FF-DBF-WIN: On the Forced-Forward Demand-Bound Function Analysis for Wireless Industrial Networks

CISTER – Research Centre in
Real-Time & Embedded Computing Systems

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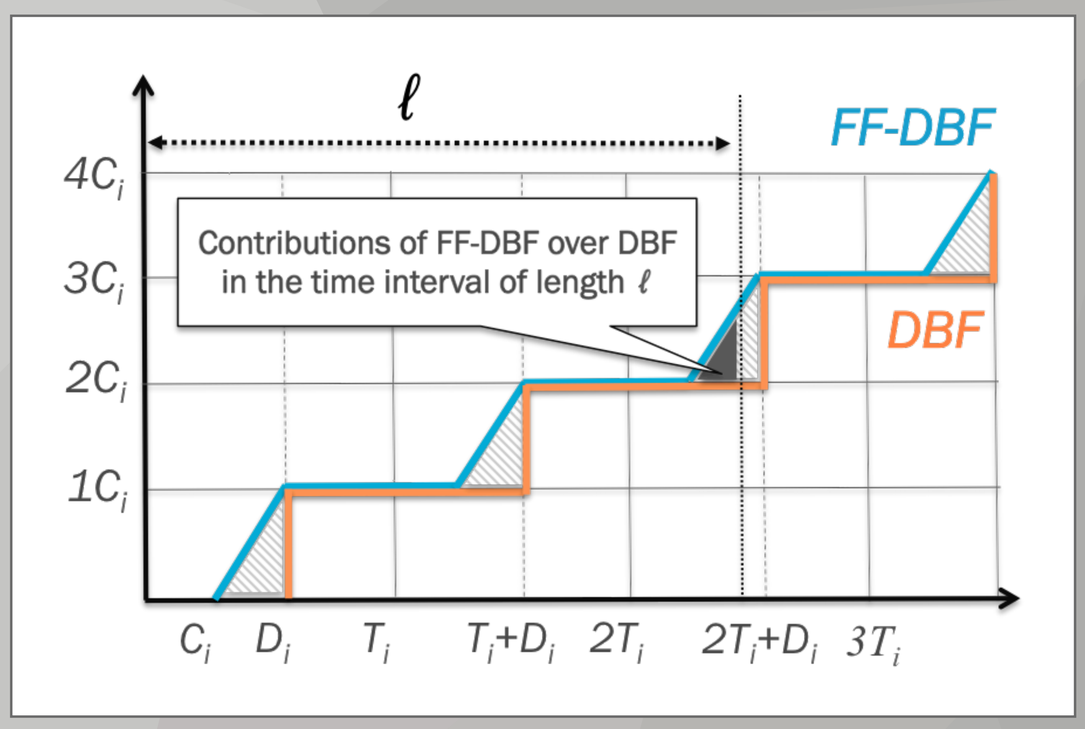
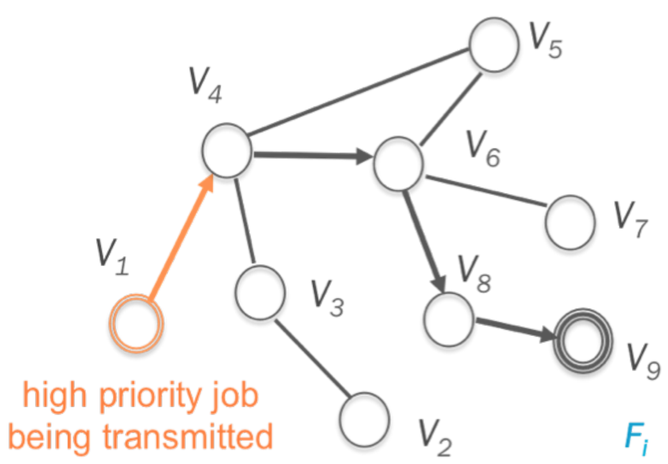
Motivation

- Industry 4.0, Cyber-Physical Systems and IoT have emphasize the need of real-time guarantees in Wireless Industrial Networks (WINs) [1][2].
- Xia et al. [3] recently propose DBF-based supply/demand analyses to estimate schedulability of network flows in WINs.
- However, DBF [4] concept do not consider all flows that can potentially contribute to network demand.

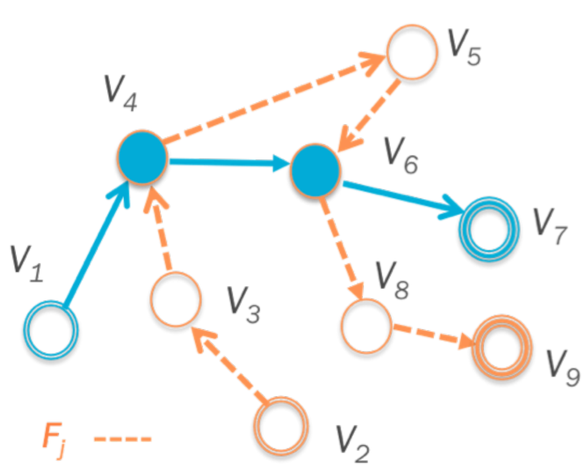


State-of-the-Art

Channel Contention



Transmission Conflicts



Supply/Demand-Bound Function Analyses

DBF

$$\sum_{F_i \in F} \mathrm{DBF}(F_i, \ell) \le \mathrm{sbf}(\ell), \ \forall \ell \ge 0$$

FF-DBF

Proposed Approach

Network Model

$$G = (V, E, m)$$

$$F_i = \langle C_i, D_i, T_i, \Phi_i \rangle$$

$$\text{FF-DBF}(\ell) = \underbrace{\frac{1}{m}\sum_{i=1}^{n} \text{FF-DBF}(F_i, \ell)}_{\text{refined channel contention estimation by using FF-DBF}} + \underbrace{\sum_{i,j=1}^{n} \Delta(ij) \max\left\{\left\lceil \frac{\ell}{T_i} \right\rceil, \left\lceil \frac{\ell}{T_j} \right\rceil\right\}}_{\text{same transmission conflicts estimation}}$$

Conclusions

- By revisiting equations in [3], we proposed the FF-DBF as a refinement of the DBF to characterize the network demand and better determine the wireless network schedulability.
- We believe our equation is a more accurate upper-bound estimation of network demand thus it will outperforms the schedulability analysis proposed by Xia et al. [3].
- Future works will seek to formally demonstrate our claims and conduct simulation experiments to validate the efficiency of the proposed approach.

References

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