PPW with Dark Silicon and Thermal Model

I. NEW METHOD

In the coming many-core era, due to the tight power budget, power efficiency is cricital for many-core processor design. In the previous work by Dong Hyuk Woo, evaluation of energy efficiency on the basis of performance and power (PPW) models is developed, which shows the tendency of PPW with number of cores. We implement the dark silicon and thermal model into evaluation of PPW to gain a better understanding of PPW in the dark silicon era. Different from previous work, the performance of the many-core processor is expressed with the summary of operating frequency of all cores:

$$Perf = \sum_{i=1}^{n} f_i \tag{1}$$

However, the $Perf$ is not able to take into account of fraction of computation that can be parallelized, it should be replaced in further versions. The average power consumption of the many-core processor is as follows:

$$W = \frac{P_1 \times (1-f) + P_n \times f/n}{(1-f) + f/n} \tag{2}$$

P_1 is the power consumption during the sequential computation phase, P_n is the power consumption during the parallel computation phase.

$Perf/W$ of a many-core processor is expressed as

$$\frac{Perf}{W} = \sum_{i=1}^{n} f_i \times \frac{(1-f) + f/n}{P_1 \times (1-f) + P_n \times f/n} \tag{3}$$

A. Power consumption of many-core processor

P_1 is consisted of the power consumption of n-1 idle cores and 1 active core. The expression of $P_1 = 1 + (n-1)k$ is not implemented, for the power consumption of idle cores and active core is not consistant, due to the influence of the temperature. Also, P_n is not expressed by $P_n = n$, because of the thermal constraint.

II. CONCLUSION