MeshAIR API – Standardizing Next Generation

Air Monitor (NGAM) Interfaces

Steve Drevik, Agilaire

What's the Issue?

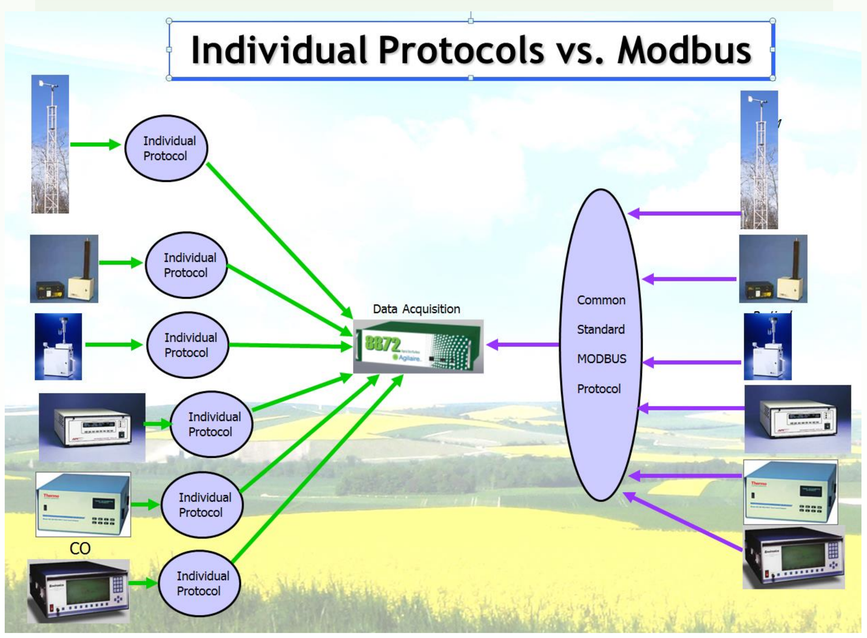
The growth of lower-cost next generation air monitors (NGAM) poses several challenges for Local and State air quality monitoring agencies, many of which require easy and quick access to the data and integration of the NGAM data with primary SLAMS monitors. Without the ability to integrate this data and quality assure it, NGAMs have limited value, and a new project could prove to be a failure and waste of resources.

Currently, NGAM monitors use no consistent protocol to transfer their data externally. Some are tied to mobile apps and can only display data. More professional monitors require download of text files, that then require a manual process to integrate with SLAMS data, often in the form of external spreadsheets with limited utility.

Lessons Learned

This problem is not a new one. State and Local air monitoring agencies have already faced the same channel moving their existing SLAMS monitors from analog measurements to digital measurements. Initially, this transition was hampered by each analyzer manufacturer using their own RS-232 protocol, and in some cases, the protocols would vary by different models of instruments from the same manufacturer.

This mish-mash of protocols created numerous problems, but the situation was made easier when analyzer manufacturers started adopting a common, open standard- Modbus. The Modbus protocol had a defined set of commands, defined response formats, and was easily adopted to the kinds of data required from air quality monitors and calibrators (values, control, status).



A common communication framework enhances access to data, simplifies setup and operation, and improves data accuracy

Best Practices

To fully utilize the anticipated benefits from NGAMs, a standardized, open protocol should be promoted and adopted by the instrument manufacturers, the same way Modbus was adopted for NAAQS level monitors. Use of the standardized protocols should be encouraged by State/Local agencies and researchers by requiring or encouraging the use of the standardized protocol in procurement specifications, providing clear incentives for the manufacturers.

Why Not Modbus?

The Modbus protocol was designed as a real-time communication protocol, with commands only obtain the most recent reading, or the current status of a device, calibrator, etc. This is well suited for a SLAMS site, where an array of monitors (some Modbus, some not, some still analog) are connected to a central data logger, which then formulates the averages, runs calibrations, etc.

Most NGAM monitors have their own internal data recorders, forming simple averages (e.g., minute, 5-minute), and storing the data in a date/time stamped records for later retrieval. Modbus is simply not designed to manage this kind of data. A new standard needs to be developed to easily access time-stamped records, and to leverage the most common existing formats already implemented in most NGAM monitors- delimited files (e.g., CSV files, or some other delimited type of file).

By designed a protocol already close to what most NGAM manufacturers have implemented, the likelihood of adoption and success of NGAM programs is dramatically increased.

MeshAir API

The MeshAir API protocol leverages existing monitor output formats by solving the issue of transfer of those files. Most instruments require specialized software to download the file, and often limit the download to "get everything in memory", rather than allowing query of data in a specific time frame, wasting time, memory, and potentially creating conflicts between different data sets downloaded at different times (perhaps after the first set is already quality assured / edited).

The MeshAir API protocol recommends the following:

- Easy command start/stop characters to allow easy implementation on small processors
- A command to retrieve data between date/time X and date/time Y
- The command may allow retrieval of certain average interval, if the instrument supports storing data in multiple intervals
- Response in a delimited format with date/time stamps on each line
- Flexibility by the manufacturer on choice of date/time formats, delimiters, and commands, to support existing capabilities that may already be close to MeshAir standards.

An example command might be as follows:

<ESC>GIVEDATA, 1m, 01/01/2016 14:00, 01/01/2016 15:55<ENTER>
Or
!PD, 001m, 20160101, 1400, 20160101, 1455<ENTER>

All of these being trivial to implement even on small device CPUs. Response files may contains headers (or not), with the MetOne BAM device being a typical example:

Station, 1
Time,Conc(mg/m3),Qtot(m3),WD(DEG),WS(MPS), ATEMP(DEGC),RH(%),Delta(C),Status
02/06/09 13:00, 0.985, 26.9, 0.7, 0.3, 30, 52.1, 0.797,0000
02/06/09 14:00, 0.985, 26.9, 0.6, 0.2, 29, 52.0, 0.797,0000

Anticipated Benefits

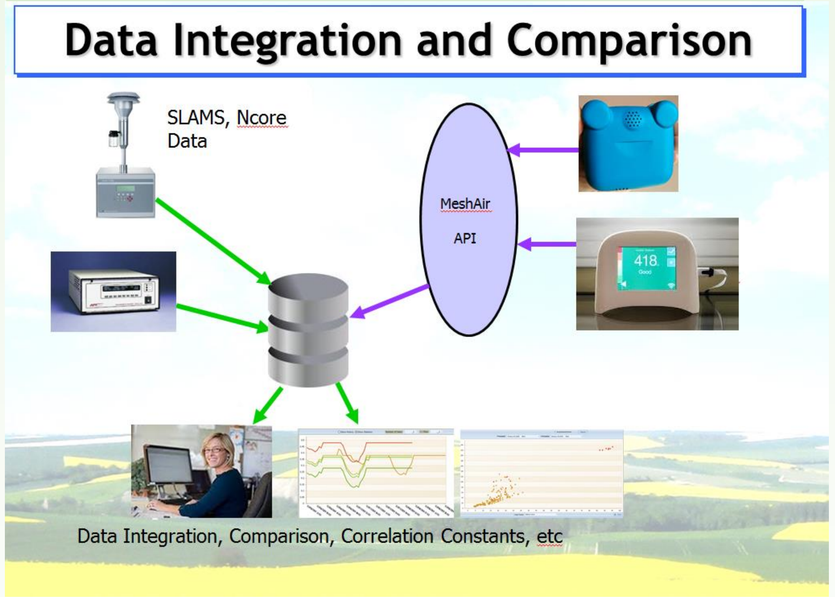
Because the MeshAir API is easy to program to, it should be easy for most NGAM manufacturers to implement in the next two years, if given the proper incentives (e.g., procurement specifications). The ability to import these files is available on most AirVision systems, in use by 70% of state and local agencies in the U.S., allowing quick and easy adoption of the standard. It would be trivial for other vendors to support import of a standardized format as well.

As an additional benefit, the addition of standardized commands to retrieve the files allows for NGAM monitors to be directly 'polled' and form a real-time network to fill spatial gaps in monitoring networks, allowing for fast identification of 'hot spots' and improving local, regional, and national forecast maps like AIRNow.

Integration of NGAM data with existing SLAMS databases (rather than external Excel spreadsheets) can provide multiple benefits:

- Quality assurance and development of correlation coefficients to correct NGAM data with SLAMS data
- Quality assurance of SLAMS data with sufficient NGAM data – once reliable correlation curves are developed, a SLAMS monitor could be checked against an average of multiple nearby NGAM devices.

Right now, those advantages are entirely out of reach with the current method of data collection.



MeshAir API

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