

# **Introductory talk: Future of Nano CMOS Technology:**

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Integrated Circuits Technologies are still very important for Green or power saving!

## 1. Green by Integrated Circuits

Power saving by Microprocessor control for all the human systems

## 2. Green of Integrated Circuits

Power saving of Integrated Circuits by Down Scaling of MOSFETs in PC, Data Center, Router, etc.

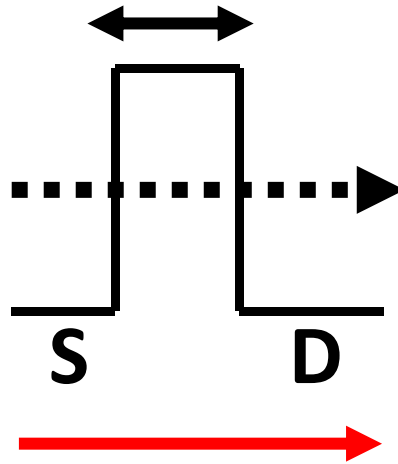
Question:

How far we can go  
with downscaling?

# Predicted limit now

Tunneling distance

3 nm



MOSFET operation

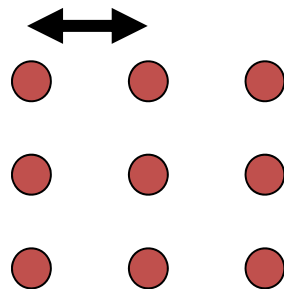
**$L_g = 3 \text{ nm?}$**

Below this,  
no one knows future!

Ultimate  
Limit

Atom  
distance

0.3 nm



# How far can we go?

Past

0.7 times per 3 years In 40 years: 15 generations,  
Size 1/200, Area 1/40,000

1973年



8 $\mu$ m → 6 $\mu$ m → 4 $\mu$ m → 3 $\mu$ m → 2 $\mu$ m → 1.2 $\mu$ m → 0.8 $\mu$ m → 0.5 $\mu$ m

→ 0.35 $\mu$ m → 0.25 $\mu$ m → 180nm → 130nm → 90nm → 65nm → 45nm

Now



Future

→ 32nm → 22nm → 16nm → 11.5 nm → 8nm → 5.5nm? → 4nm? → 2.9 nm?

- At least 5,6 generations, for 15 ~ 20 years
- Hopefully 8 generations, for 30 years

# Today's Discussion

What about the future of nanoelectronic devices?

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Thank you  
for your attention!