Precise Scheduling Mixed-Criticality Gang Tasks with Reserved Processors

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 Parallel Workload Model



• Energy-efficient computing



• Faster computing

These figure are adopted from Guo et. al. ECRTS' 17 paper and presentation.

- Parallel Workload Models
 - o fork-join model
 - \circ DAG model
 - $\circ \quad \text{gang model} \quad$

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• Traditional gang task model

$$\begin{array}{c}
\tau_{1} = (1,3,5) \\
\tau_{2} = (5,2,8) \\
\tau_{3} = (2,3,10) \\
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\tau_{4} \\
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\tau_{4} \\
\tau_{5} = (2,3,10) \\
\tau_{5} = (2$$

• Traditional gang task model

$$\tau_i = (\mathbf{c}, m, \mathbf{T})$$















$$\tau_i = (\mathbf{c}_{\mathbf{h}}, \mathbf{c}_{\mathbf{h}}, m, T, \mathbf{x})$$

 $\tau_1 = (1,2,3,5,HI)$ $\tau_2 = (5,5,2,8,LO)$ $\tau_3 = (2,6,3,10,HI)$



$$\tau_i = (c_{\rm h}, c_{\rm h}, m, T, x)$$





$$\tau_i = (c_l, c_h, m, T, x)$$





GEDF-VD

• At LO-criticality mode, set a virtual deadline (VD) to all the HI-criticality tasks.

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P₁ 0 1 3 5 6 7 9 10 11 15 18

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- **Precise MC-Gang:** No-jobs are dropped in H-Mode
 - In L-Mode, tasks execute only on M^L processors
 - Out of *H* processors, only (at max) *L* processors can be used in L-mode
 - In H-Mode, tasks may execute on all M^H processors

Schedulability Test (Utilization)

 Lemma 1: Under GEDF-VD scheduling, all (LO- and HI-) tasks must meet their virtual deadlines in L-mode, if

$$\forall i, x \geq \frac{m_i U^L + \left(M^L - \Delta_i^L - m_i\right) u_i^L}{m_i \left(M^L - \Delta_i^L\right)}$$

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Schedulabilty Test (Utilization)

 Lemma 2: Under GEDF-VD scheduling, assuming all virtual deadlines are met in L-mode, all (LO- and HI-) tasks must meet their actual deadlines in H-mode, if

$$\forall i, x \leq 1 - \frac{m_i U^H + (M^H - \Delta_i^H - m_i)u_i^H}{m_i (M^H - \Delta_i^H)}$$

Schedulabilty Test (Utilization)

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Thank You