Data Integration in Computer Distributed Systems

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Abstract. In this article the author analyze a problem of data integration in a computer distributed systems. Exchange of information between different levels in integrated pyramid of enterprise process is fundamental with regard to efficient enterprise work. Communication and data exchange between levels are not always the same cause of necessity of different network protocols usage, communication medium, system response time, etc.

Keywords: PLC, ERP, MES, SCADA, data integration.

1 Introduction

The development of computer technologies is supporting creation of new solutions or optimizations already existing. In contemporary systems of the computer science, of which architecture is often created on the basis of distributed systems, applying computer networks is essential – Fig. 1. On account of the specificity of the work of these systems, the exchange of data between its nodes many times must be determined in time. Character of the network work and the communications bandwidth medium are forcing into applying appropriate communications protocols.

The desire of increasing data transfers and reliability became stimulus of going more and more popular standard of the network – Ethernet, which in spite of is not deterministic in time, more often find it applying in computer industrial installations [1]. It is possible to justify it by fact that both the software and the hardware connected with using the Ethernet network widely are spread and applying industrial technologies in many branches [1,2]. Using Ethernet is not limited only to steering, regulation and monitoring the industry of computer systems. It concerns also systems of managing the production – MES [3] (Manufacturing Execution System) and managing whole production plant – ERP [4] (Enterprise Resources Planning). For MES systems the information exchange in the real time is essential cause of the supervision in progress of a production process that thanks it is possible quickly to react to the state and parameters of the industrial computer object [3]. Next the ERP system supported by MES is integrating the information about events coming from the industrial computer

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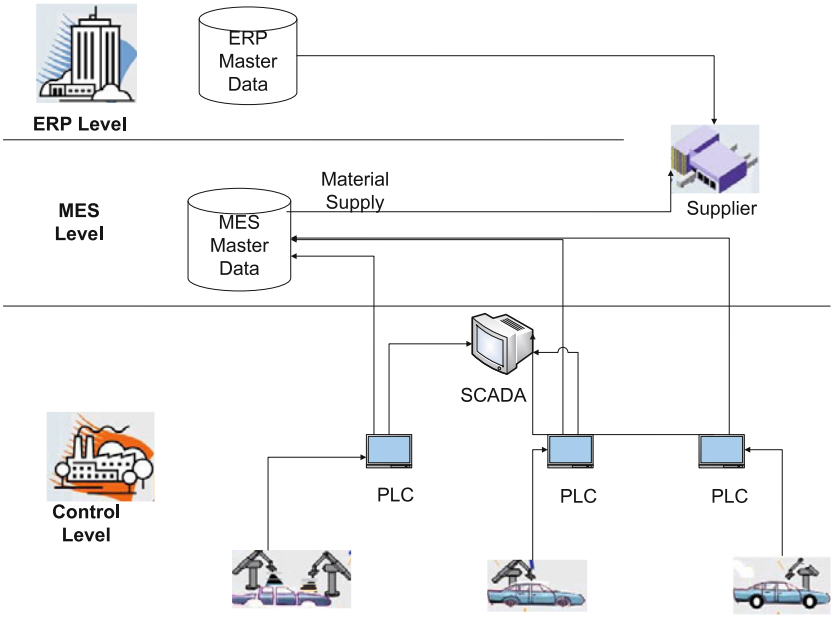

Fig. 1. Model of computer distributed systems

object with the information about business events, it delivers in the real time information about the current state and parameters of production and enables accurate analysis of the profitability and accurate costs of the production [5]. The typical, hierarchical model of management and controlling an enterprise is shown below – Fig. 2.

Level 1 takes systems of steering and the control represented by local like of also steering by distributed territorially real-time systems, carrying the service of algorithms out on the level of individual technologies resulting in a production process of the enterprise.

Level 2 takes systems of the HMI (Human Machine Interface) class, which is a platform between systems of steering and the maintenance crew staff serving them. Applied solutions on the level 2 enable an access to the information of devices describing the work put on the level 1. Additionally they allow making the parameterization of these devices and manual steering.

The level 3 assures information exchange between systems of steering (level 1) systems of the visualization (level 2), and ERP (Enterprise Resource Planning) class systems (level 4). ERP systems support production processes. Because of this systems organization of the production became easier as well as supporting the action starting from the stage of accepting the order, by the preparation, protecting and keeping up with the production, until the stage of the delivery of the final product to the recipient [6].

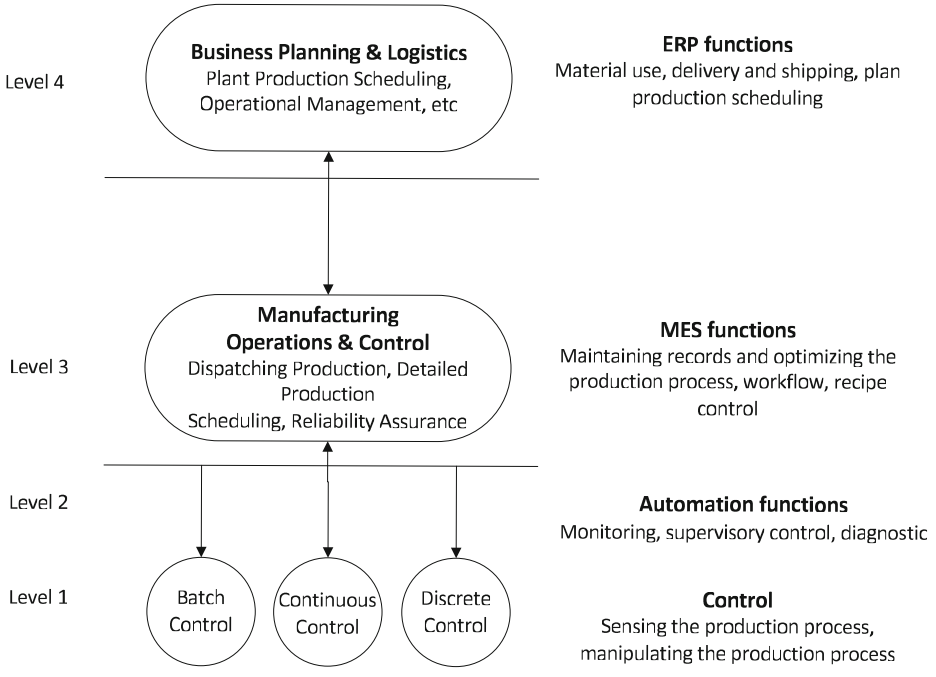

Fig. 2. Hierarchical model of industrial computer object [5]

All four levels of the presented model can harmonize with themselves only by dint of to the mutual information exchange. Integration of the different levels of the industrial computer object on the level of the computer network is crucial and essential for its correct functioning.

2 Systems Integration

In accordance to the Sect. 1, effective integration of production systems with business is possible, management layer must at first appear in the production layer. In other words, apart from devices and the SCADA application one should create the right infrastructure and the computer system, responsible for the realization and the recording of the production. MES systems are accomplishing the double role. Firstly, they provide indications essential for the staff. Those indications are current dates concerning the production – production orders, warehouse states, available machines and their productivity – those dates enable an efficient planning and what is more realization and the optimization of the production. Secondly, they enable a full integration of company management systems. This integration is most often two-way. The production systems systematically deliver and convert information about goods orders made by customers, specifications and required parameters of this orders. The ERP systems is being sent an information

about production in progress, productivity of this production, real costs, quality and all deviations from the plan which can influence on realization of the dates – of the ones and of different orders. All information is collected in the relational database which enables to prepare analyses of product, production orders, production part or to reconstruct of genealogy of products.

Integration of systems will be effective, elastic and it had the low cost of the exploitation only when it will be marked with certain special properties. Above all it should enable the automated, electronic exchange of production data with many ERP systems and with transaction systems. The big openness has been essential since in many factories we are dealing with the heterogeneous computer environment. The solution should also has mechanisms of the buffering and diagnostics, guaranteeing reaching the information into the right place and in case of the riot of the mistakes – to the buffering of the information and fast detecting causes of problems. Also applying standards have an important role in the system of data exchanging, the same as ISA/S95. The fact of applying the standards is not only organizing the way of the exchange of data, but it also helps to establish a clear function division.

3 Data Exchanging

In the company based on production collecting and management of the information is a crucial element in decision-making process. It leads to increasing the production effectiveness and the quality of computer systems improvement. What is more it is a great aid for functioning the company base on production on all its levels – from machines and production lines, through engineering departments, to all the way of administrative departments. In lowest levels there are applied superior systems of steering and the data acquisition – SCADA, industrial arrangements of steering CNC (Computer Numerical Control), PLC (Programmable Logic Controller), IPC (Industrial PC), sensors, executive elements and different devices of industrial automation. They constitute a specific computer system that is active in a real time, of which controlling machines and production lines is a basic task [7]. In highest levels of the industrial enterprise there applied systems, of which effective leading a production process on the basis of accurate and current production data coming from systems of steering and the data acquisition – MES systems, and systems managing supplies of materials, human resources, finances, enterprise resource planning – ERP systems.

An essential element of the modern MES system is a possibility of a simple integration with systems of industrial automation (PLC, SCADA) and with databases in which production data is stored. MES systems join steering of the production departments, keeping the movement departments, qualities departments and different sources of data into a uniform computer system, using provided standard components software so as: OPC Client, OPC Server and ActiveX. These modern computer technologies in the considerable way are reducing the total cost of MES integration with systems of automation and databases as well as they are securing IT investments in the future. However designing the

communications system isn't a simple task and it requires providing many technical parameters of the computer network, communications protocols, interfaces linking computer systems, as well as considering time requirements, the safety of the data transmission and limitations resulting from the bandwidth of the network and technical requirements [7]. The data acquisition in industrial plant show below – Fig. 3.

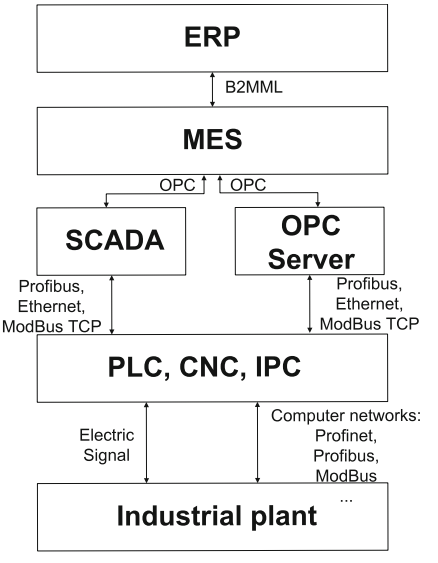

Fig. 3. Data acquisition

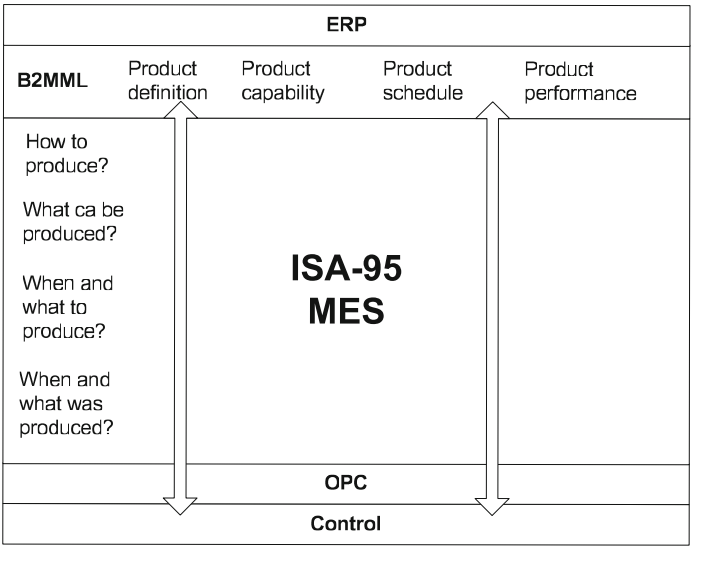

Fig. 4. Exchange of data between layers [8]

Between the ERP system (higher level) and the control layer (lower level), the MES system in accordance with ISA will be crucial for an exchange of data in both directions to help answer the questions: how to produce, what can be produced, when and what to produce, when and what was produced. In the ISA model, a B2MML layer provides connectivity between the ERP system and the MES. At the bottom, OPC (OLE for Process Control) connects data from the control system to the MES – Fig. 4 [8].

4 Conclusions

To sum up, the process of designing communications systems for the automation of production are applied computer systems, applications, interfaces, systems of control, computer networks, databases and functional requirements of final users. It should be put extra attention to analyze requirements concerning the amount and the time of the data transfer between applications. Industrial communications systems like OPC are very well fulfilling their objective in production area where they require transmission of data in the short time e.g. 1 s. These high time requirements are not having to be fulfilled in computer applications so as MES or the ERP. It is possible to imagine the situation, in which generating the report for the manager cockpit will be a second longer, because of load the computer network, and this delay will be acceptable, and not unnoticeable for the end user.

References

1. Kwiecień, A.: Analiza przepływu informacji w komputerowych sieciach przemysłowych. Wydawnictwo pracowni komputerowej J. Skalmierskiego, Gliwice (2000)
2. Cupek, R.: Protokół TCP/IP w systemach wizualizacji procesów przemysłowych. In: Studia Informatica, Gliwice, vol. 22(3) (2001)
3. Kletti, J.: MES – Manufacturing Execution System. Springer, Heidelberg (2007)
4. Lech, P.: Zintegrowane systemy zarządzania ERP/ERP II. Wykorzystanie w biznesie, wdrażanie; Wydawnictwo Difin, Warszawa (2003)
5. Zaborowski, M.: Sterowanie nadążne zasobami przedsiębiorstwa. In: Wydawnictwo pracowni komputerowej J. Skalmierskiego, Gliwice (2008)
6. Cupek, R.: Akwizycja danych z sieci PROFINET CBA do systemów klasy MES. In: Sieci komputerowe. Aplikacje i zastosowania, WKŁ, Warsaw, June 2007, vol. 2, pp. 389–399 (2007)
7. Skura, K., Smalec, Z.: Integracja systemów informatycznych w automatyzacji procesów produkcyjnych. PAR. Pomiary, Automatyka, Robotyka 8(7/8), 6–11 (2005)
8. Siemens Energy & Automation, Inc.: Why integrate MES and ERP? Because you can't afford not to! Process Automation Systems (February 2006)