Theses

1. It becomes apparent that none of the established Industrial Ethernet systems meets all requirements concerning high reliability, scalability, flexibility in terms of self-configuration and cost-effective standard Ethernet hardware. No currently established solution achieves isochronous real-time data transmission without special hardware and single point of failure at the same time.

2. A fully decentralized network can enable hard real-time operations without single point of failure. Such a solution simplifies administrative scalability and usability in adding and removing further instances as no managing central instance is necessary. Every node in such a network is able to act autonomously on its given data in a deterministic way to enable the hard real-time behavior.

3. A comprehensive modeling approach like joint routing and scheduling is the method of choice for routing and scheduling of time-triggered networks. Fixed routing approaches either have drawbacks with respect to schedulability or latencies, while joint routing and scheduling yields good results with respect to both of these aspects. A scheduling approach with fixed load balanced routing shows higher flow latencies and a scheduling approach with fixed shortest path routing cannot schedule as many flows as joint routing and scheduling.

4. However, if the algorithms often need to react to dynamism in the network at runtime even solving medium-size scheduling and routing problem instances becomes an issue in terms of computation times. Approximation algorithms with polynomial runtime can help to reduce computation times but are currently only able to reserve routes and have to be extended by the ability to compute schedules.

5. Wireless mesh networks and applications executed in such networks benefit from cross-layer cooperation in terms of performance and robustness. These optimizations should, according to a cross-layer principle, take into account the behavior of applications and services of the intelligent environment and configure the physical network accordingly, as well as provide information from the lower network layers to higher layers in order to adapt the communication behavior to the given network structure and quality.

6. Distributed applications in dynamic opportunistic networks with highly dynamic participants have been shown to be able to be accurate and scalable. However, the dynamism due to mobility imposes tight constraints on the convergence speed of the algorithm. It is questionable whether an approach different from broadcasting is feasible to exchange information between mobile nodes in highly dynamic scenarios.

7. If the node density in an opportunistic network is sufficiently high, the accuracy of estimates for distributed voting and crowd counting results approaches 100% compared to the real value.