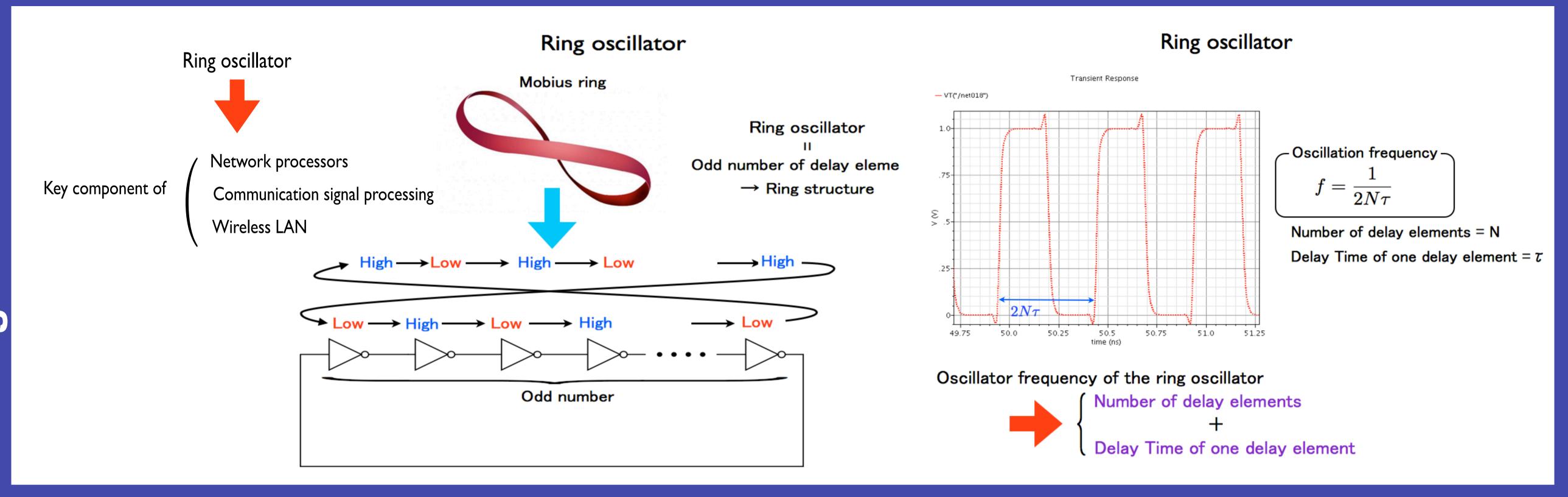
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# Low-Voltage High-Frequency Gate Ring Oscillator Using Bootstrap Technique

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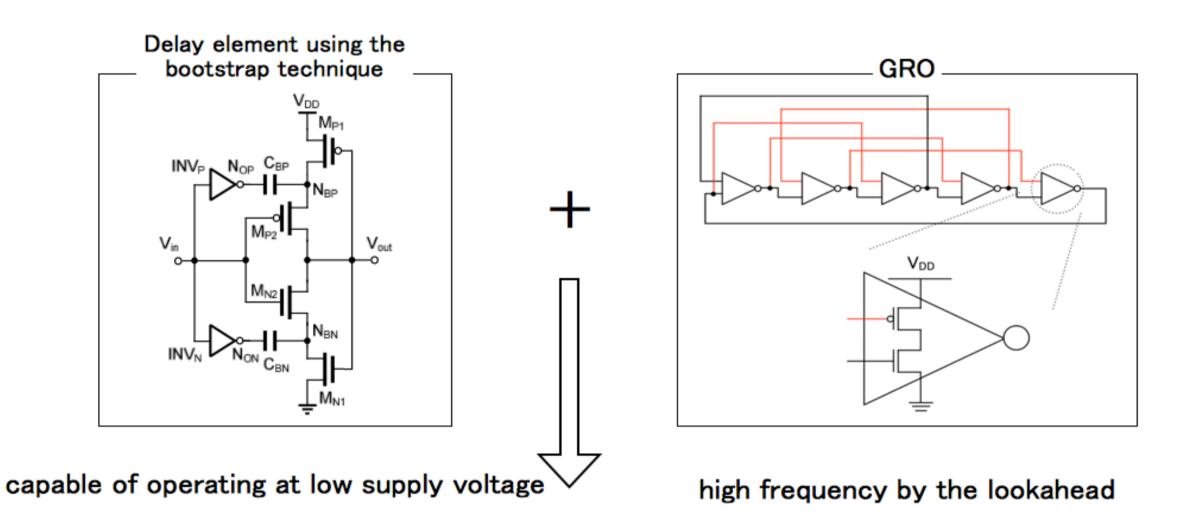


 $\beta \cdot 2V_{DD}$ 

NoP is Low→Switches to High

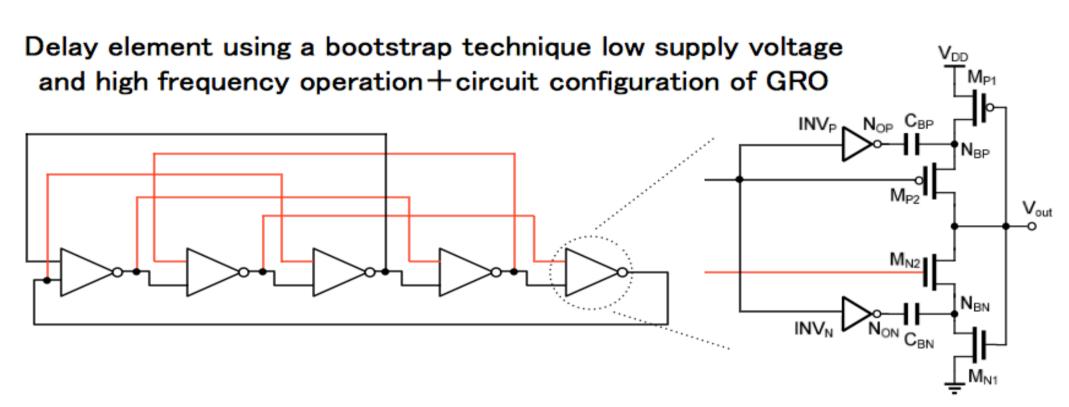
 $V_{DD}$  charge to  $C_{BP}$ 

#### Application of GRO in ring oscillator using the bootstrap technique



Aim of the proposed circuit Low supply voltage and high frequency operation

### Proposed circuit configuration

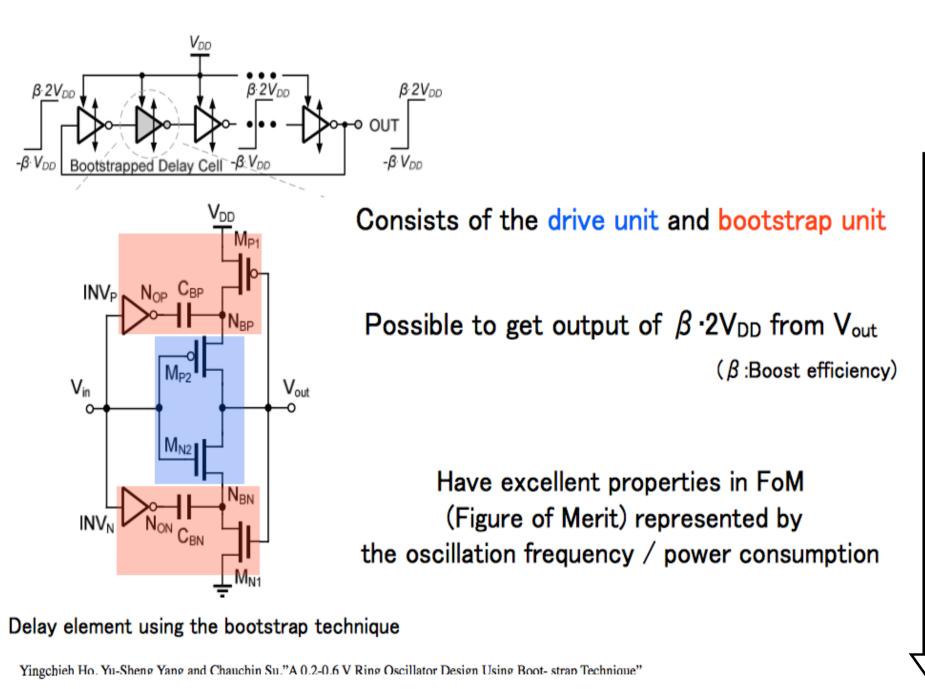


Referred circuit operates at a high frequency because the lookahead signal is used as

Designed both the conventional circuit and the proposed circuit using 65nmCMOS technology and therefore compared their performances

\*Conventional circuit: Ring oscillator using the bootstrap technique \* Proposed circuit: Ring oscillator using the bootstrap technique+GRO

## Ring oscillator using the bootstrap technique



65nm CMOS process used

# V<sub>in</sub> is High V<sub>in</sub> is High→When Vin is switched to Low Simulation results

 $N_{BP}$  is pull up to  $\beta \cdot 2V_{DD}$  by  $N_{OP}$  and  $C_{BP}$ V<sub>in</sub> is ON for the M<sub>P2</sub> is Low  $\beta$  -2V<sub>DD</sub> is supplied to the output

Low output

# GRO(Gated Ring Oscillator) Circuit Configuration of GRO Timing diagram lookahead signal input signal··· High frequency Operation of oscillator for input lookahead signal output signal-Applied to a ring oscillator using the bootstrap technique 1/2Vdd→Vdd

#### Frequency[MHz] FoM[fJ] 1200 **→**提案回路 1000 200 ──従来回路 150 100 50 $V_{DD}(V)$ 0.8 V<sub>DD</sub>(V) Energy per cycle (pJ) \* Figure of merit (FoM) = FoM of the proposed circuit/ FoM of the conventional circuit In the vicinity of 0.6V, confirm the effect 0.88 of the higher frequency by the proposed circuit 0.84 0.82 •In FoM, verify the improvement of 12% to 14% by using the proposed configuration 8.0 0.8 V<sub>DD</sub>(V) 0.2

# Summary

### Conclusion

 $_{ extsf{-}}$  GRO applied to the oscillator using the bootstrap technique  $_{ extsf{-}}$ 

- Applying GRO to perform high-frequency operation in the lookahead to ring oscillator using a bootstrap technique for low supply voltage operation
- Check the operation in high frequency in the vicinity of 0.6 V
- Ensure improvement of 12% to 14% FoM represented by the power consumption/oscillation frequency

 $\frac{\text{Power }(\mu \text{W})}{\text{Freq. (MHz)}} = \text{Energy per cycle (pJ)}$ \* Figure of merit (FoM) =