Data Acquisition & Handling System for Emission Trading Scheme

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Introduction

Cement, Power, Textile, Chemical and several other industries are pillars of industrial landscape of a country. In an aspirational society and country like India these industries form the back bone for growth and hence are a national priority. However, all these industries are energy intensive and directly or indirectly burn fossil fuels. This has adverse impact on environment due to considerable emission of polluting gases and particulate matter from these industries.

Like other countries, India has been following a regulatory regime to control industrial emissions. But in a developing country like India, industries face challenges to follow this regime due to various factors like lack of technology, paucity of resources, etc. On the other hand regulatory regime mandates emissions limits, but there are no incentives for compliance and also for further reduction in emissions.

On this background, MoEF is evaluating an innovative scheme for pollution regulation – Emission Trading Scheme (ETS) for Particulate Matter. This is based on a Cap & Trade mechanism for total emissions in a given period for participating industries. Such a system is obviously dependent on ability to acquire and process reliable and validated data from all participating industries. Such data will actually be "money" to be traded in the system.

This paper discusses the underlying backbone of ETS - an integrated **Data Acquisition and Handling System (DAHS)** to acquire, store, analyze, validate and benchmark particulate matter data from multiple plants. The paper also presents architecture, characteristics and features of such a platform.

ETS Overview

Emission Trading Scheme for Particulate Matter aims to establish an innovative market based regulatory instrument for stationary sources in designated industry clusters in India. ETS will follow a '**Cap and Trade**' mechanism based on total emission load (mass emissions) of PM measured over a period of time. In this the regulator sets the overall amount of emissions (a cap) for an industry cluster but does not decide exactly how much each source will emit. Industries and other polluters are not given fixed emission limits, but are free to decide for themselves within a reasonable upper limit. Each industry holds emission permits and can trade un-utilized permits with other industries in the cluster. Prices of the permit will be decided by the market. This is expected to give continuing incentive to industries to cut back pollution which will translate into better environment.

ETS pilot was launched by MoEF in March 2011 and is guided by a Technical Committee comprising of all the members of CPCB and piloted SPCBs. State Pollution Controls Boards of Maharashtra, Gujarat and Tamil Nadu are participating in the pilot. The pilot will be run in total 1000 industries in identified clusters in these states. J-PAL (South Asia), a research organization based at IFMR, Chennai is managing the project. Ascent Strategic Management Group is associated with the project as Technical Consultants and solution architects including implementation of pilot system.

Key challenges

There are various technologies available for Continuous Emission Monitoring of Particulate Matter. These are light scattering, beta attenuation, triboelectric, transmissometer, etc. These instruments measure mass / concentration for a stationary source and make it available locally. The data needs to be acquired from this point and uploaded to a central location and then processed. Though this is not a challenge in terms of technology, there are other challenges in deployment of CEMS and data transmission to a central server. Some of the major challenges are:

1. Different hardware vendors' offer localized systems that connect with only their analyzers and instruments. Plants almost always have devices from multiple vendors and hence multiple such systems. Thus the challenge is to collect data from devices of different makes and models and aggregate it on a central server
2. Eliminating attempts of data cleansing to keep it within permissible limits before it is sent to central system
3. Ensuring proper upkeep (maintenance and calibration) of devices so that data measured is reliable
4. Creating a state / national level database(s) of emissions of all industrial sources in a particular region
5. Ensuring continuous and reliable data availability

DAHS Architecture

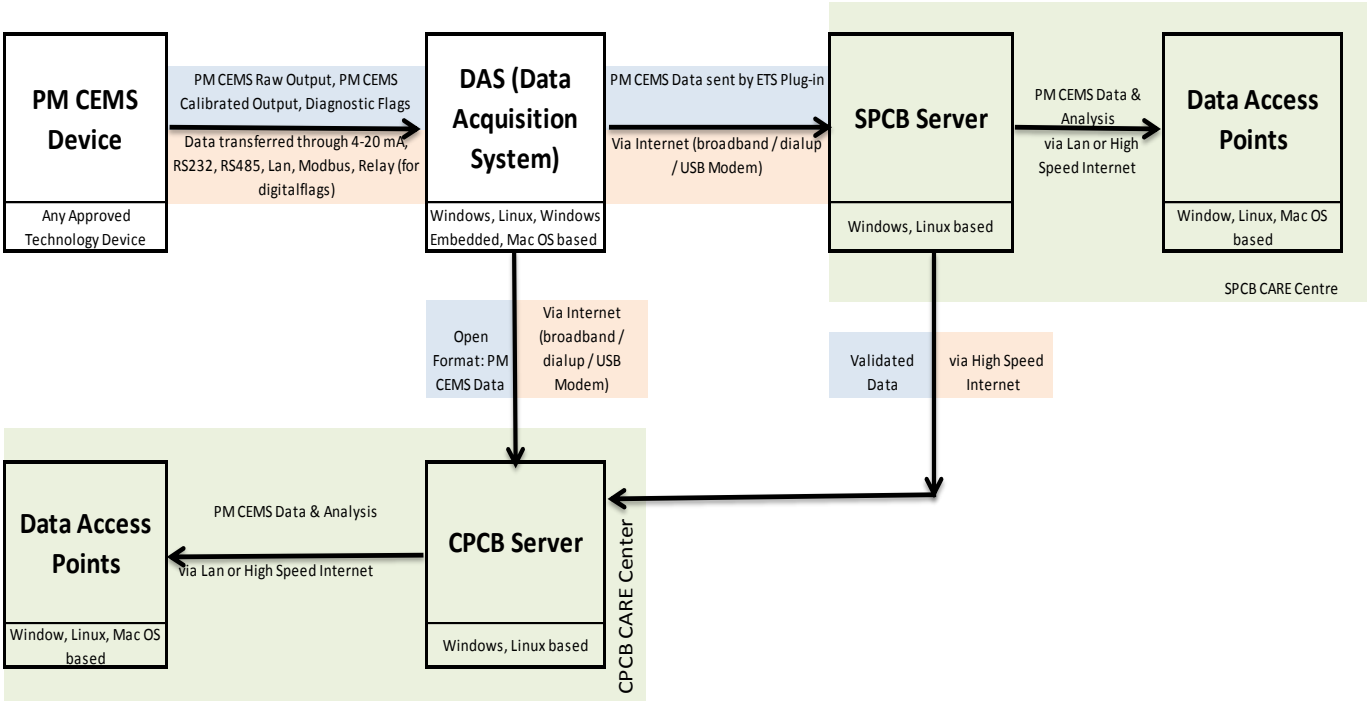

Figure 1

Figure 1 shows various components of DAHS designed to ensure integrity of emissions data and permit designated regulators to manage and analyze data securely. Let us see how this architecture helps to overcome challenges listed above (also *see text in italics below*). DAHS is comprised of following components:

1. PM CEMS Device
    a. Firmware / software of CEMS vendor
2. DAS PC
    a. CEMS vendor software
    b. ETS Bridge software
3. CPCB Server
    a. ETS Server software
4. SPCB Servers
    a. ETS Server software
5. Data Access Points
    a. Client software for visualization / analysis etc. Mostly browser based

ETS Bridge software is a standalone application that resides on DAS in each industry. This software has a published standard interface for receiving real time data from CEMS vendor's software residing on same machine. *Thus ETS Bridge is vendor neutral and any CEMS vendor can implement the ETS Bridge interface.* ETS Bridge collects real time data, instrument status and diagnostics flags from CEMS software, encrypts it and sends to DAHS server(s) in secure and reliable manner. *This prevents any tampering of data.*

ETS Server software resides on SPCB servers. It collects data from all ETS Bridge in the state, runs certain automated validation algorithms and allows regulator to analyze and further validate the data. CPCB server receives data from 2 sources – from ETS Bridge and validated data from SPCB Server. This allows re-validation and cross verification of data *creating a reliable database of PM emissions*. ETS Server receives instrument calibration data from ETS Bridge and *enforces periodic calibration of each CEMS instrument ensuring proper maintenance of instrument and hence data reliability*. Figure 2 shows device dashboard of ETS Server

Figure 2

Important features

- Real time data collection and upload to server in secure manner
- Secure long term data storage on server
- Data flagging and alarms
- Automated as well as manual data validation
- Calculation of total mass emissions for given period
- Tools for data visualization and analysis
- Exhaustive reporting and querying
- Ability to control CEMS device remotely
- Ability to provide maintenance as well as process improvement inputs to manufacturing process based on emissions data

DAHS Trials

DAHS trials were conducted by MPCB in the state of Maharashtra recently. Following are the details of these trials –

- Three CEMS devices with different technologies were used in the trials. Technologies used were DC tribo, opacity and light scattering. DC Tribo directly measures mass flow whereas other 2 technologies measure mass concentration. Mass concentration readings are multiplied by flow to arrive at mass flow.
- Two of these devices (DC tribo and opacity based) were installed on same stack. This gave a good insight into how the measurements converge over a period
- CEMS vendor software and ETS Bridge was installed in each industry and continuous data collected and sent to ETS Server setup in MPCB.
- More than 99% data is collected by ETS Bridge in real time from 2 of the 3 devices during month of April.
- Graph in Figure 3 shows comparative readings of 2 CEMS devices on same stack for 24 hours. Even though

Figure 3

the individual readings differ, the total mass emissions for a day converge within 5 to 10%. This is expected to further improve when data for larger periods is available.

Conclusion

Emission Trading Scheme for Particulate Matter is a path-breaking project. The trials and other ground work and research done in last 1 year indicates feasibility of ETS in India. Its success will ensure significant improvements in industrial air pollution. It will also open doors for other such schemes in the country.

Advance technology, communication infrastructure, dedicated team, cooperation from industries as well as vendors and commitment and guidance from regulator and government will ensure that ETS is successful in India.

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Sujata has over 22 years of experience in software industry, in various positions and roles. An Instrumentation and Control engineer, Sujata is a recognized expert in Industrial Automation domain and an accomplished System Architect. Under her guidance, AIPL has built PlantConnect AQMS, a web-based air quality monitoring solution. Sujata is associated with various State Pollution Control Boards as IT expert and is involved in ETS project as an IT expert.