WiP Abstract: TCP Congestion Control Principles for Highly Available Reconfigurable Conveyor Systems

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***Abstract*—Advanced Manufacturing systems, such as reconfigurable conveyor systems, are critical to several economies and societies. They enable the rapid reconfiguration of the system at the level of individual units or subsystems to cope with the needs of emerging markets and applications. However, because of the immense scale of these systems, several components tend to fail on a regular basis. There is an urgent need for autonomous fault tolerance techniques that will ensure high availability of these critical cyber physical systems. In this paper, we present preliminary results from our design of a highly available reconfigurable conveyor system. At the core of our approach are ideas for fault tolerance derived from TCP sliding window flow control and congestion control approaches.**

***Keywords*-Reconfigurable conveyors, Fault tolerance and high availability, TCP congestion control.**

I. Introduction

Reconfigurable conveyor systems (RCS) are critical to address the emerging needs of advanced manufacturing [1]. Manufacturing facilities tend to be large operations. In such a large and complex facility, faults are likely to occur on a daily basis for a variety of reasons. For example, a fault in the system may be an intentional outage due to necessary maintenance or reconfiguration activities, or due to failure or malicious events. High availability is of utmost importance but hard to implement. Individual elements of a reconfigurable conveyor system are controlled by a microcontroller, which contains only local knowledge of the conveyor element they control. These microcontrollers do not have any knowledge of the distributed deployment of the conveyor elements and their connectivity in the deployed end system. Addressing these needs requires a higher-level decentralized, distributed controller solution. Any failures in individual conveyor elements must be handled at the level of the decentralized, distributed controller through a real-time coordination of the local microcontrollers.

In this paper we present preliminary ideas for developing highly available conveyor systems that are assembled from reconfigurable building blocks. Our design currently applies to an abstract model of the building blocks that we have used in our work to date [2].

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II. High Availability using TCP Flow Control and Congestion Control Principles

At the core of our design are ideas based on the TCP flow and congestion control mechanisms. Recall that in TCP, flow control is a mechanism initiated by a receiver using a sliding window to control the rate at which a sender can pump packets so as to match the rate at which it can consume them. Congestion control is a reaction by the TCP end points after they determine that packets are getting delayed or lost in the underlying network through indicators, such as timeouts and triple duplicate acknowledgments [3]. TCP congestion control uses the *Additive Increase, Multiplicative Decrease* approach.

We identified striking similarities between a computer communication network and a reconfigurable conveyor system, which enabled us to approach high availability solutions for reconfigurable conveyor systems using the TCP algorithms. In our scheme, we view the input and output bins as the end system hosts of a computer network while the switching elements are the routers, and the connected segments are the links. We are working towards developing high availability solutions for reconfigurable conveyors that are influenced by TCP congestion and flow control ideas.

References

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