ASP-DAC'2013 University LSI Design Contest

1D-3

# A Low Power Multimedia Processor Implementing Dynamic Voltage and Frequency Scaling Technique

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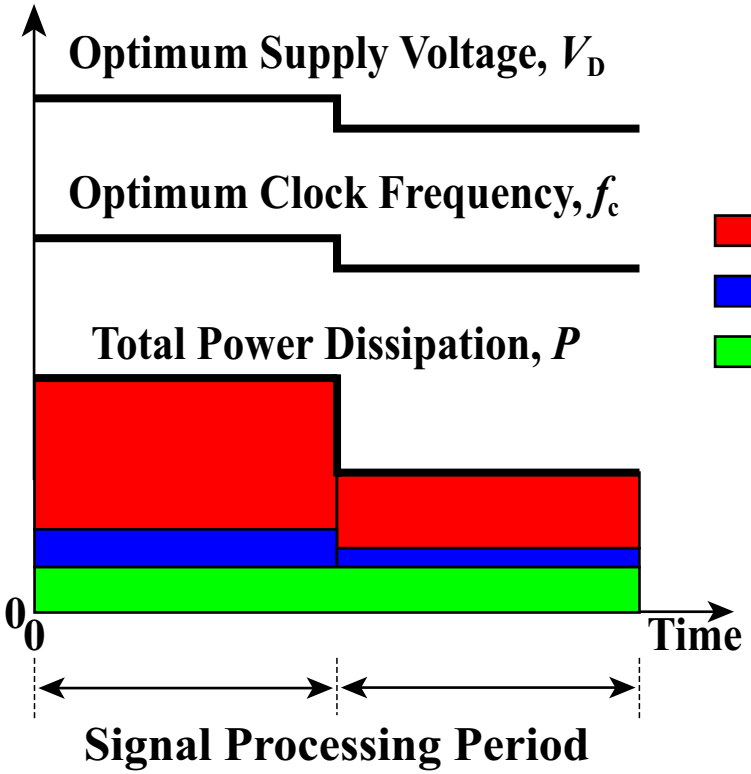
# Dynamic Voltage and Frequency Scaling Technique




: Dynamic $P$

: Static $P$

: Dynamic $P$ of Controller

$$P = V_D^2 f_c \sum_{g=1}^{G} (\alpha_g C_{Lg}), \quad f_c' = \eta f_c, \quad V_D' \propto \eta V_D, \quad \eta < 1$$

$$P' = (V_D')^2 f_c' \sum_{g=1}^{G} (\alpha_g C_{Lg}) = \eta^3 V_D^2 f_c \sum_{g=1}^{G} (\alpha_g C_{Lg}) = \eta^3 P$$

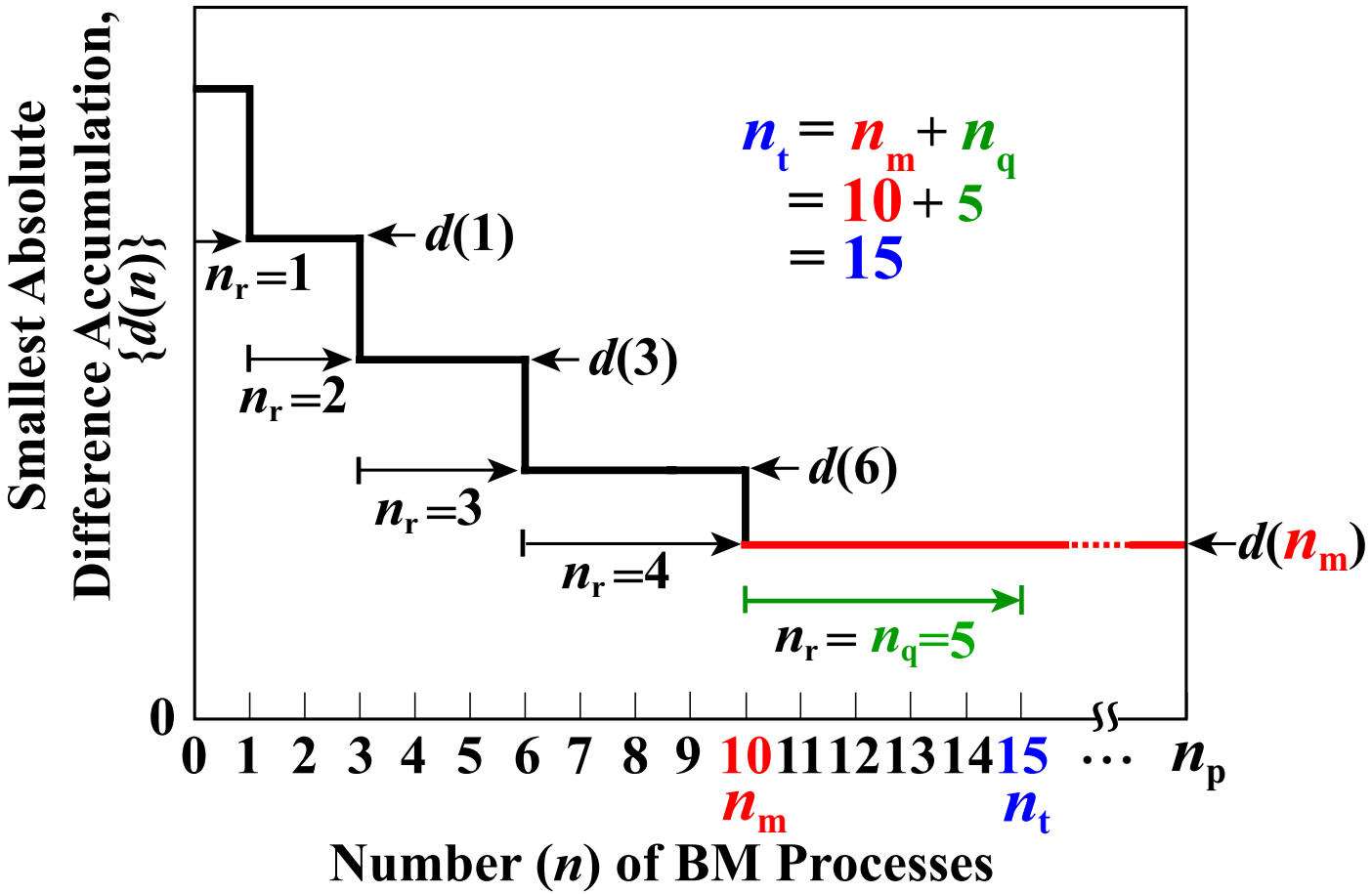
## DVFS Technique:

To supply
optimum supply voltage ($V_D$) &
optimum clock frequency ($f_c$)
to the processor.

## Newly Developed Techniques in implementing the DVFS scheme :

1. Block Motion Estimation (BME) Algorithm
2. DVFS Controller
3. Built-in DC/DC Level Converter
4. PLL Clock Driver

# Adaptively Assigned Breaking-off Condition ($A^2BC$) Block Motion Estimation (BME) Algorithm




**$d(n_m)$:**
Minimum absolute difference accumulation

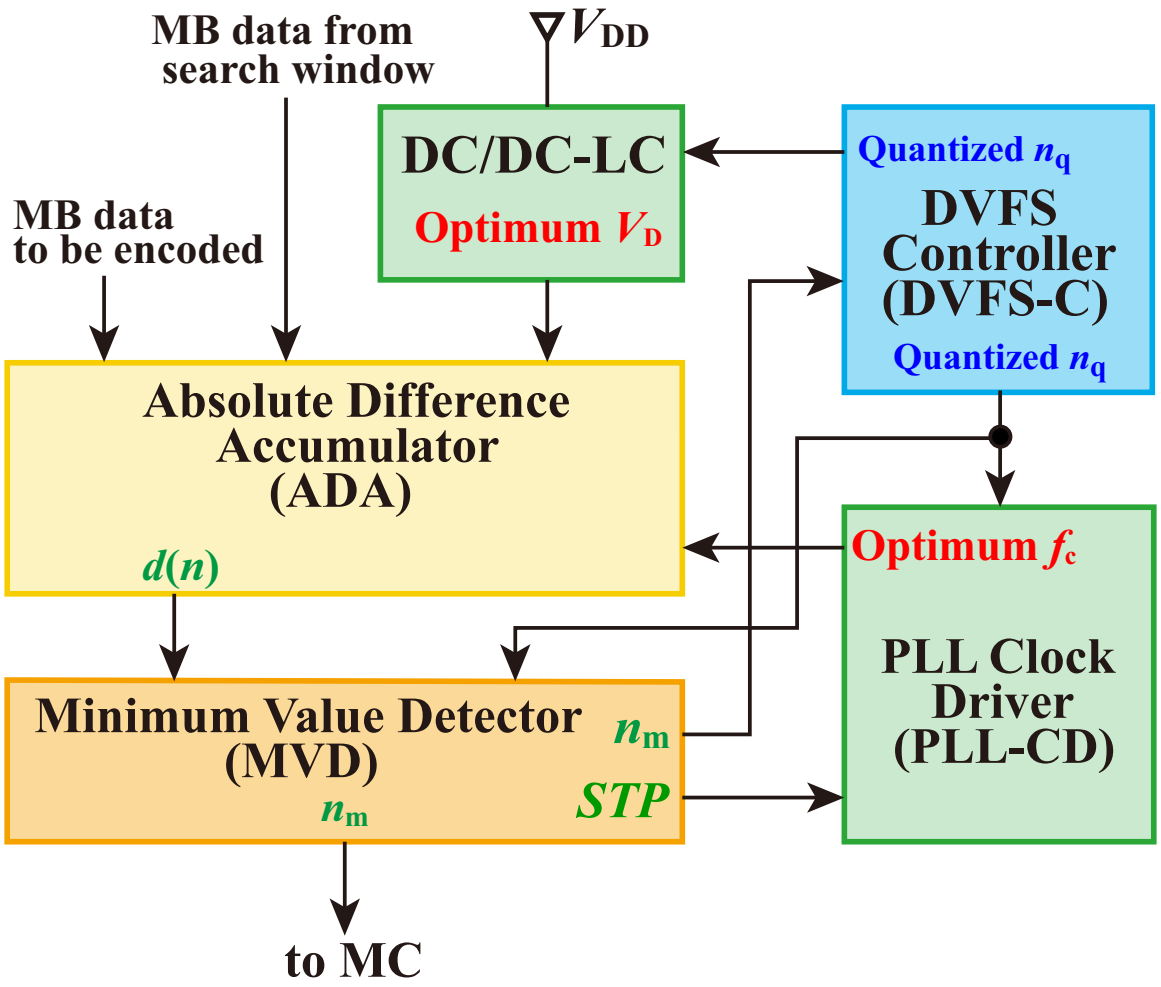
**$n_m$ :**
Number of Block Matching (BM) processes at $d(n_m)$ is found

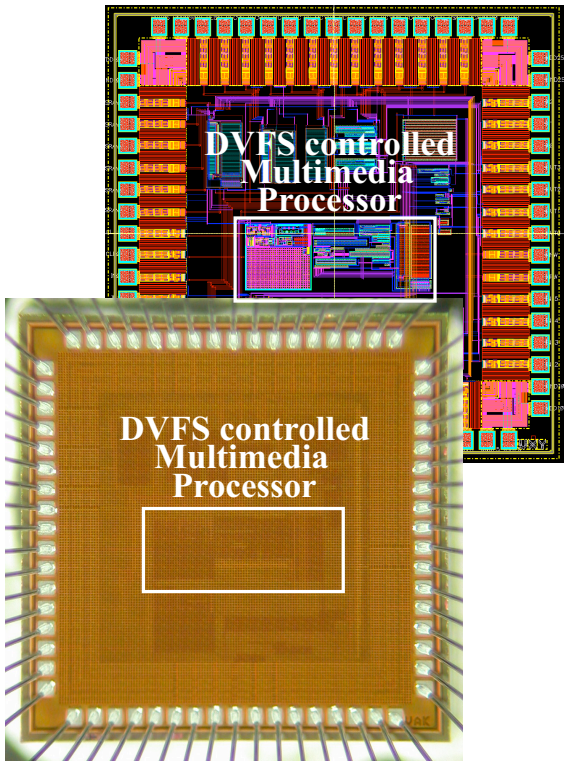
**$n_t$ :**
Total number of BM processes

**$n_r$ :**
Number of BM processes after the value of $d(n)$ decreases

**$n_q$:**
Assigned Number of BM processes

# DVFS Controlled Multimedia Processor




**Chip Size:** 2.5 mm × 2.5 mm

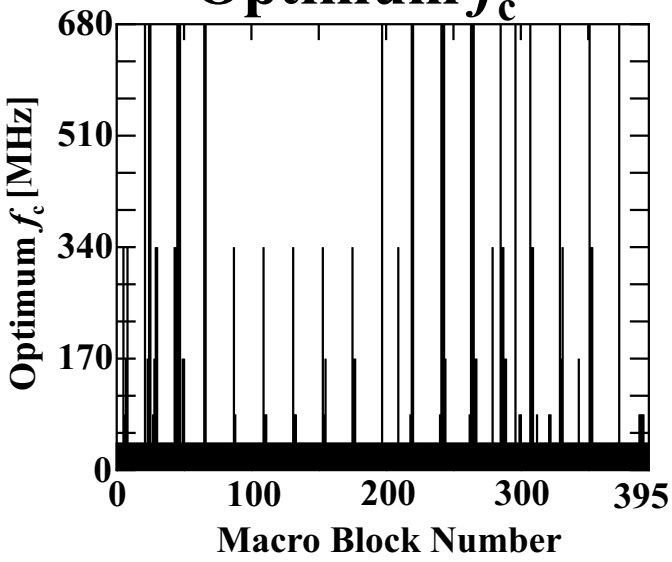
**Si Area:** 970 µm × 330 µm

**No. of MOSFETs:** 50,000

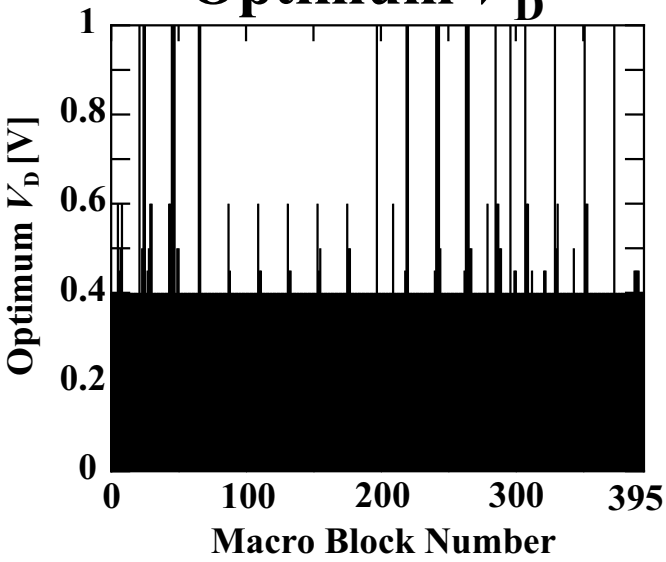
**Clock Frequency:** 680 MHz

# Characteristics of A²BC & DVFS for Each MB

## Optimum $f_c$

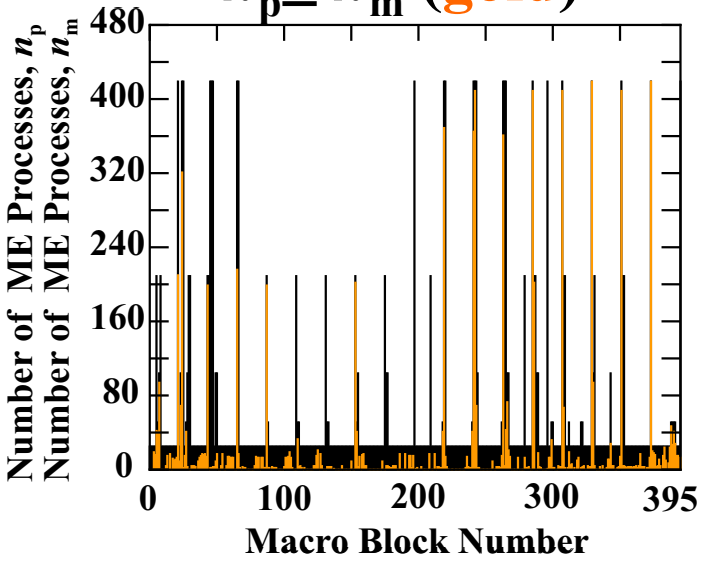



## Optimum $V_D$

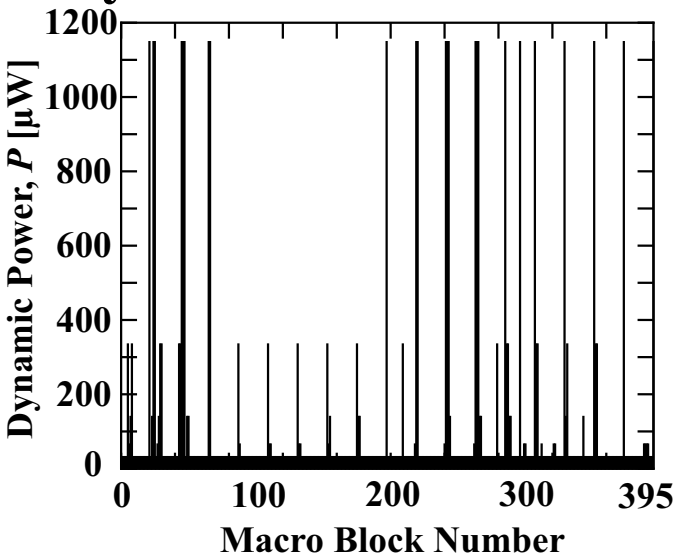



198th Frame of "Foreman"

## $n_p \leq n_m$ (gold)




## Dynamic Powers of ADA



# Power Dissipation of DVFS Multimedia Processors

| | Conventional | DVFS Controlled |
|---|---|---|
| Dynamic Power of ADA [μW] | 1,177.5 | 34.74* ~ 92.50** |
| Dynamic Power of Peripheral Circuits [μW] | 2,628.3 | 2.454*～5.598** |
| Static Power of Peripheral Circuits [μW] | 0 | 1.294*～1.264** |
| Total Power [μW] | 3,805.8 | 38.488* ~ 99.362** |
| Ratio [%] | 100 | 1.011* ~ 2.611** |

($V_{DD}$ = 1 V)

* Akiyo ~ **Foreman