SCHEDULABILITY ANALYSIS OF THE LINUX PUSH & PULL SCHEDULER WITH ARBITRARY PROCESSOR AFFINITIES

Arpan Gujarati, Felipe Cerqueira, Björn Brandenburg
Max Planck Institute for Software Systems, Germany (Kaiserslautern - Saarbrücken)

1 Multiprocessor Real-Time Scheduling

THEORY

Schedulability analysis  No deadline misses!

State-of-the-art analyses exist for the following scheduling algorithms:

Global scheduling (unrestricted migrations)

1 2 3 4

Partitioned scheduling (no migration)

1 2 3 4

Clustered scheduling (restricted migrations)

~ generalizes global and partitioned scheduling

1 2

3 4

2 Meanwhile Real-Time Systems in PRACTICE…

CPU affinity interface in Linux

int sched_setaffinity(pid_t pid, size_t cpu_setsize, cpu_set_t *mask);

int sched_getaffinity(pid_t pid, size_t cpu_setsize, cpu_set_t *mask);

Arbitrary Processor Affinities (APA)

Overlapping clusters

~ Flexible task migrations

~ Example APA scheduler: Linux push & pull scheduler

3 This work addresses the following QUESTIONS

How can we derive schedulability guarantees for APA schedulers?

Does APA scheduling have interesting theoretical implications?

4 New Approach to Schedulability ANALYSIS

Schedulability guarantees for APA schedulers:

APA scheduling problem  reduction  “global-like” subproblems

At least one subproblem should be schedulable using any global schedulability analysis

Exponential number of subproblems — we also propose a fast and accurate heuristic

Theoretical implications:

APA scheduling strictly dominates global, partitioned, and clustered scheduling for job-level fixed priority (JLFP) policies

5 CONTRIBUTIONS

We are the first to propose an analysis for the APA scheduling problem

Our heuristic-based analysis is almost as good as exhaustive analysis