

# **Synchronous and Asynchronous Circuits**

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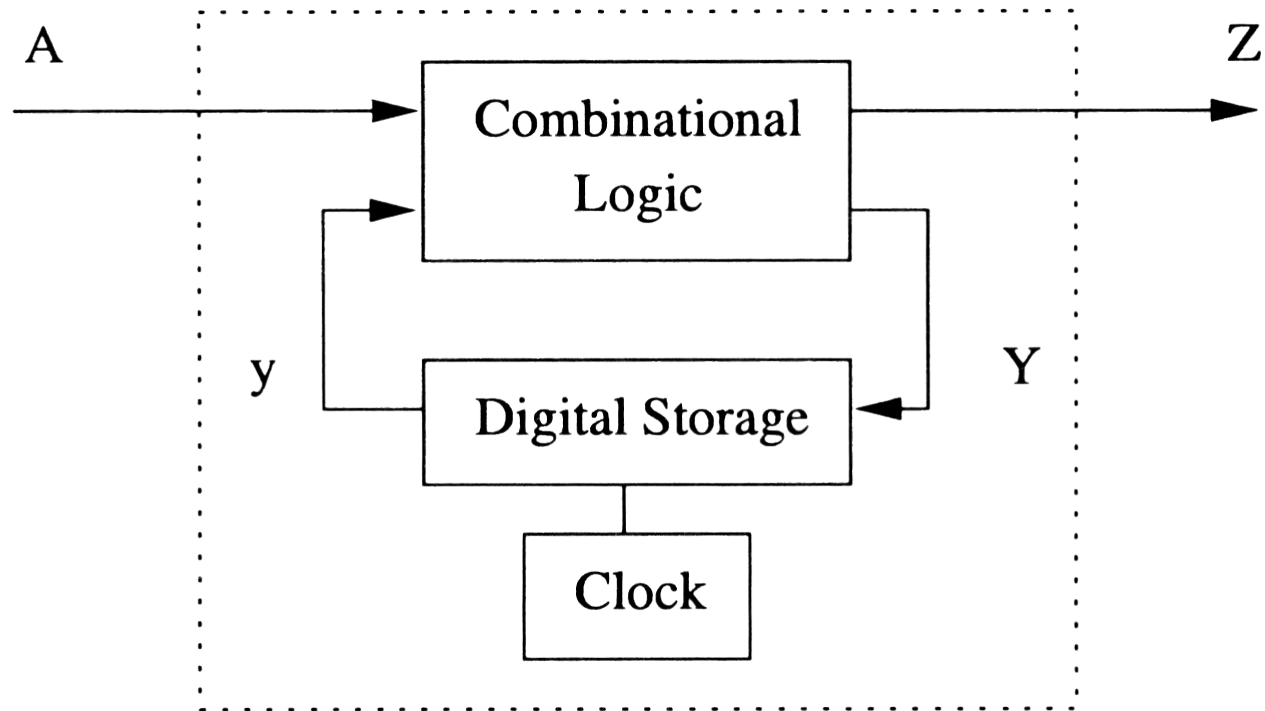
Kevin Yu

# Overview

- Introduction
- Applications
- Advantages/Disadvantages
- Optimization

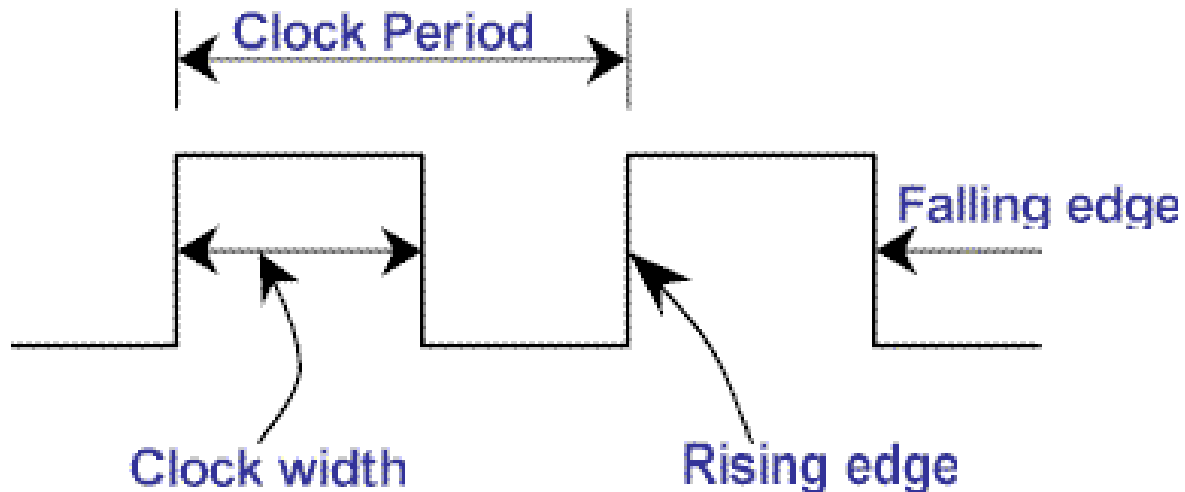
# What is a synchronous circuit?

- Digital circuit synchronized by a clock



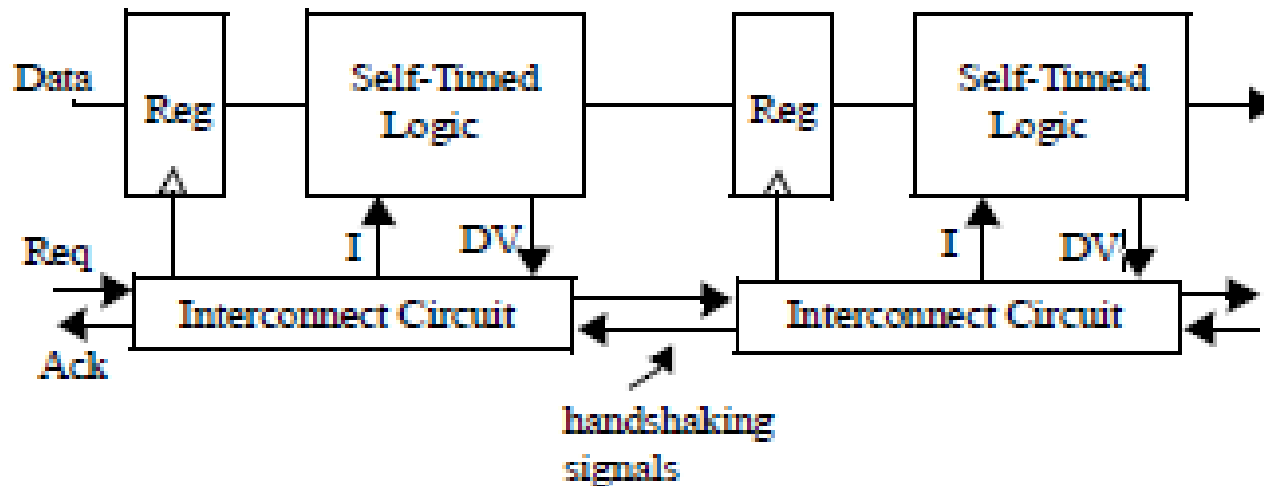
# Clock Signal

- Circuits change their states and output values at discrete instants of time, which are specified by the rising and falling edge of a free-running clock signal



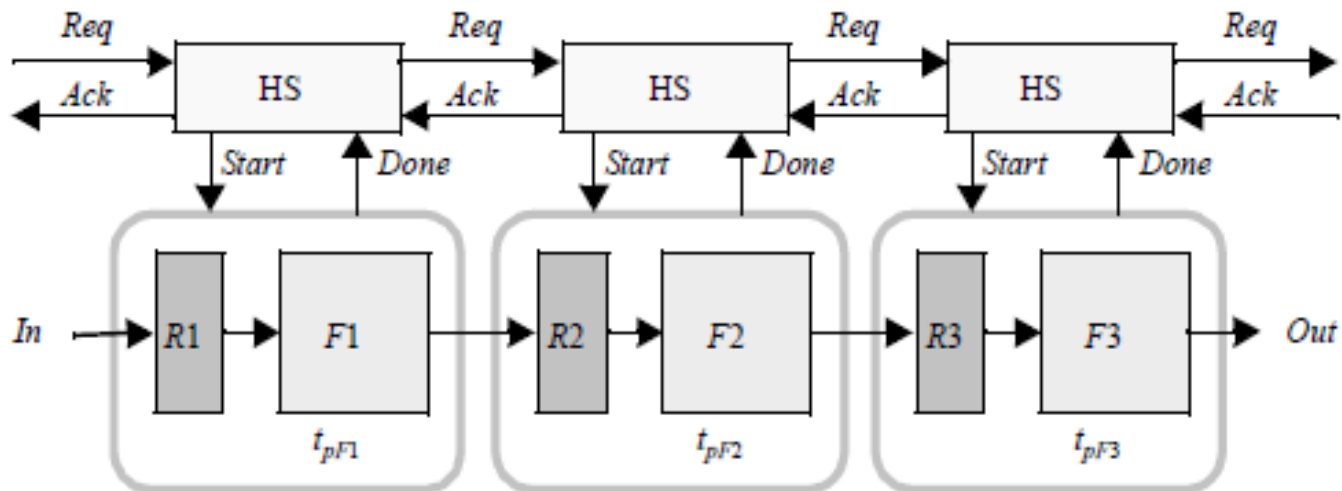
# What is an asynchronous circuit?

- A self timed circuit
  - A digital circuit not governed by a clock
  - Uses signals



# Handshaking Protocol

- A series of signal events
  - i.e Acknowledge and Request signal



# Applications – Synchronous

- Predominates asynchronous circuits
- Typically used to perform activities that need to happen at precise times

# Applications – Asynchronous

- Signal processing
- Fast arithmetic unit
- Simple microprocessors
- Memory(static,RAM,FIFOs)
- ILLIAC



# Advantages – Synchronous

- Simplicity
- Widely taught and understood
- Available components
- Simple way to deal with noise and hazard

# Disadvantages – Synchronous

- Sensitive to variations in physical parameters
- Not modular
- Power consumption
- Clock distribution is difficult due to clock skew
- The maximum possible clock rate is determined by the slowest logic path in the circuit, otherwise known as the critical path

# Advantages – Asynchronous

- High performance
- Low power dissipation
- Low noise and EM emission
- Good match with heterogeneous system timing

# Disadvantages – Asynchronous

- Substantial circuit level overhead
- Lack of CAD tools
- Delay

# Optimization – Synchronous

- Pipelining
  - Improves performance
- Clock Gating
  - Reduces dynamic power dissipation
- Retiming
  - Improve its performance, area, and/or power characteristics

# Sources

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