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The Protocol War: Leaders and Followers

Introduction

X-by-wire systems will be connected to a network bus. Currently two architectures of automobile buses are competing to become the industry standard. These are the TTTech, Time- Triggered Architecture (TTA) and FlexRay. Within the automotive industry there is an ongoing debate about which of these technologies is the best. It is likely that the final choice of which protocol standard to adopt within the industry is not going to be made for some more time. One of the main reasons why certain companies have been reluctant to choose a particular safety-critical data bus standard is because it is considered as one of the key elements of future vehicle design and they do not want to make a hasty decision.

One of the similarities between the different protocols is that they are both time-triggered and fault tolerant. This implies that the safety-critical applications do not fail, because it is ensured that electrical bus and controllers do not stop operating in the event of, for example, a short circuit, a software malfunction or a failed sensor.

Time-Triggered Architecture

Time-triggered architectures are one of the key solutions for safety-critical applications, in order to eliminate the risk that a message fails to get through. Message latencies might occur, which might degrade the responsiveness of a real-time system and can create "orphans", in which a receiver misses a message as a result of timing out before the message arrives. These so called orphans degrade system performance, since they do not deliver timely data and they must be dealt with carefully to avoid compromising system integrity. Safety-critical applications demand time-triggered based architectures because it ensures that the device with the most "dominant" levels always win.

TTA Versus FlexRay

One of the strong points favouring TTA over FlexRay is its proven ability to be safer for safety-critical applications, due to its time-triggered functioning. Experts also believe that TTA is more mature, whereas FlexRay is still in a development stage. They argue that TTA has been tried and tested for about 20 years and has already been used for flight-critical functions within the aircraft industry, whereas FlexRay has been under development only for an year or two.

Main automotive VMs backing TTA are Volkswagen, Audi and recently PSA. Although PSA indicated that, for the moment, the TTA protocol will only be used in its x-by-wire prototype, it will not necessarily be used in production vehicles. Semi-conductor suppliers that are focusing mainly on TTA are Oki and NEC. The IP licensing company ARM is also known to have a strong interest in the TTA architecture. Some of the participants in this study tell Frost & Sullivan that Japanese VMs seem to be very interested in TTA. The fact that Oki (using the IP of ARM), as a tier 3 supplier to some of the main Japanese VMs, is clearly involved with TTA might be a good indicator of Japanese VMs future choice.

Those in favour of FlexRay believe the architecture offers the same safety as its competing technology, but with the advantage that it is more flexible in serving the automotive production environment. FlexRay champions believe that having the addition of event triggered functionality to time triggered is essential in certain cases of emergency.

FlexRay is the current choice of DaimlerChrysler and BMW. GM has also joined the consortium. Philips backs the FlexRay protocol. Motorola is interested in both protocols; however, being one of the founders of FlexRay, Motorola is more involved with FlexRay. Ford is rumoured to be interested in FlexRay.

Interestingly, DaimlerChrysler and BMW were original participants of the TTA forum, but then they broke ranks to develop their own system. Some market participants think that it is quite possible that the decision on which protocol to use will be made in the court, based on Intellectual Property rights violation.

Main Difference Between TTA and FlexRay

TTTech is now making its technology freely available to the industry by giving up the patents to an industry consortium. FlexRay has so far shown no signs of making FlexRay a free and open standard.

TTA's main focus is on time-triggered operations, which deliver efficiency, partitioning and efficiency, but at the expense of flexibility. The reason why FlexRay is considered more flexible is because FlexRay uses both static and dynamic components. The dynamic part is event- driven, whereas the static portion is time-triggered and synchronised to a clock mechanism.

Engineers can decide how large the static portion should be against the dynamic portion. VMs see this as a main advantage because they can easily adapt the architecture depending on the model. On the contrary, those in favour of TTA feel that flexibility puts safety at risk. Some members of the FlexRay consortium argue that vehicles can have small disruptions and still be allowed to be operated further. Then the question is whether this is to be considered as a risk or not.

TTP/C is also expected to be cheaper to implement than FlexRay.

Other Alternatives

There are no real serious alternatives that currently exist for a safety-critical data bus standard. The reason why CAN, currently used for automotive controls like power train, is not considered as a possibility is because it is not reliable and sophisticated enough for x-by- wire. There is an advanced version of CAN, TTCAN, but it is solely event-based and does not eliminate the risk the way other time-triggered solutions do.

However, CAN will still be used as a complementary system for future body electronics. Even though CAN is not an alternative for safety-critical applications, vehicles may carry a mixture of either TTA or FlexRay along with CAN, since these technologies have potential to complement each other.

Cost Implications of the Absence of Protocol Standard

The lack of a single set of automotive bus communication standards has negative cost implications for all industry participants. Tier 1 suppliers need to make their x-by-wire products compatible for both the architectures, since they will have to deliver what VMs are asking for. Furthermore, VMs might now choose the protocol they feel comfortable with. However, if eventually the two different architectures come together, they will have to adapt their systems. Furthermore, one of the aeroplane makers indicated that 70 percent of the total development costs related to the implementation of fly-by-wire are allocated to the testing and certification of the system. One might expect the costs to be on a similar level for VMs. There are extra costs for semi-conductor companies as well: they might be required to invest in three different systems (TTA, FlexRay and TTCAN). Besides, the absence of economies of scale (similar to one for the IT/computer industry) means that costs and margins will be under higher pressure.

To conclude, the absence of a standard in the industry does not only cost the market players money, it also holds up future development.

Likelihood of Single Global Protocol

It must be noted that in the past different global standards have been set as a result of successful cooperation between the VMs and suppliers. Examples are medium-speed CAN, OSEK operation systems and low-speed LIN. It is therefore quite possible that sooner or later the protocols will merge to one standard.

For the moment, it is very likely that the debate over the technology to be chosen will carry on for a while, as a result of some elementary differences between the two parties. Interestingly enough, the discussions between TTTech and FlexRay is no longer focused on technology any longer - it has turned into a political debate.

Almost everyone Frost & Sullivan spoke to hoped for one standard protocol, including VMs, and about 85 percent of the market participants in this study expected a common standard in the next two years or so.

Source: European Automotive Market for X-by-wire Technologies (B015-18)

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