

DISTRIBUTED CONTROL OF A SMART GRID USING IEC 61499



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Research Motivation

The ever increasing complexity in the nature of power distribution and loads in a power system network demands the need for flexible control and automation solutions that can manage the system in an efficient manner. Traditional control systems lack this flexibility. The IEC 61499 distributed automation standard provides a reference architecture as a solution.



Figure 1. Visualization of a Smart Grid

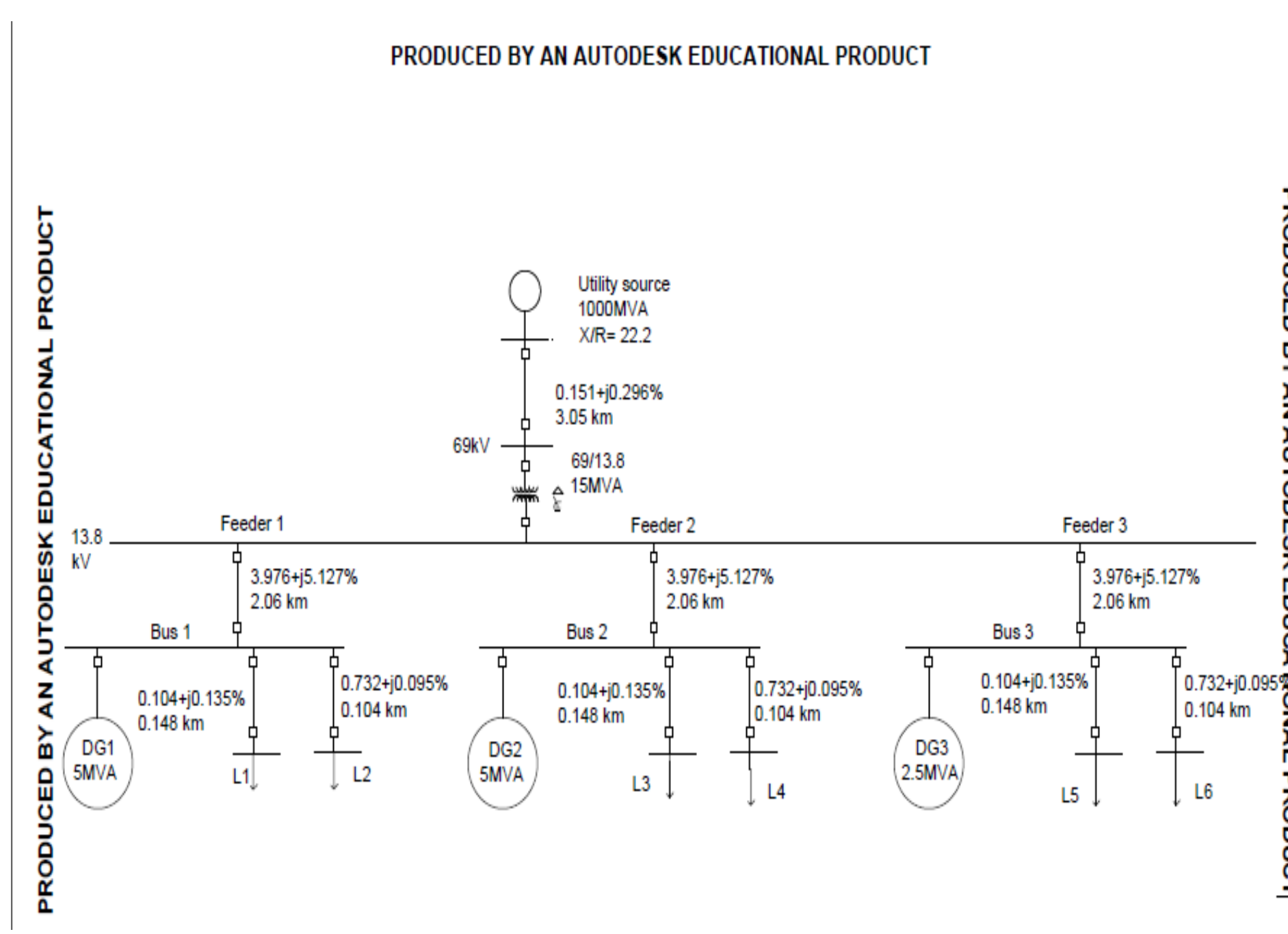


Figure 2. Single Line Diagram of Power Network implemented in this research

Contribution

The contribution of this work is the development of an Economic Dispatch application for a micro-grid based power system network, that balances loads whose short-term requirement and duration is forecasted. Each load has a reference threshold, which when exceeded receives power from the generating source that has the excess capacity at the lowest price while considering the economic constraints of the generating units. The application is an example of distributed control using the IEC 61499 reference architecture. The application is a step further in the work that has previously been carried out in this field that considers only the generating capacity to balance loads. The application addresses the issues of supplying varying loads in a cost efficient manner and caters to the need for flexible control systems.

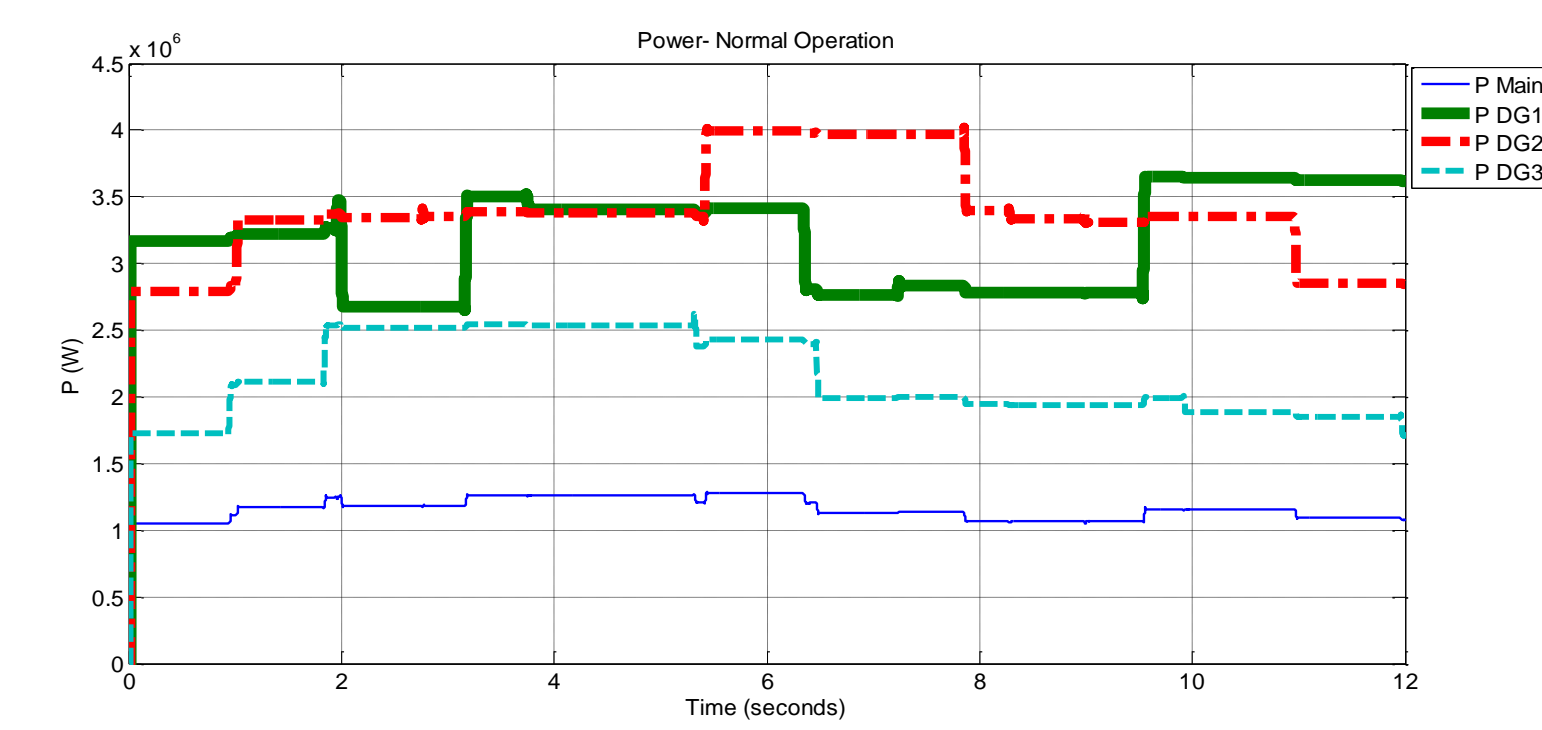


Figure 4. Power supplied by Generating units under Normal Operation

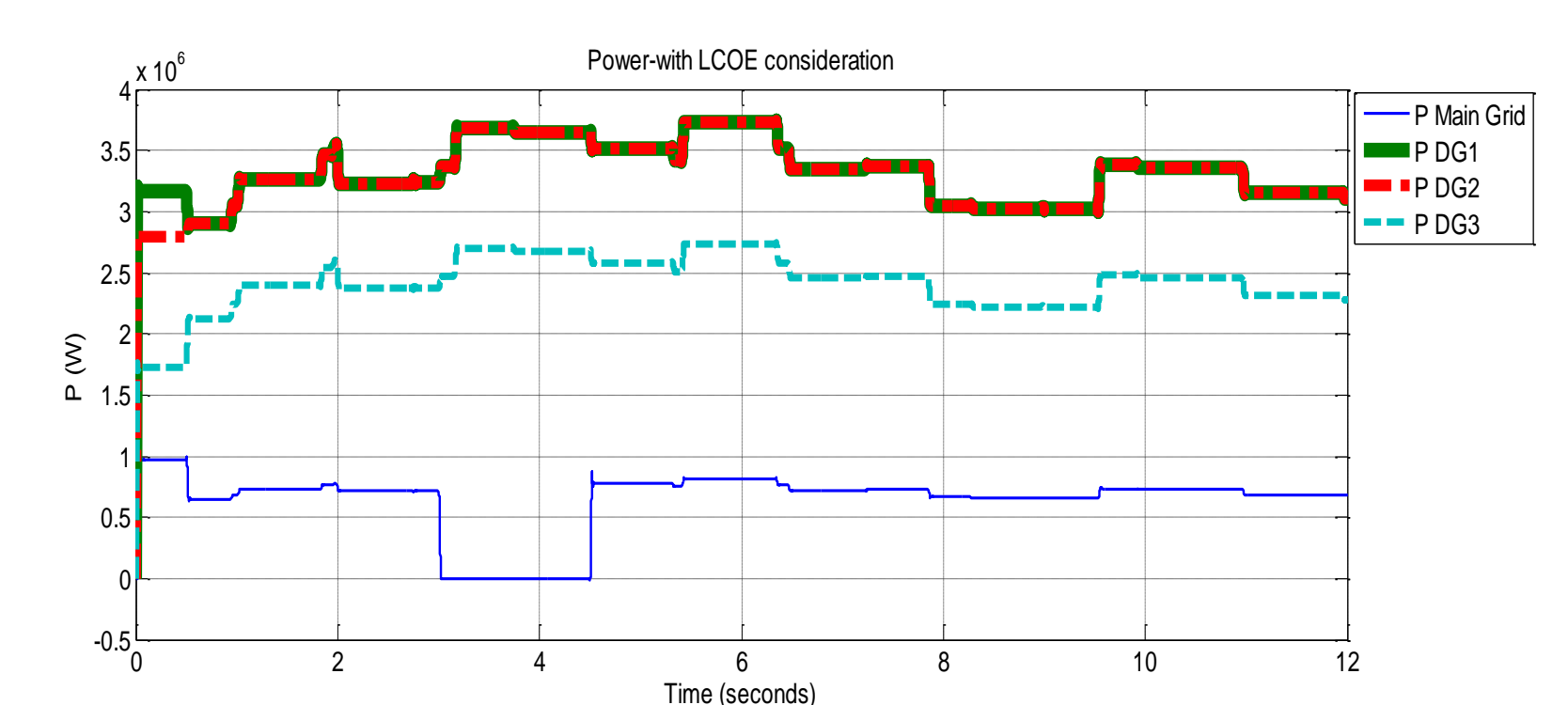


Figure 5. Power supplied by Generating units under Load Balancing application

Introduction

The IEC 61499 automation standard is built on the concept of a software entity called Function Block (FB). A FB performs a specific task by executing an algorithm encapsulated within. FBs are interfaced through data and event connections. A group of FBs linked through the data and event connections form an application. The event connections are used to synchronize the FBs in an application.

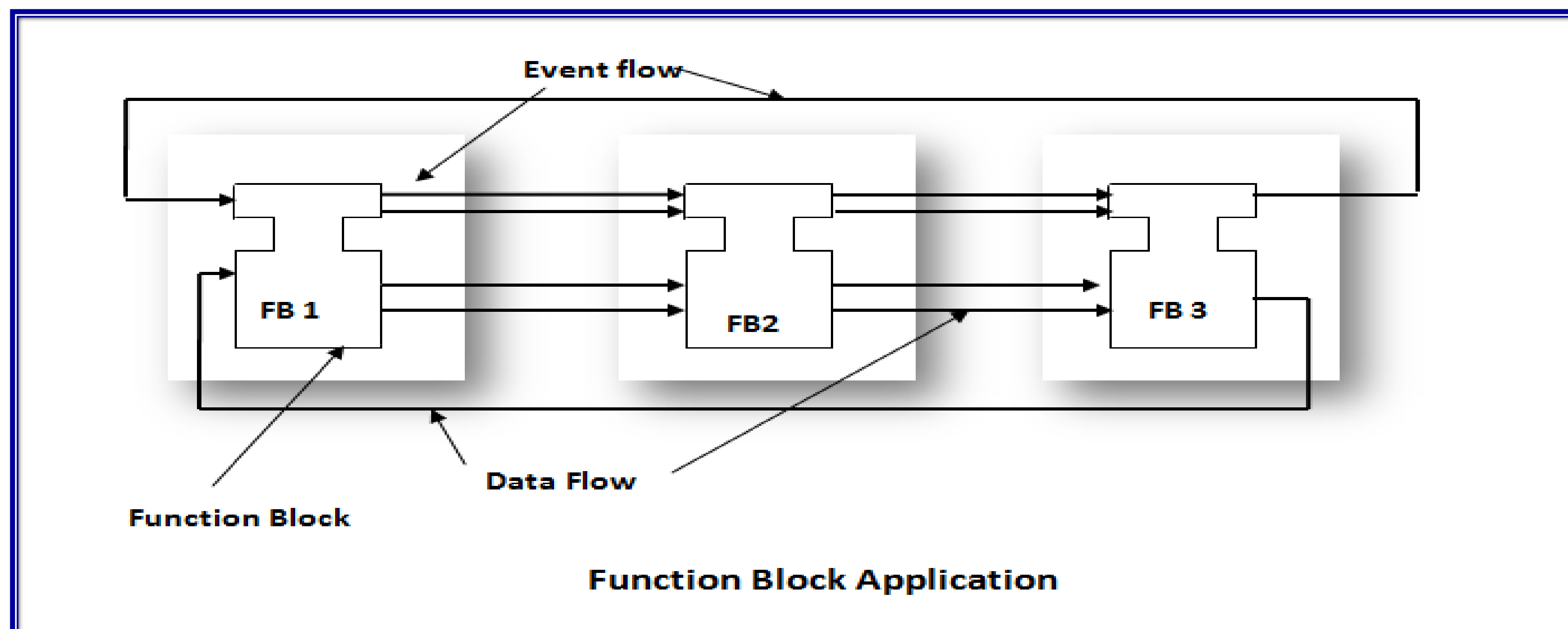


Figure 3. Representation of Function Block Application at Application Level

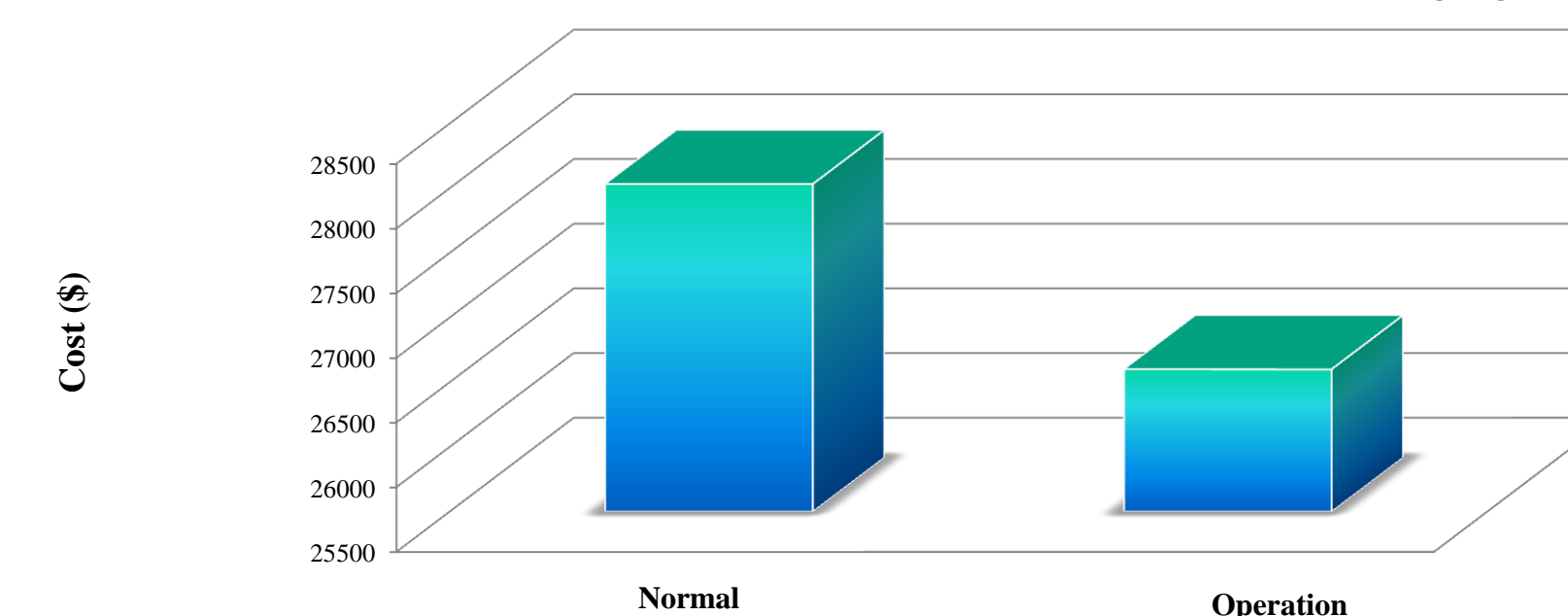


Figure 6. Cost of operation for 24 hours for the cases displayed in Figures 4 and 5

Conclusion

The results depicted in Figures 4 and 5 show the operation without and with the load balancing application respectively. Figure 6 shows the corresponding cost of operation for 24 hours. A significant dip in the cost of operation is observed which depicts the effectiveness of the Load Balancing application developed using IEC 61499 reference architecture.

Acknowledgments

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References

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- V. Vyatkin, "IEC 61499 as Enabler of Distributed and Intelligent Automation: State-of-the-Art Review," *IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS*, vol. 7, no. 4, November 2011.