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NPTEL ONLINE CERTIFICATION COURSE

VLSI Physical Design with Timing Analysis

Lecture – 16: STA considering OCV and CRPR (Hold check)

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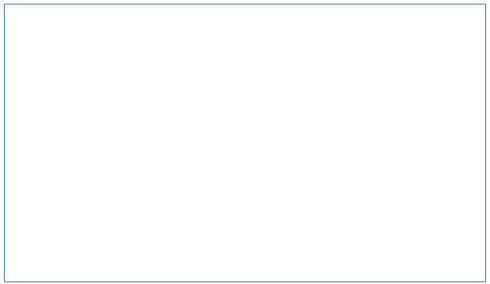
Contents

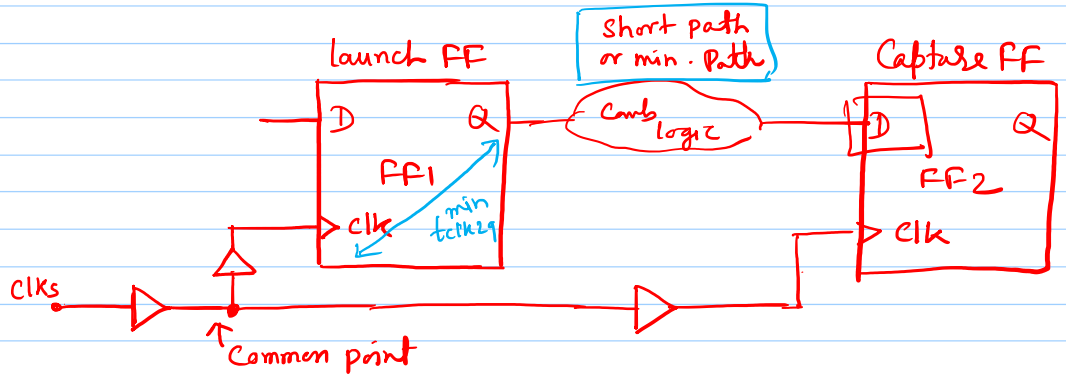
- Launch FF and Capture FF
- Min. timing analysis (hold check) without variation
- Min. timing analysis (hold check) with on-chip variation (OCV)
- Min. timing analysis (hold check) with OCV + CRPR



STA (Minimum Timing Analysis)

⇓

Hold Check



For Hold check

Data arrival time (DAT) = launch Clock Path + Min Data Path

$t_{clk2q}^{min} + t_{comb}^{min}$

Data Required time (DRT) = Capture Clock Path + t_{hold}

For Hold check : Data arrival time ≥ Data Required time

Slack = Data arrival time − Data Required time

Case I : Slack is +ve ⇒ DAT > DRT ⇒ No hold violation

Case II : Slack is -ve ⇒ DAT < DRT ⇒ hold violation

Special Case! (No buffer in the clk trace)

launch Clk Path = 0

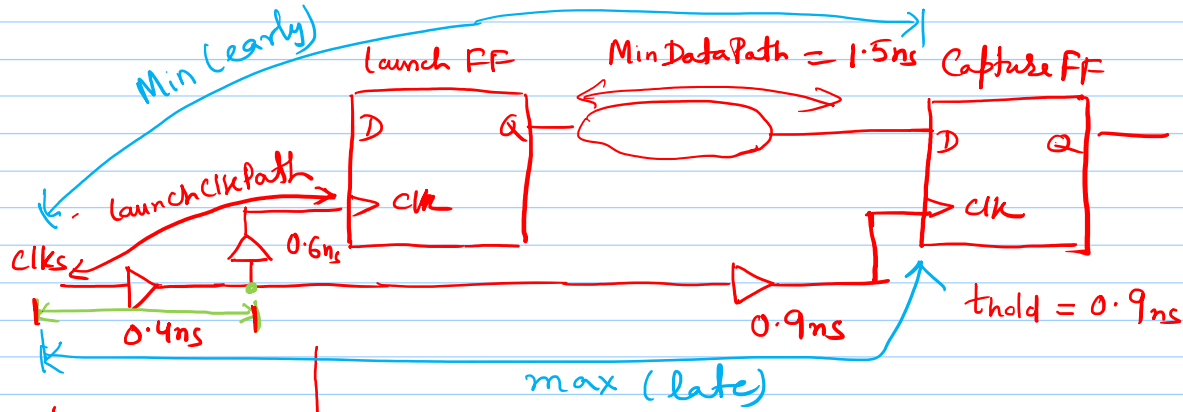
Capture Clk Path = 0

D.A.T. $\geq$ D.R.T.

Min Data Path $\geq$ t_{hold}

$\Rightarrow$ $t_{clk2q}^{min} + t_{comb}^{min} \geq t_{hold}$

Ex: 1



Case I (without variation)

Launch Clk Path = 0.4 + 0.6 = 1ns

Min Data Path = 1.5 ns

Capture Clock Path = 0.4 + 0.9 = 1.3ns

thold = 0.9ns

DAT = 1n + 1.5 ns = 2.5ns

DRT = 1.3ns + 0.9ns = 2.2ns

Slack = DAT − DRT = 2.5 − 2.2 = 0.3ns

Slack is +ve

hold requirement is met

Case II (with OCV) — local variation inside the same die

set_timing_derate -early 0.85

set_timing_derate -late 1.1

set_timing_derate -early 0.9 -cell_check (thold)

Launch Clk Path = 1ns × 0.85 = 0.85ns

Min Data Path = 1.5ns × 0.85 = 1.275ns] early

Capture Clk Path = 1.3ns × 1.1 = 1.43ns] late

DAT = 2.125ns ; DRT = 2.24ns

Slack = DAT − DRT = −0.115ns

Slack is −ve ⇒ hold violation.

Case III (with OCV + CRPR)

$CPP = 0.4 \times 1.1 - 0.4 \times 0.85 = 0.1\text{ns}$

$Slack = -0.115 + \underbrace{CPP}_{0.1\text{ns}} = -0.015$

$= -15\text{ps}$

Hold violation exists

⇓

Buffer insertion in the Datapath

Note! Hold check is independent of the time period of the clk.

$Slack = DAT - DRT$

Case II (OCV)

$Slack(OCV) = DAT - DRT$

Case III (OCV + CRPR)

$Slack(OCV + CRPR) = DAT - DRT + CPP$

$= (DAT + CPP) - DRT$

Thank You