



Scheduling, Mapping and Communication Synthesis for Distributed Real-Time Systems

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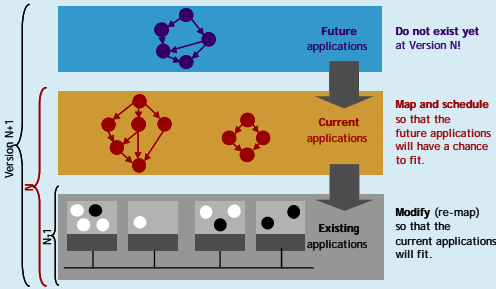
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Minimizing System Modification in an Incremental Design Approach

Paul Pop, Petru Eles, Traian Pop, Zebo Peng

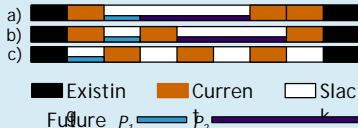
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Incremental Design

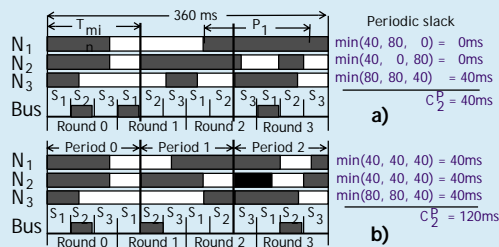


- Start from an already existing system with applications
- Implement new functionality on this system Mapping and Scheduling
- To reduce design and testing time: As few as possible modifications of the existing applications
- After the new functionality has been implemented: It should be easy to add functionality in the future

Design Criteria



- First criterion: C_1^P, C_1^m** How well the resulted slack sizes accommodate a future application



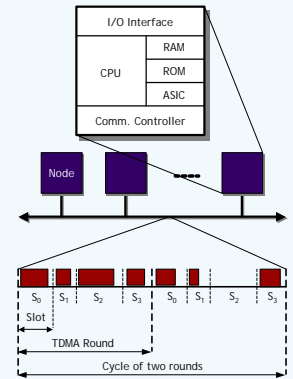
- Second criterion: C_2^P, C_2^m** How well the slack is distributed in time to accommodate T_{min} , t_{need} and b_{need}

Paul Pop, Petru Eles, Traian Pop, Zebo Peng:

An approach to Incremental Design of Distributed Embedded Systems, Design Automation Conference, 2001

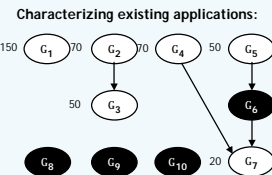
Summary

- Mapping and scheduling of distributed embedded systems for hard-real time applications
 - Static cyclic scheduling of processes and messages,
 - Bus access scheme: time-division multiple-access.
- Incremental design process
 - Already existing system,
 - Implement new functionality,
 - a) Existing system modified as little as possible,
 - b) new functionality can be easily added to the system.
- Mapping strategy
 - a) Subset selection to minimize modification time,
 - b) Two design criteria, objective function.



Problem Formulation

- Input**
 - A set of *existing* applications.
 - A *current* application to be mapped.
 - The system architecture.
- Output**
 - A **mapping and scheduling of the *current* application**, so that the incremental design requirements are satisfied.
- Requirements**
 - a) constraints of the *current* application are satisfied and minimal modifications are performed to the *existing* applications.
 - b) new *future* applications can be mapped on the resulted system.



- Characterizing future applications:**
 - Typical WCETs
 - Typical message sizes
 - Smallest expected period T_{min}
 - Expected necessary processor time t_{need}
 - Expected necessary bandwidth b_{need}

Mapping Strategy

- Initial mapping and scheduling
- Requirement a) **Subset selection problem** Select that subset Ω of existing applications so that the current application fits and the modification cost $R(\Omega)$ is minimized:

$$R(\Omega) = \sum_{i \in \Omega} R_i$$

Three approaches to the subset selection problem

- Exhaustive Search (ES)
- Ad-Hoc Solution (AH)
- Subset Selection Heuristic (SH)

- Requirement b) Objective function minimization:

$$C = w_1^P (C_1^P) + w_1^m (C_1^m) + w_2^P \max(0, t_{need} - C_2^P) + w_2^m \max(0, b_{need} - C_2^m)$$

