Poster: Improving Manufacturing Processes using Open-IoT BatNet Technology

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Abstract

Optimizing energy use in industry is a decisive competitive factor, therefore reducing costs and increasing production in industrial processes are essential requirements. Getting detailed information about power consumption of different systems, machines and production processes is the cornerstone to achieve energy reduction. Here, we present the real implementation of a syncronous energy monitoring solution based on BatNet technology. The solution has been installed in a plant dedicated to the manufacture of steel and aluminium parts. Initial consumption data analysis shows estimated energy savings of 6%.

1 Introduction

Industry 4.0 is expected to have a major effect on global economies, since it can deliver estimated annual efficiency gains in manufacturing of between 6% and 8% [1], by allowing flexibility in production, improving manufacturing speed and increasing productivity, among others. Regarding productivity, industrial processes need to reduce costs and increase production. Process optimization in production plants would be possible by detecting energy efficiency improvements and reducing man/hours spent on the processes.

We present an Open-IoT solution which measures consumption in electric boards and associates it to the state of the machine or a particular process, thus allowing to know the costs associated with each phase of production. The solution has been installed in 9 Gonvarri plants (distributed in Spain, Portugal and Brasil) dedicated to the processing (cutting and pressing) of steel and aluminium parts for automotive, road safety, energy, storage and mecano industries.

2 System description

The goal of the Open-IoT Solution is to monitor the energy consumption of the different facilities of the factory and specifically the energy consumption of the industrial processes: cutting and pressing (among others)[1]. The solution is based on BatNet network technology [2] and BatMP management platform[2]. BatNet connectivity is based on a network of nodes with mesh topology that communicates through Std.IEEE802.15.4 Physical and Link Layers, and a 6LoWPAN Network Layer. The Transport Layer is UDP and the Application Layer is based on CoAP (Constrained Application Protocol) (see Figure 1).

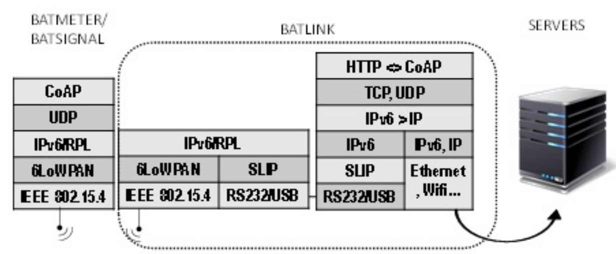

Figure 1. Communications protolocols of BatNet.

Figure 2 shows the solution architecture for the Barcelona plant, composed of three types of nodes: BatSignal, BatMeter and BatLink. BatSignals collect changes of processes within the production lines and send them to the BatLink. The BatLink matches the production line (and the specific process) to the corresponding electrical line and asks the BatMeter device (and specific accumulator, a variable where the energy consumption for a concrete process is stored) for the measurement. BatMeters measure energy consumption at the electric board and send the energy measurement to the BatLink, where the data is stored and periodically sent to a server where an energy analysis software is running.

2.1 BatSignal

It is a device in charge of capturing the changes produced within the cutting and pressing processes and registering cuts/hits (events) and cutting/pressing speed. The BatSignal is connected to the control board of each production line (or machine) through digital and analog inputs. When there is a change in one of the signals (e.g. a packet change or the cutting start), the BatSignal sends a message to the BatLink.

[1]Gonvarri processes http://www.gonvarristeelservices.com/en/processes/
[2]BatMP description http://www.cedint.upm.es/en/project/batmp

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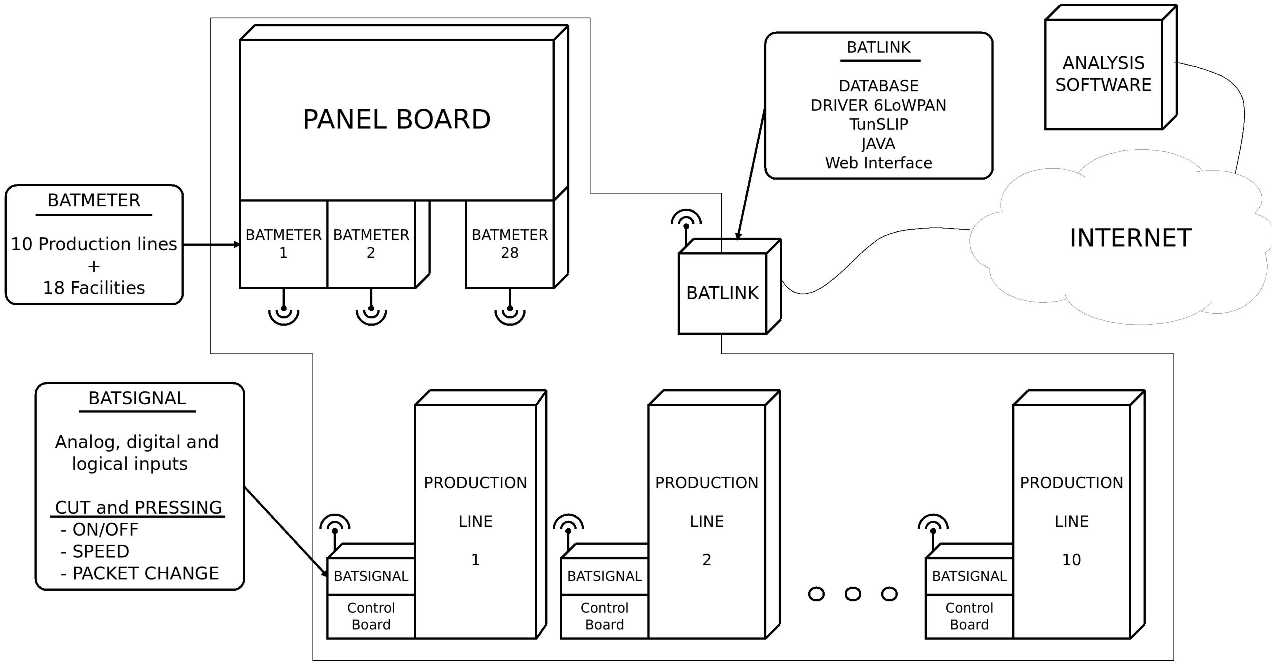

Figure 2. Solution architecture.

2.2 BatMeter

This device is devoted to measure energy consumption of the three phases of a single electric line, by monitoring real time voltage and current of the lines at the panel board. Peridiocally and when the BatMeter receives a request, real power, apparent power, real energy, apparent energy, power factor and frequency are calculated and sent to the BatLink. In order to measure the energy consumption of individual processes, an accumulator is associated to each process.

2.3 BatLink

This device is where the BatMP runs and it is in charge of the solution management and the communication to internet. When the BatMP receives a message from the BatSignal, it checks to which BatMeter belongs and it sends a measuring request to that BatMeter. After receiving this request, the BatMeter device answers the BatLink with an Accumulation (energy) measure which will be stored in the database.

3 Results

After troubleshooting some issues during the implementation phase (change of requisites, high CPU usage, memory overload), the solution has been properly working for more than five months now in the Gonvarri plant in Barcelona. An initial analisys of energy consumption data has conducted to an estimated energy consumption reduction up to 6% due to the optimization of the processes associated to the production lines and auxiliary processes (compressors, air pumps). The estimated energy reduction for the rest of the Gonvarri plants varies between 5% and 14%, depending on the processes involved. Additional energy savings may be achieved optimizing the use of the general purpose facilities (e.g. illumination, HVAC). Regarding communications, network analysis shows a packet loss rate of 0.000043% using retransmissions and a measure recovering service.

4 Conclusions

In this work we present an Open-IoT solution conceived to help optimizing energy use in the automotive industry by identifying energy consumption of specific production processes. This solution comprises a three-phase energy meter and a device which detects processes changes within the machines or production lines. Initial results of the real implementation show relevant potential energy savings (5%-14%). Detailed energy consumption data per process may be used to accurately determine the energy cost of manufacturing a product. Regarding the system architecture, future improvements should be considered, e.g. the direct communication between BatSignals and BatMeters when measuring energy consumption of processes.

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6 References

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