



P R O F I N E T
INDUSTRIAL ETHERNET

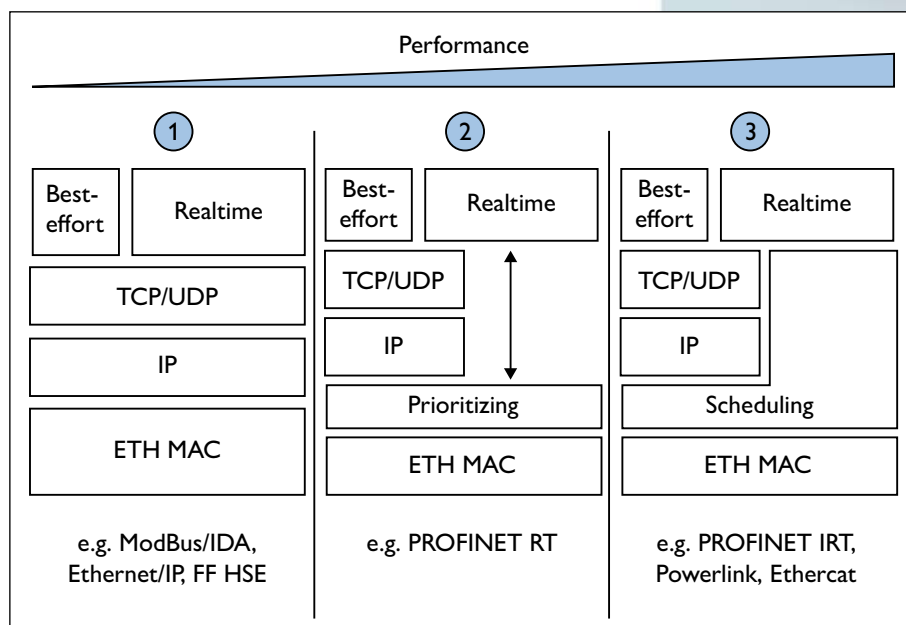
Profinet IRT –

The fastest and most
future-proof realtime
Ethernet system

A project of the German Federal Ministry of Education and Research underlines the advantages of Profinet IRT as regards performance

Currently, 22 different realtime Ethernet protocols are available on the market. In the framework of the joint project “Realtime Ethernet in sensor/actuator networking” of the German Federal Ministry of Education and Research, which started in October 2006, the partners involved, Institut Industrial IT (inIT), MAZeT, Phoenix Contact, Siemens and the TU Berlin investigated which of the approaches offers the highest performance potential.

The documents for the joint project can be downloaded at www.interbusclub.com



The realtime Ethernet protocols can be classified into three different categories with regard to the achievable performance (see Figure 1). The Class 3 protocols investigated use either the summation frame method as their transmission method, where several devices are supplied with data simultaneously with one frame, or individual frames with which the data is delivered address-based. In the framework of the joint project, Ethercat as a representative of the summation frame method as well as Profinet IRT based on individual frames were investigated.

Figure 1:
Classification of the realtime Ethernet protocols into different performance classes

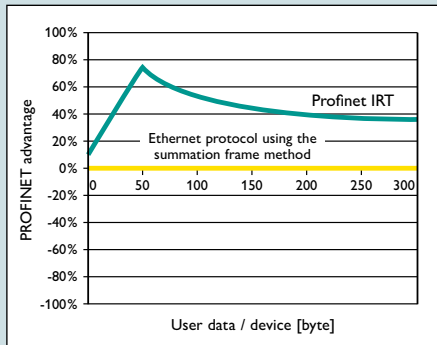
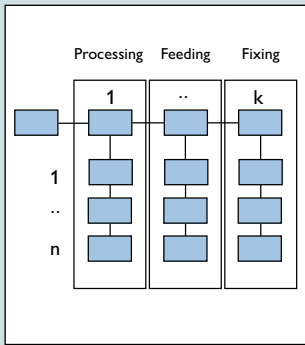
The scenarios

In the performance assessment, the physical runtime as well as the transmission time of the frame, which are important for realtime Ethernet systems, are taken into consideration. In mechanical and plant engineering, there are not only machines with simple sensor/actuator networking, but also complex systems with a comb-like structure are increasingly establishing themselves, which is why two different scenarios have been considered:

Comb-like structure

Branches with ten devices all branch off from each of the eight stations on the main line. The distance between each of the individual devices is 50 meters, the transmission speed is 100 Mbps. Due to different update time requirements, the assumption is based on the scenario that all devices in the main line are operated in every cycle and the devices in the branch in every k^{th} cycle.

Due to the different update times, Profinet IRT meets the requirements more flexibly because of the principle of individual frames. In protocols using the summation frame method, all devices must also be run through twice, which prolongs the physical runtime. The performance of Profinet IRT is thus higher than that of the Ethernet protocols using the summation frame method in any case, whereby the absolute difference grows quadratically with the number of devices.

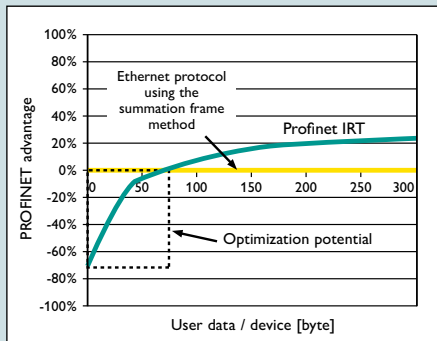
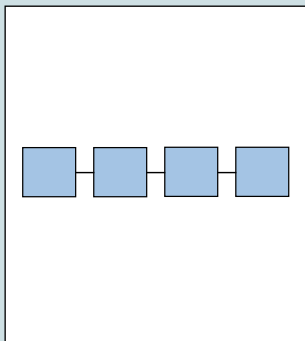


Profinet IRT always offers higher performance in the comb-like structures of complex systems.

Linear structure

The line consists of 50 stations which are each 50 meters apart from each other. A 100 Mbps connection is used for data transmission.

If only a few bytes of user data are sent, Ethernet protocols using the summation frame method were shown to be twice as fast as Profinet IRT. Starting from a user data volume of 60 bytes, Profinet IRT offers performance advantages of up to 20 percent.



Performance in the process of transmitting just a few bytes of user data can be further optimized with Profinet IRT.

The optimization approach

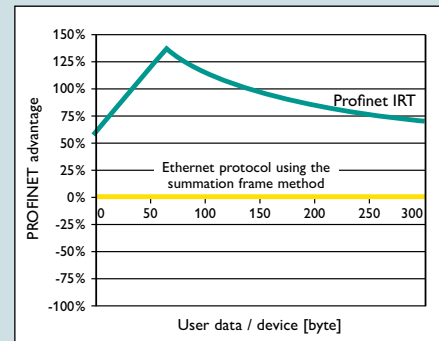
In order to make Profinet IRT the fastest realtime Ethernet system independent of the network topology, the joint partners have optimized the protocol in different ways. In addition to shortening the run-through times in the devices, the telegram overhead has been reduced. If the frames are first transmitted to the device which is physically last, and transmitted to the directly neighboring device last, a "slipstreaming" effect can be utilized.

The optimization approach described is now being specified and extensively tested. At the Hanover Fair 2008, the partners will demonstrate a prototype, which proves the superiority of Profinet IRT even on linear systems with small amounts of data and a transmission speed of 100 Mbps.

The conclusion

In the area of complex machine/system structures, the performance of Profinet IRT compared to other realtime Ethernet systems has proven itself to be considerably higher. An increase in the transmission speed in the linear-based test set-up to 1 Gbps has also shown that Profinet IRT is already superior to the Ethernet protocols using the summation frame method in their present form. For simple sensor/actuator networking and a transmission rate of 1000 Mbps, even a few bytes of user data are also sent in half the cycle time required by Ethernet protocols using the summation frame method.

The approach of individual frame delivery based on Profinet IRT thus offers the greatest performance potential, because, at high transmission rates, the runtime effect on the medium and the devices to be run through have a dominating significance. The joint project shows that Profinet IRT profits more than all other realtime Ethernet systems from the further development of the standard Ethernet, and therefore is the most future-proof of all solutions.



The transmission of individual frames profits more strongly from the increase in the bit rate than the summation frame method.

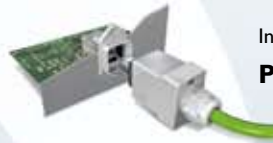
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