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On the power of cohorts – Multipoint protocols for fast and reliable safety-critical communications in intelligent vehicular networks

Abstract:

We report on recent findings related to safety-critical V2V multipoint communications in ad hoc networks of fully automated vehicles, in the presence of communication failures. Neither classical failure assumptions nor multipoint protocols at the core of existing communication standards can be considered, since they do not meet the high reliability and strict timeliness requirements set for safety-critical scenarios. We introduce a novel unbounded omission failure model, the concept of proxy sets which builds on the cohort construct, and Zebra, a suite of geocast, convergecast, and multicast protocols specifically designed for safety-critical 1-hop multipoint communications. Analytical expressions of worst-case termination time bounds are given for each Zebra protocol, which is mandatory with safety requirements. These results have a number of practical and theoretical implications, which will be discussed.

Short Bio:



Dr. Gerard Le Lann holds French degrees, a M.S. in Applied Mathematics, an Engineering Degree in Computer Science (both from the University of Toulouse) and a Ph.D in Computer Science (University of Rennes). He started his career at CERN, Geneva (Switzerland), and joined IRIA (now INRIA) in 1972. His main areas of research are distributed dependable computing and networking, real-time computing and networking, proof-based system engineering and, more recently, mobile wireless safety-critical cyber-physical systems and networks. At Stanford University (1973-74), working with Professor Vint Cerf, he was involved in the design of what became known as the Internet TCP/IP protocol. In 1977, he published one of the founding papers on distributed fault-tolerant computing. In the early 80's, he published innovative results on non blocking concurrency control in distributed databases, which work was eventually supported by Digital Equipment Corp. In the mid 80's, he co-patented a deterministic version of the Ethernet protocol, which became a French Navy standard. More recently, he has published papers on safety-critical time bounded communications in intelligent vehicular networks, and has started work on cyber-energy transition. In 2012, G. Le Lann has received the Willis Lamb Prize from the French Academy of Sciences for his work applicable to defense systems.

Besides its current affiliation with INRIA as Emeritus Research Director, G. Le Lann is an international consultant. He has conducted a number of audits and managed more than 50 contracts in his research areas, for US, European, and French organizations and companies.