
People take measurements today using box instruments (like Scope, DMM, Function Analyzer, etc.) or PC-based instruments. In PC-based instrumentation, sensors are connected to data acquisition boards to bring measurement data to the PC in order to apply analysis, presentation and communications functions, all under a virtual instrument that is PC-based. This measurement method works very well in production automated testing on a production line or in laboratory experiments. Distributed and remote measurements are done using wireless sensor networks (Bluetooth, ZigBee, WiFi, serial proprietary) and firmware that supports hopping, meshing, TCP/IP, serial bit banging, etc. When using wireless measurement nodes, users can choose to bring their data to a PC running the application software. This, again, is for PC-based data acquisition. However, users can also choose to send the data to the Internet via off-the-shelf APs. The following question is very important:

Where do users send their digitized data?

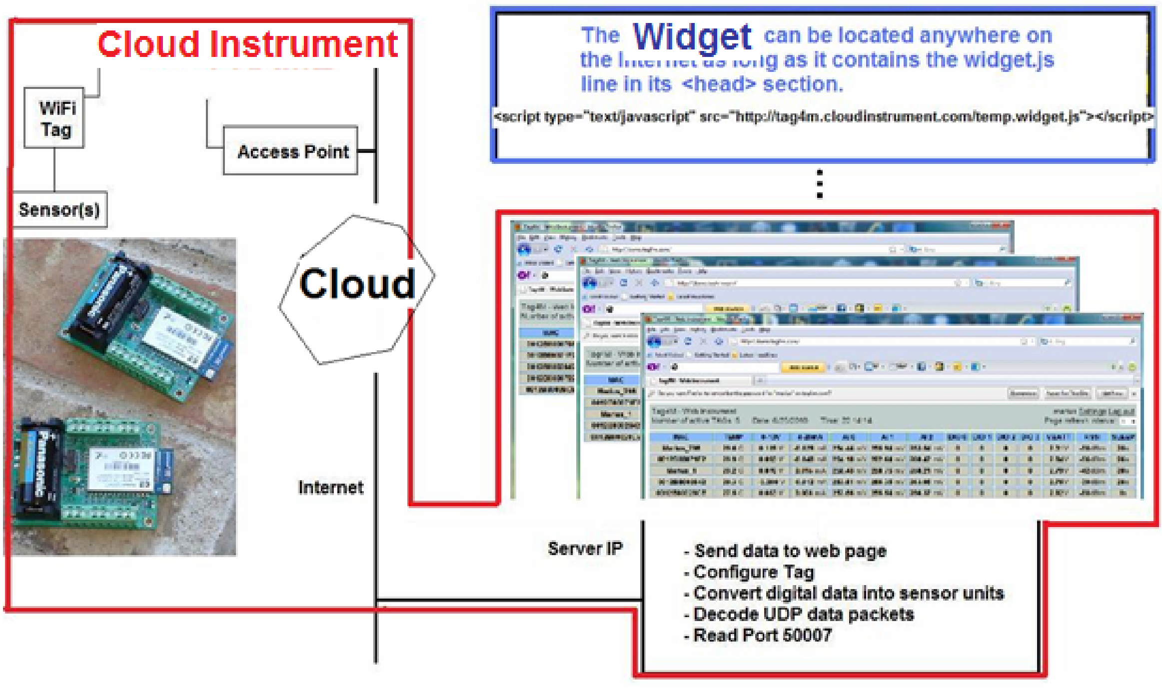
a) Directly to a PC for PC-based instrumentation, or
b) Directly to the Network or Internet via off-the-shelf Access Points for Cloud Instrumentation.

The concept of Cloud Instrumentation is based on this fundamental distinction. A sensor becomes a Cloud Instrument when it is connected to a WiFi tag. The tag digitizes the data to send it on to an Access Point, where the data is routed to the Internet and a Server IP. Here, a customized engine collects the data to feed web-based applications like metering, charting, control, display, analysis, modeling, data mining, etc. The customized engine is a web page instrument.

The following is a picture of a cloud instrument.



The WiFi tag and the Web Page Instrument serve the purpose of bringing sensor data to web pages. Once data is in the Cloud, it can be made available to vertical cloud applications, an integration space open for segment experts, companies with expertise in sensors, analysis, temperature, light, humidity, pressure, force, etc. Further on, in this chain, cloud instruments are interconnected to web widgets that bring the expertise in sensors, analysis, location, phenomenon dynamics, etc. to social media sites for display and dissemination.



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