Data, This is Your Life

by Robert Findley, Director, Business Development Systems and Solutions
Remote Automation Solutions
Emerson Process Management

Introduction

It is the realization by many famous thinkers, physicists and mathematicians over the course of history that everything in the world can be represented by groups of 1s and 0s. The foundation of almost all information can be broken down into a simple true/false, yes/no, 1/0 over time. (Quantum Mechanics theories can prove the writer wrong someday, but for the purposes of this paper, this is a fair statement.) Information (or data) can be represented by electronic, mechanical, printed text or smoke signal and the objective of distributing it over any communication medium is the key to its existence.

As stated above, data is the representation of information. In most cases, this information will need to be communicated from one location to another. These locations can be close in proximity or extremely far away, however this information will need to make the trip safely and securely ensuring the correct transfer of the data. There are many different concerns to be aware of whenever data is required to be moved and delivered.

From here on out the focus of this paper is to provide a clear description of the “life” of data. Beginning with the remote process point, the paper will watch data mature from its initial location to its final usage. The paper has been written to target the Natural Gas/Water/Wastewater marketplace, but the analogies and descriptions that are used within fit many different industry applications.

In the process control world, up front planning, best practice engineering and effective implementation is the difference between a good night’s sleep or a weekend service call when related to data. It is the most import asset to remote monitoring of a network of processes as many are monitored on a 24 hour basis. Let’s take a look how data is analogous to life.

Raising Data

Just as the Obstetrician delivers a baby in the operating room, Electronic Field Technicians have one of the most critical roles in obtaining reliable data at all companies. OK, I may be stretching the analogy a bit, but you cannot argue that they are responsible for ensuring that data is created properly. Through simple, but important, fundamentals such as clean wiring practices, proper calibration routines and input protection methods, they control data at its infant state. Field technicians must understand the basics of how information can be represented and communicated. Electrical representation of data is by far the most common practice, but mechanical processes (such as pressure gauges, pneumatic controllers) are still used for certain applications. When mechanical processes are used, they are normally complemented by an electronic device that can represent and communicate to a central control room.

The representation of data is handled in different way depending on the type process that is being monitored. The “basic” characteristics of data are represented as follows: (I stress basic as there are others)

- state (on/off, true/false, yes/no) – logical values
- proportionalities (representation of a range of values) – analog values
- accumulation (state changes counted over time / frequency) – counter/high speed counter values

While these characteristics are a little tough to describe verbally, they are easily identified in the applications that they serve.

Please see the basic application example below.

Basic Application Example

As an application example of data representing a process point, start with a valve in its simplest form; a device that can open and close. Its state can be the representation of the current status as an input. State change can instruct the valve to open or close as an output. State allows for basic monitoring and control of a valve. A jogged state is a more advance way of using a simple on/off output to gradually open and close a valve. This is done by toggling the state on/off for short periods of time which will instruct the valve to open and close in small increments and provides a regulated control of the open/close operation.

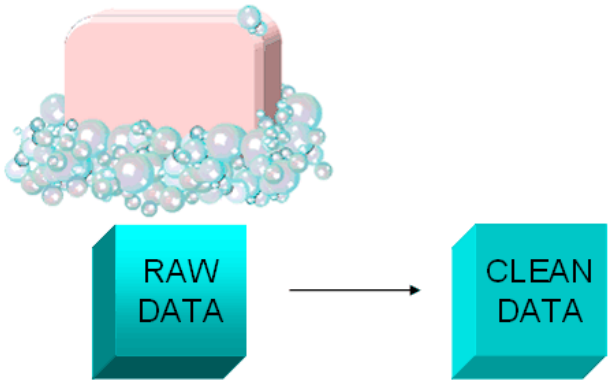
If you wanted more information from the valve, like its exact position between open and closed, the state characteristic is not enough. This is where the data characteristic proportionality become more effective as it can represent the position (in %) of the valve moving towards a full open or closed condition. Incremental, continuous current/or voltage to the valve represents the exact amount of open (or closed) position that is required.

Combine the two pieces of information, now you can easily represent which direction a valve is moving as well as how far it is from reaching either state. Add accumulation (count) to this and you can now count how many times a valve operated in either direction. This would provide additional information that can assist in the maintenance of a valve.

The representation of the valve as data is obtained using the different characteristics of data. These characteristics are measured differently in a remote electronic device that is used to gather and communicate the information and is explained below.

Connection to an RTU

If any device can be considered as the “parent” of data, it is the electronic hardware (also called the Remote Terminal Unit) to which it is attached. At a minimum, it is the job of the RTU to represent, monitor, store and communicate connected process points. As added value, the RTU can provide alarms, filter and control remote process points. In



other words, an RTU prepares data for it existence in a network similarly to how parents prepare us for our life on earth.

It is important to note that the RTU device is not just a computer, but it designed to be rugged, prepared for any obstacle and protective of what it controls. I don’t know about you, but that’s what I thought of my parents growing up (and still to this day). In electronic terms the RTU must be able to withstand a wide ambient temperature ranges (-40 to 70C), humidity, vibration and electronic disturbances. Let’s face it, remote process information is not usually located in the most optimal locations. Consider a regulator vault, manhole or caustic area as a few of the non-optimal remote sites that data can

reside. Also consider that geography and external climate can have locations where data is required (such as Antarctica or the Sahara dessert) as an RTU must be able to exist in these applications. Try running your average laptop in these locations and you will quickly realize how vulnerable you data can be. RTUs can run in these environments by using components rated for industrial conditions. They are designed with no moving parts (i.e. fans) for longevity. In an RTU the CPU processor speed is usually optimized for the performance that is required to minimize power consumption and to prevent excess heat generation limited in speed to prevent overheating compared to current processor technology. Standard PC designs do not take these issues into consideration.

Once a process input/output point is connected to the RTU, the data then takes on a new shape of electronic format. This shape is the bits and bytes that are being passed along extremely small integrated circuits found on a circuit board. If you are lucky you may have had the opportunity to examine a circuit board, take a close look at the intricacy of their design. Through layers of microscopic connections, data is routed to a processor for preparation to be communicated. After the RTU processor completes it tasks, data is represented in numerical structures which are designed to transmit via a communication medium. The numerical format compacts data into the format that will be interpreted between remote devices.

Unlike many devices, RTUs also give a meaningful name to the data point. They are referred to as descriptive “Tag” names or variable names. The naming convention is certainly preferable to just placing a value in some memory location. Suppose you were talking with a friend and describing a character Sherlock Holmes. Wouldn’t that have a lot more meaning than and be easier to understand than referring to the resident of 221b Baker Street.

Data leaves the nest

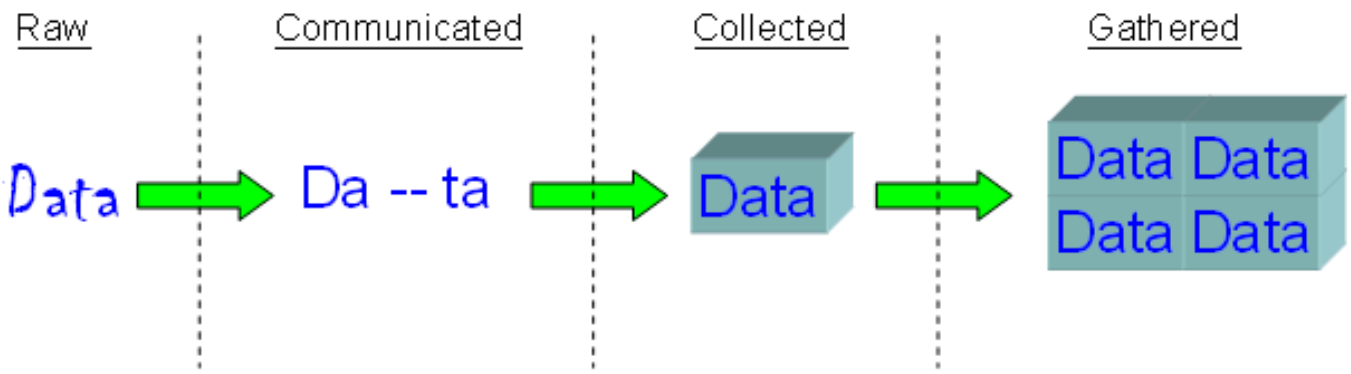
Once the RTU has prepared data for life on the network, it then sends it to a centralized location or control room. When I left for college I was clearly prepared for leaving home, but unaware of what was in store for me. Luckily, I always had a lifeline to my parents to continue to guide me through. This is identical to how an RTU can control data at a remote site, but also sends it on it’s way so that it can present it information to others for additional value.

When data is sent from the remote location to the network, the reliability of the communication path is a critical component in the successful transfer. The RTU still has an important role in ensuring that the data is communicated and will still protect it from harm by maintaining control from far away. Depending on what form of transportation is available; the speed at which it is transfer is tied directly to the network. My parents will always remind me of my “extended route” through college, but regardless, I still graduated.

From a remote location to a central location data is transmitted via many different communication mediums. Each medium has it own specific characteristics that make it very unique. The time it takes for the medium to transmit and respond to a request is critical to the movement of data. Also each communication medium has power requirements and bandwidth limitations, which need to be consider as more data is acquired at remote installations.

Protocol is the language by which we communicate the pieces of data. A good protocol has a fixed structure and embedded correction of incomplete messages to handle the unknowns of the communication medium. Protocol is analogous to different languages which have their own unique dialects and structures. A good protocol is designed to protect the transaction of data so that it arrives in the same condition as it was sent.

Not only is the language important, but a secure transfer of the language is imperative. It has been stated that a key component to our victory in WWII was due to our ability to decode encrypted data that was being sent by the enemy. Data in the case of critical operations is important enough to be protected against external influences and should be sent via encrypted format. In these times, it is clear that safe data will be required / mandated by the industry and process control companies have been working to achieve a clear standard for the future.



Data gets a job

Data can be gathered from multiple sites and brought back to a central location. Once it is here its usefulness as a monitored value, billing component or control point become evident. Communication, distribution and reporting practices at a control room fully use the value of the data. From control rooms, data from many areas can be brought together to make immediate and informed decisions about a process.

The gathering of data is the engine that keeps a process running as it allows us to see the process real-time with many different characteristics. If you think about it, different skill sets that each person brings to a company are critical to its successful existence in a marketplace. Without a diversity of skills in a company it cannot survive, similarly without different characteristics of data about a process it cannot be managed effectively.

As data is used for informational purposes, it becomes an invaluable tool to a business or process operation. At a split second in time, many pieces of data (or datum) gathered together can inform you of how a process is operating, this can drive improve decisions thus save money, time and headaches in the long run. The immediate values of data can clearly be seen in process monitoring, but more effective use is the historical review that can drive predictive control as described below.

Data matures

With the experience and information that you have gained, you become more valuable to your organization. Your knowledge allows to meet current expectations and gives you insight to what is in store for the future. Gathering pieces of data for extended periods of time is the foundation for process modeling, preventative maintenance practices and overall safe operation of a process. This process could be one location to thousands and can the information gathered may span for many years. In historical gather form it is at its most mature stage, just as you are to your company.

Storage and easy retrieval of information is an important aspect of data. The more real time experience of a process gathered for extended time periods make the user better educated on decision made in the future. The data is collected and stored for historical records on robust central servers that follow maintain safe redundant and data backup practices. Data querying methods can tied many variable together in a view that provides a wealth of information. This is what separates basic monitoring from advanced control, obtaining data is a major investment so it is best to get the most out of it.

Conclusion

Sure I stretched a few analogies, but did you read it until the end? Data definitely lives and breathes in our networks and is critical to the process control world. Without remote data, many concepts and practices would be impossible to achieve in the ever expanding infrastructure occurring today. Whatever your process is, the increased availability of information allows you to make better, faster and more informed decisions. These result in more safe, reliable and economical results to your company as well as your customers. Obtaining and raising data as carefully as you would treat your children could be the same as whether your data will take care of you in the end.

Emerson Process Management
Remote Automation Solutions

Watertown, CT 06795 USA T 1 (860) 945-2200
Mississauga, ON 06795 Canada T 1 (905) 362-0880
Worcester WR3 8YB UK T 44 (1) 905-856950

Website: www.EmersonProcess.com/Remote

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