A Layered Modeling Framework for Performance Evaluation of PROFIBUS Networks

Tae-Eog Lee* · Dong-Seok Sun*

* Department of Industrial Engineering, KAIST

Abstract

We develop a three-layer performance evaluation model of PROFIBUS networks. Performance of a PROFIBUS network is determined not only by the protocols themselves but also by the architecture of the application programs, the network configuration and the dynamics of job flows. Nonetheless, the conventional network models usually address only the data link layer and assume random, Poisson arrival processes for the service requests at the layer. Further, it is not easy to correctly estimate the offered load for the service requests. Thus, we need a layered model where we can realistically predict the input traffic processes and offered loads for the lower data link layer from the upper layer models for the job flows and the application programs. We present a layered performance model for PROFIBUS networks that can address all these components. The model consists of three layered models, the job flow model, the message model, and the network model. The job flow model describes flows of jobs among the processing machines or the material handling equipment as usual factory simulation models do. For each occurrence of the events in the job flow model, we generate a set of communication commands for controlling devices or delivering information or data, which are necessary to perform the associated processes such as processing a job or movement of a job by a handling device. The communication commands are then translated into a sequence of appropriate acyclic PROFIBUS service request or response messages, which may be PROFIBUS-FMS or PROFIBUS-DP services. The translation model depends on how a command is implemented by the available PROFIBUS communication services in the application program. The message model also generates cyclic PROFIBUS service messages for periodic tasks such as monitoring the device states, which are periodically generated regardless of the occurrences of the events in the job flow model. The network model addresses the PROFIBUS network protocols themselves and translates the PROFIBUS service reques