A general Framework for the design and the real time performance analysis of an industrial embedded network

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PROBLEM STATEMENT

With the continuous development in automotive and aeronautic industries, like development of self driving vehicles and AFDX network in airplanes, there are more **time constraints in the networks**. **Switched Ethernet** technology is a promising candidate that provides **large bandwidth** of data transmission at lower cost.

Quality-of-Service (QoS) mechanism is used for **efficient use of bandwidth**: the available bandwidth is shared between traffic classes (critical & non-critical) based on scheduling policies like FIFO, DRR, WRR & FP etc.

Worst-case traversal time (WCTT) analysis to obtain guaranteed bounds is mandatory for **certification**.

Objective: Develop a general framework for real-time performance analysis of industrial embedded Ethernet network using various schedulers.

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SWITCHED ETHERNET NETWORK

Advantages :
* Large bandwidth : up to 100 Mbps
* Availability of off-the-shelf components = Low cost
* Reduced wire complexity & weight
* High reliability

Disadvantages :
* Indeterminism at switch level
* Congestion
* Latency
* Jitter

AFDX Network

Contributions

SIES 2017

Evaluation of upper bound on pessimism in Network Calculus in the analysis of an AFDX network with FP/FIFO. Evaluation show that the NC approach introduces pessimism of about 10%.

ETFA 2018, RTNS 2018 & RTSS 2018

Integration of offset in Network Calculus in analysis of an AFDX network with Round Robin Schedulers. Offset integration show reduction of pessimism in the NC approach by 27%.

Optimization of Network Calculus Service Curve in analysis of an AFDX network with Round Robin Schedulers. Optimization result in reduction of pessimism up to 48%.

Bandwidth sharing among traffic classes (critical & non-critical) through Deficit Round Robin (DRR) and Weighted Round Robin (WRR) Scheduler. DRR shows better performance for heterogeneous flows.
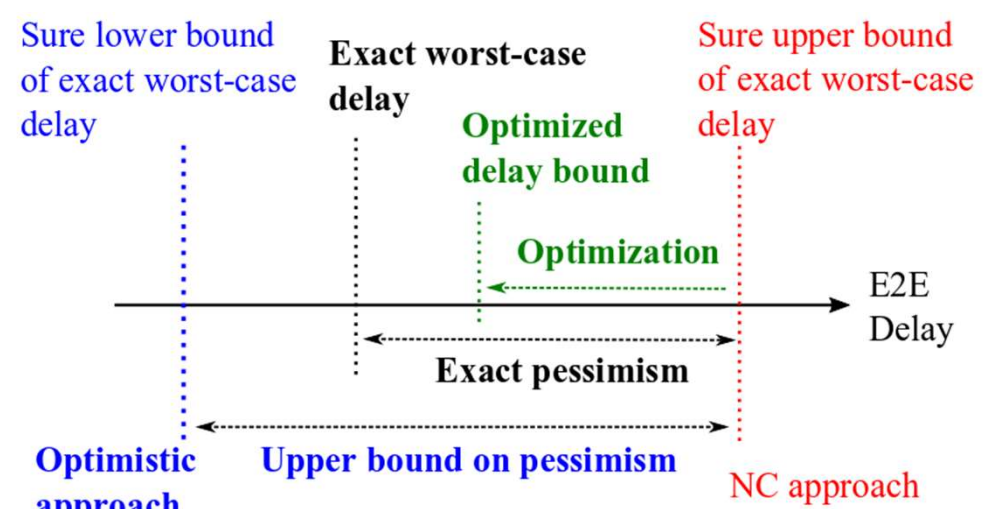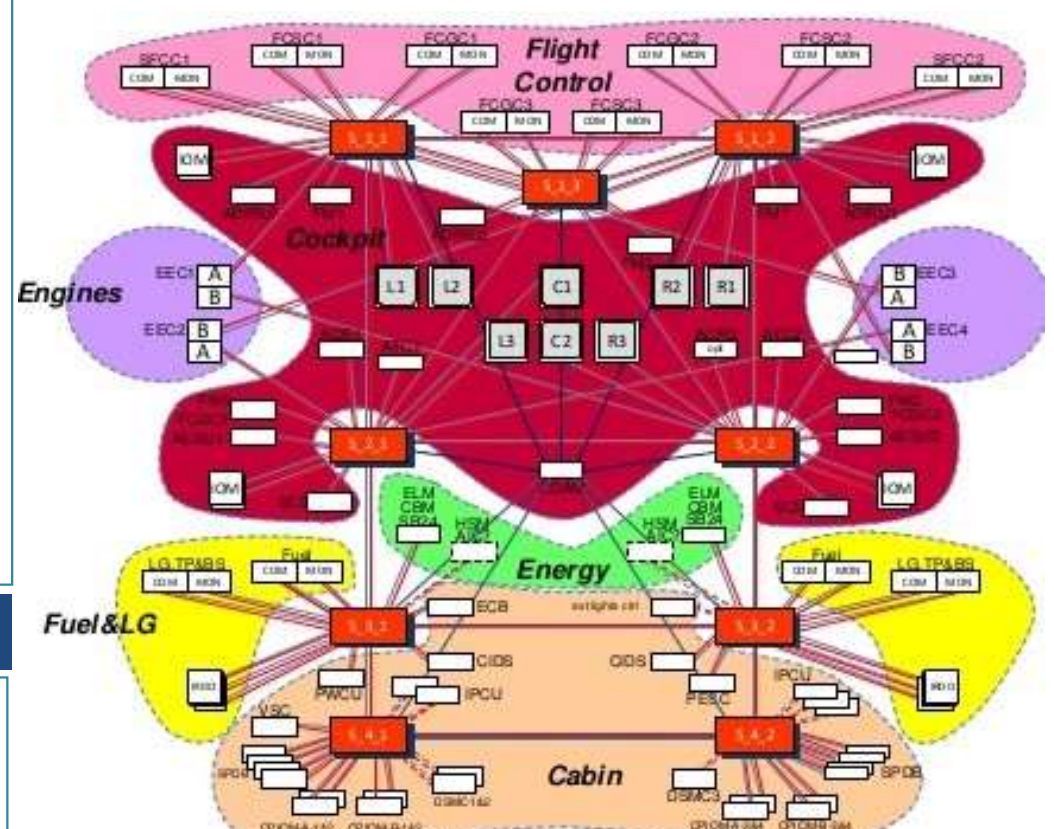
PERSPECTIVE

* Exact Worst-Case Delay analysis using Model Checking approach.