

"CLOUD INSTRUMENTATION", AN APPLICATION TO CLOUD COMPUTING

Uma Naik, Prof. V. C. Kotak

Department of Electronic Engineering, SAKEC, Mumbai

Abstract— History based on traditional instruments, followed by interface bus and cards to access data to measure and control, thus elaborating the concept of Cloud Instrumentation is a fundamental step in knowing more about instruments accessed from cloud.

The measurement technology sounds to be the new era of development of parameters to be measured and controlled with instruments and sensors accesses through internet.

Index Terms— Wi-Fi Tag, Cloud Instrument, Web Page Instrument, PC based Instrumentation, Tag4M, Future Instrumentation.

I. INTRODUCTION

The importance of Cloud Instrumentation development can be seen from the very first emerged instruments, being the standalone traditional type instruments like multimeters, oscilloscopes and others. The user can get direct access to connect the input and measure the output on the same device as these devices had in built measurement circuitry and displayed the output. Further engineers built, instruments communicating with each other with the interface bus or card like IEEE-488 interface bus or USB or Ethernet cards. Later PC based instrumentation concept evolved with PCI plug in cards. Expansion slots provided in such technology proved fruitful for engineers to get their work done at much quicker rate and price. Now a stage has arised where engineers demand to get access to sensors and application not at their end but thru third party provider, i.e. cloud and save time and cost to get much better results [2] [3].

Thus the instrument being placed on cloud and accessing web based application will be easy to all once in existence fully. Research demands this concept to emerge in coming years, where digitized data sent through internet and their new technology will definitely get existence to measurement technology throughout the world for measurement analysing and presentation.

II. CLOUD INSTRUMENT

A Cloud Instrument will send digitized sensor data (in form of packets) to concerned terminal location on the internet, and will use local software or web based applications/programs for computation, simulation, modeling, analysis and presentation.

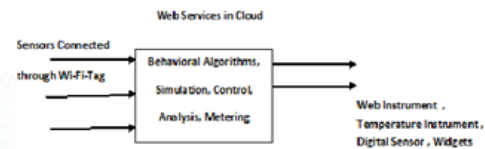


Figure 1: Cloud Instrument

Here hardware are free from cabling and software not dependent to specific terminal. At present we need to work on sensor data being available on the cloud. This opportunity to get sensor data easily available & then web based application to emerge, for which “Instrumentation Cloud” technique has a great opportunity[2].

Two possibilities needed which help measurement applications where things need to be monitored are sensor and hardware component designed into fabric of things and software component to be pushed from local terminal to cloud for better processing capability, speed, visibility and reach.

III. RESEARCH ACTIVITY

Companies have came up with solutions like Tag4M Wi-Fi Tag. A wireless tag such as Wi-Fi Tag digitizes the data to send it on to an access point where data is routed to internet and a server IP.

A Wi-Fi tag is a small, battery powered device allowing both analog and digital sensors. When tag is powered, it shows web page instrument. The web page instrument standard tag display contains tag MAC, measurement channels, battery voltage, RSSI and tag sleep time. The web page instrument gives list of all tags present and associated with access points all over the internet[2].

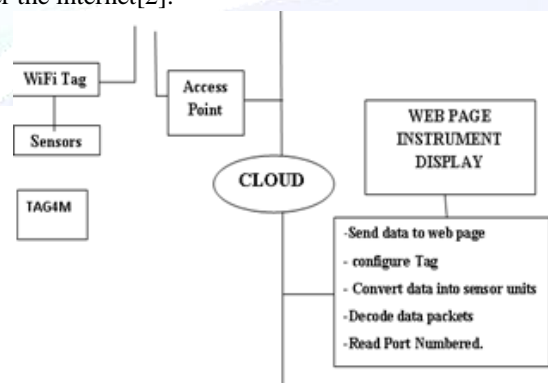


Figure 2: Data and Instrument Access on Cloud

IV. TAG4M PROVISION EXTENDED

Tag4M provides Tools for companies to implement Cloud Instruments. Web Page interface to Widget Instrument using Smart Phone interface. It can be customized to show number/images as city image and temperature indication on it.

The Cloud Instrument service provider is hosting the Web Page Instrument and provides the user the code for embedding Widget Instrument into a web of media site.

V. BUSINESS FOR CLOUD INSTRUMENTATION

Engineers looking to benefit from instruments having a larger display, more storage capability, more flexible hardware with precise ADC converters at high scan rates. Smarter technology existed named automated test and measurement. Companies in new business of Cloud based services, offer services likes high performance data transport to, from and between remote cloud infrastructures, IT financial management solutions, automation of IT management functions, database security, risk and compliance (SRC) solution for the enterprise, real time route planning and enterprise class optimization. Banking, IT, Administration of personnel, Corporate world are markets where such application is required[2][3]. Cloud Instrumentation will provide sensor monitoring and measurement capabilities of very wide and well organized space where services, data, events and much more than a simple sensor to offer.

VI. LIMITATIONS OF CLOUD INSTRUMENTATION

Cloud Instruments includes two technology i.e. Internet and Cloud Computing. Limitation will allow us to think on problems like data security, confidentiality, reliability, availability and latency that these two technologies have and transfer to the Internet[3]. Regarding limitation two folded aspects for cloud will be – to take care of wireless segment by setting standards that regulate interfaces between radio digitized chip and sensor/access point, & - ride the technology wave that will improve security and latency over internet by using off the shelf protocols and standards.

There are ways to be taken care for handling the limitations as the radio digitizer chip code will include authentication security function and the firmware will define to read, digitize packets and send sensor data over wireless such that maximizes data security, confidentially, reliability, availability and latency.

VII. FUTURE TREND OF INTEGRATING INSTRUMENTATION INTO THE CLOUD

Grid-enabled instrumentation has brought together different scientific labs for complicated cooperative experiments. Instrument resources sharing and managing remotely over the Internet are also realized by such systems. Nowadays the rise of cloud computing, which is developed from grid computing and other distributed parallel computing technologies, has attracted attention of science communities and many institutes already begins to establish cloud for scientific applications. As

the science cloud has the same requirements of integrating data sources, which are instruments and sensors, as the grid it is believed that future trend of integrating instrumentation into the cloud is coming soon. This paper argues for the feasibilities and advantages of cloud-enabled instrumentation in the near future. Firstly the requirements for future instrumentation are analyzed and then related achievements made in grid-enabled instrumentation are introduced. By briefly comparing the grid and the cloud further verifications and advantages for developing cloud-enabled instrumentation are given. Based on the work that has already been done in the research of grid-enabled instrumentation considerations for developing cloud-enabled instrumentation systems is elaborated. Finally challenges and problems that may be encountered in designing cloud-enabled instrumentation systems are also illustrated. This paper can inspire and guide researchers especially in the instrument and measurement fields to develop new efficient instrumentation systems for their experiments and applications.

Many new concepts are introduced both in instrumentation field, such as cloud instrument/instrumentation, and Cloud Computing field, such as SIaaS (Sensing Instrument as a Service which is similar to IaaS, PaaS and SaaS. These new concepts indicate the future trend to combine instrumentation and clouds both conceptually and technically. However current research work only focuses on very limited part of this cross-domain area and much more effort is very necessary to prepare instrumentation for the future “Cloud Era”[2][3]. Based on the analysis of grid-enabled instrumentation and present studies on cloud instrumentation, it is believed that there are two main directions in research on cloud-enabled instrumentation.

The first direction is to develop model and application architecture for instruments and sensors which are to be connected into the cloud. It is very similar to the development of grid-enabled instrument models and architectures. However, due to the distinctions between grid and cloud there are yet many differences in developing cloud-enabled instrumentation models compared to that of grid-enabled instrumentation[6].

VIII. INSTRUMENTATION CLOUD LEADS TO NEW APPROACH OF WIRELESS SENSOR



Figure 3: Sensor Connection and access point

RFID technology is popular due to reduced cost and size. Also, the existence of web-based applications helps this new technology in better way. In this new concept known as the Instrumentation Cloud, the only physical connection is

between the sensor or actuator and the A/D or D/A front end located on a 'sensor tag,' which sends or receives data and commands to or from a commercially available wireless access point (AP) or router as shown in figure 3. Further, instead of the data being sent to a particular computer, it sends the data to an AP for further routing to an Internet IP address that defines a Server ID. A user-controlled web-based application server, or Web Page Instrument, receives the data for processing.



Figure 4: Web Page Instrument

IX. CHALLENGES OF CLOUD INSTRUMENTATION

Apart from benefits brought by such instrumentation cloud there are also many challenges as listed below[2][4]:

- Security issues. Till now the security issue is yet a challenge to cloud computing, let alone to the applications on cloud. Since integrating instruments into the cloud can bring much more threats to the equipment's more emphasis should be placed on safety matters of related cloud-enabled applications.
- Interactivity among different clouds. There is no unified standard among existing clouds and such problem may block the aggregation of instrumentation resources from different clouds.
- Fee charging for instrumentation services. No published charging scheme has been seen even for the grid-enabled instrumentation services and the commercial model of cloud instrumentation still need further exploiting.
- Other problems that may exist during the development of cloud instrumentation systems.

X. CONCLUSION

Conceptual growth of analyzing the technology of measurement in an artistic way with idea of sending data through Wi-Fi Tag and measuring it on Web Based Program known as Web Page Instrument.

Cloud Instrumentation becomes the glue that interacts with the applications, compute, storage, networking, orchestration,

trouble ticketing systems, and more. It is a foundational piece of the "Cloud Stack" and one that must not and cannot be ignored. Cloud providers may want to revisit their implementations as providing their customer's visibility into all layers of the stack would be a competitive advantage not a liability[3]. Whether you are building a private, public, or hybrid Cloud infrastructure, let's not repeat the mistakes of the past and make Cloud instrumentation a top priority.

Further comparison of the cloud and the grid demonstrates feasibilities and advantages of developing cloud instrumentation. As more and more scientific organizations adopt cloud as their computing and storage tools, integrating data sources into the cloud is inevitable. Besides the service mode of the cloud provides much easier access for individuals and small-medium organizations to the instrumentation resources. However challenges are also notable and much more effort is necessary as the Cloud Computing itself is immature.

XI. FUTURE WORK

Tag4M is working its way towards an Instrumentation Cloud where not only the sensors but also the logging, analysis, control programs, sensor Widget deployment and display can be anywhere. Analyzing the performance of this Tag4M is a challenge and will give more and more conceptual growth in the field of measurement and Cloud Computing Technologies.

In the near future a pilot system will be developed to explore the application architecture and instrument model for cloud-enabled instrumentation[6]. Firstly a cloud environment will be established by deploying the Nimbus Cloud Computing tools. Then application for connecting some instruments and sensors with simple functionalities to the cloud will be design. Upon that a unified platform will be established to complete the cloud instrumentation system and SOA will be adopted in system development. Finally the pilot system will be further expanded to set up standard 364 models and architectures for cloud-enabled instrumentation systems.

REFERENCES

- [1] Cloud Computing - Web Based Applications That Change the Way You Work and Collaborate Online - Michael Miller
- [2] Cloud Instrumentation, the Instrument is 'in the cloud'
- [3] Online Technical Support based on Google and other search engines.
- [4] <https://xively.com/>.
- [5] <http://www.salesforce.com/>.
- [6] Future trend of integrating instrumentation into the cloud, Hengjing He, Wei Zhao, Songling Huang Department of Electrical Engineering Tsinghua University Beijing, China.