

POSITION STATEMENT

Switched Real-Time Communication for Industrial Applications

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1. Introduction

An important trend in the networking community is to involve more switches in the networks (e.g., LAN, Local Area Networks) and pure switched-based networks becomes more and more common. At the same time, the industrial communication community has a strong will to adapt LAN technology (e.g. Ethernet) for use in industrial systems. The involvement of switches does not only increase the performance; the possibility to offer real-time services is also improved. Now when the cost of LAN switches has reached the level where pure switched-based networks have become affordable, the collision possibility in IEEE 802.3 (Ethernet) networks can be eliminated and methods to support real-time services can be implemented in the switches without changing the underlying wide-spread protocol standard.

This research aims to provide such methods with the focus on industrial applications. The research is motivated by the large interest of using cheap and simple technology (like Ethernet) in industrial and embedded systems. Ethernet has already today been introduced to these applications but has, at the same time, introduced problems with (or lack of) real-time services and analyzability.

The main research question is how to form methods to be able to support typical industrial real-time traffic (e.g., small periodic messages) without changing the underlying protocols and while still supporting existing higher-level protocols for non-real-time traffic (e.g., web based maintenance which is highly desirable to coexist with the real-time traffic). Other important research questions are what degree of service (throughput, latency, delay jitter etc.) one can expect from these communication systems and how to form methods to increase analyzability (e.g., by introducing determinism).

2. Applications

The research efforts on real-time communication over non-real-time LAN technologies have so far been concentrated on multimedia and similar applications while there is a large need of research efforts in the field of industrial systems. Our focus is on industrial and embedded systems. Application examples are industrial automation, Computer Integrated Manufacturing (CIM), radar signal processing systems, airplanes, process control, and telecommunication equipment. Other applications which also might be of interest are home networks and broadband access networks, where a mix of real-time and non-real-time traffic is expected.

() A large portion of this document is copied from the ARTES project application authored by Magnus Jonsson and Bertil Svensson.*

3. Plan of research

The research work can be described as two parallel tracks that run concurrently:

- Identify industrial application demands on real-time communication services, including survey of real-time communication with focus on LAN-technology and switched communication. Case studies of industrial applications are also planned.
- Develop and analyze how methods to support traffic with industrial real-time demands can be implemented in switches and/or network interfaces to get as much functionality and performance as possible at the same time as the use of standards like TCP/IP and Ethernet is preserved.

4. Expected results and impact

As stated above we have specific ideas and we attempt to focus on real-time support for the wide-spread Ethernet standard. However, it is important to stress that we have the ambition of finding methods with general applicability in the area of real-time networking.

The main expected results are:

- Methods to support traffic with industrial real-time demands over non-real-time LAN-technology, primarily over switched Ethernet, without loss of generality to use common protocol suits like TCP/IP.
- General outlines of how to support traffic with industrial real-time demands over switched system area networks.
- Performance analysis of proposed methods.
- Implementation experiments to demonstrate the practical feasibility of the developed methods and to make performance measurements including implementation aspects.
- Case studies where the industrial applicability of the proposed methods is confirmed.