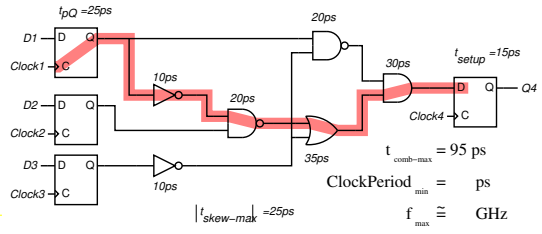
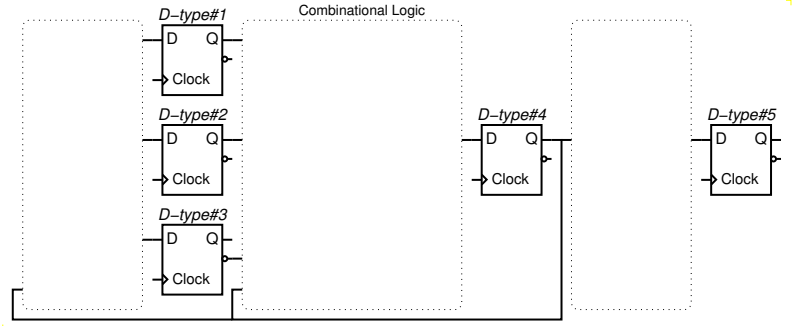


- What is the maximum operating frequency of the circuit if the clock skew is no more than 25ps?
- What is the maximum clock skew that can be tolerated before we have a potential hold violation?

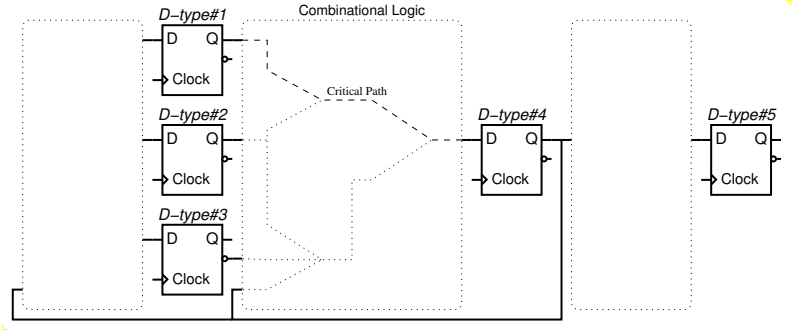
Critical Path



- To avoid a setup violation:

$$ClockPeriod > t_{pQ} + t_{critical\_path} + t_{setup} + t_{skew}$$

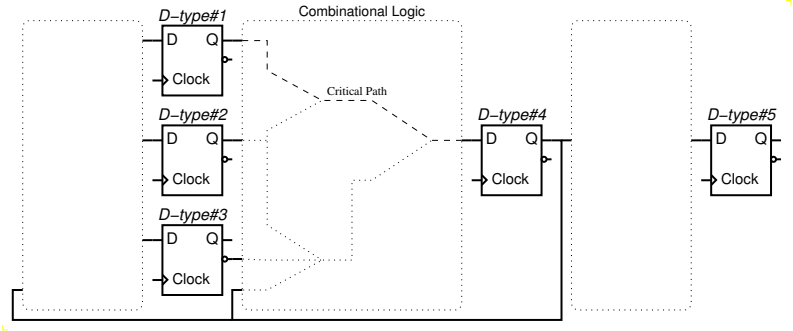
Critical Path



- To avoid a setup violation:

$$ClockPeriod > t_{pQ} + t_{critical\_path} + t_{setup} + (t_{d1} - t_{d4})$$

Critical Path

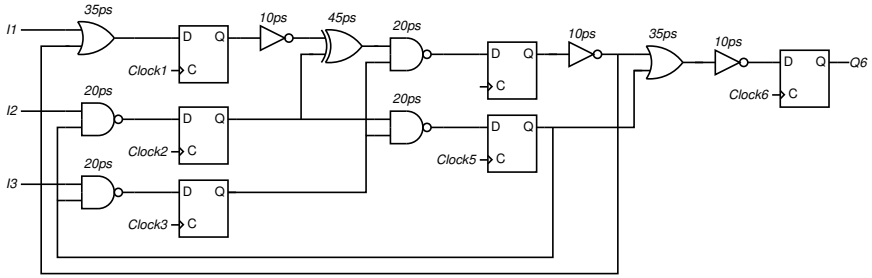


$$ClockPeriod > t_{pQ} + t_{critical\_path} + t_{setup} + (t_{d1} - t_{d4})$$

- If we can control the skew (e.g. by increasing t_{d4}), we can ease the timing constraint.[1]

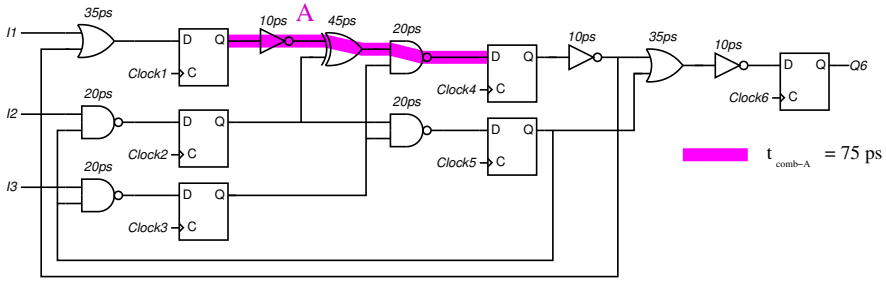
[1] this may result in the critical path moving to another part of the circuit

Synchronous Systems - Static Timing Analysis (inc. clock skew)



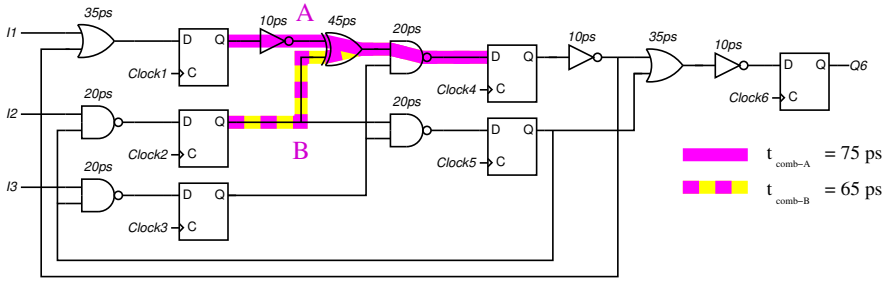
- Identify longest combinational paths

Synchronous Systems - Static Timing Analysis (inc. clock skew)



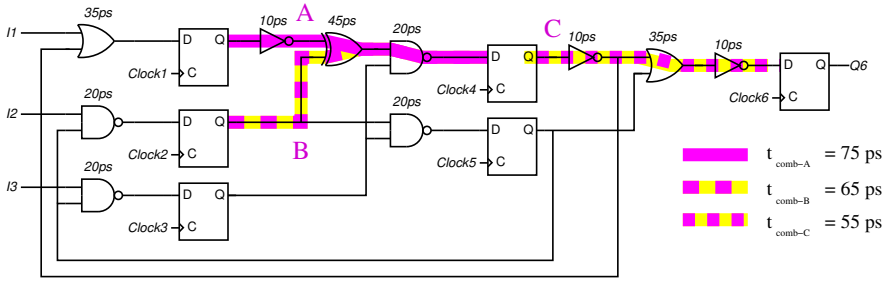
- Identify longest combinational paths

Synchronous Systems - Static Timing Analysis (inc. clock skew)



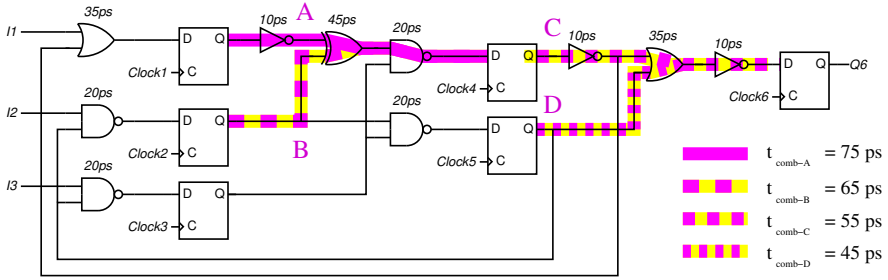
- Identify longest combinational paths

Synchronous Systems - Static Timing Analysis (inc. clock skew)



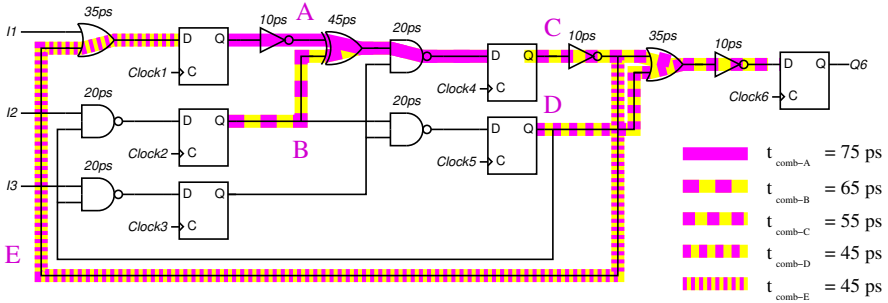
- Identify longest combinational paths

Synchronous Systems - Static Timing Analysis (inc. clock skew)



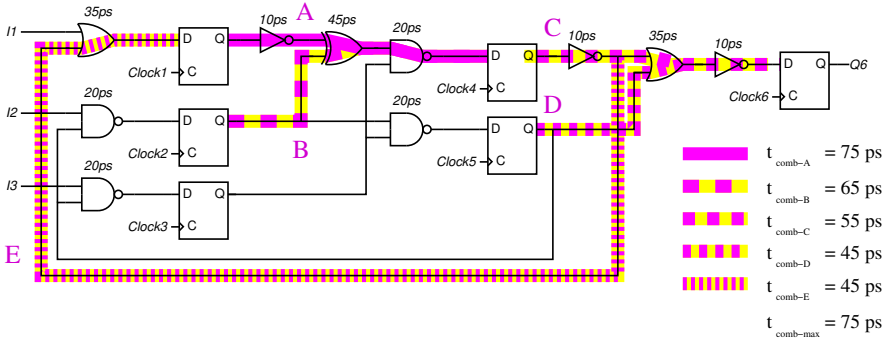
- Identify longest combinational paths

Synchronous Systems - Static Timing Analysis (inc. clock skew)



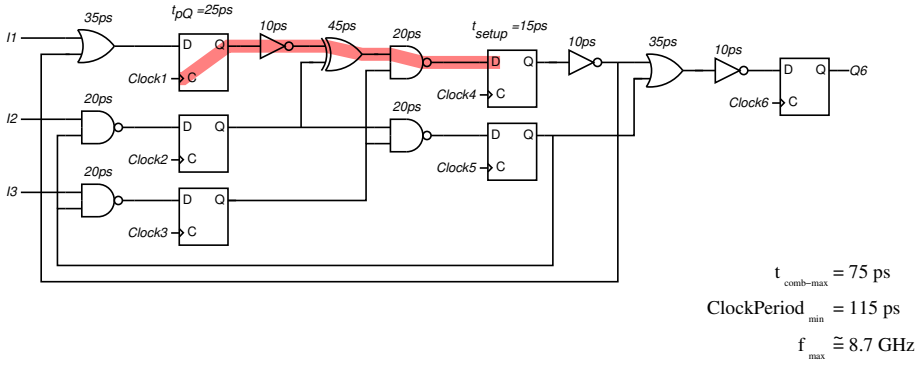
- Identify longest combinational paths

Synchronous Systems - Static Timing Analysis (inc. clock skew)



- Identify longest combinational paths

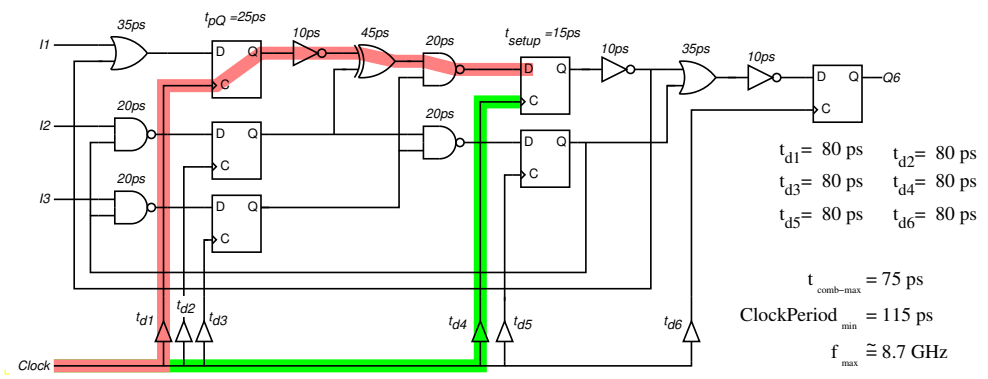
Synchronous Systems - Static Timing Analysis (inc. clock skew)



$$ClockPeriod > t_{pQ} + t_{comb-max} + t_{setup} + (t_{d1} - t_{d4})$$

$$f_{max} = \frac{1}{t_{pQ} + t_{comb-max} + t_{setup} + (t_{d1} - t_{d4})}$$

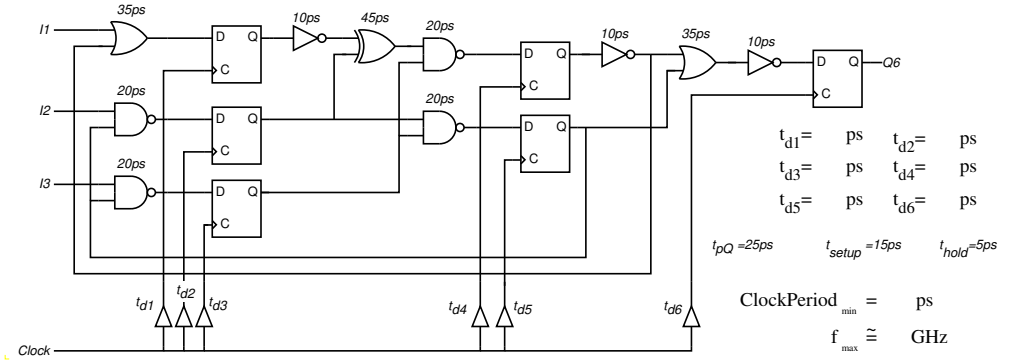
Synchronous Systems - Static Timing Analysis (inc. clock skew)



$$ClockPeriod > t_{pQ} + t_{comb-max} + t_{setup} + (t_{d1} - t_{d4})$$

$$f_{max} = \frac{1}{t_{pQ} + t_{comb-max} + t_{setup} + (t_{d1} - t_{d4})}$$

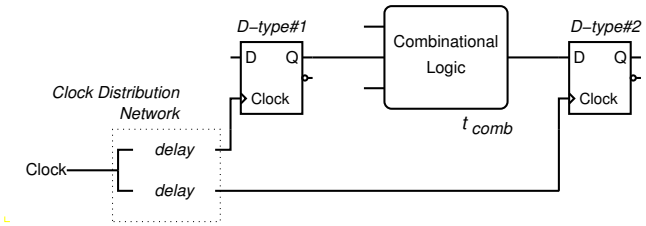
Synchronous Systems - Static Timing Analysis (inc. clock skew)



$$ClockPeriod > t_{pQ} + t_{comb-crit} + t_{setup} + (t_{ds} - t_{dd})$$

$$f_{max} = \frac{1}{t_{pQ} + t_{comb-crit} + t_{setup} + (t_{ds} - t_{dd})}$$

Synchronous Systems - Jitter



- Jitter
  Jitter is the cycle-by-cycle variation in the arrival time of the clock.
- Caused by
  - Variation in frequency/phase of clock source[2]
  - Power supply noise affecting clock distribution
  - Cross-talk affecting clock distribution
- Jitter may cause unexpected timing violations

[2] primary clock source or Phase-Locked Loop (PLL)