Comparator Gain-Bandwidth

Example:

- 4Gb/s link
- Minimum $\Delta V$: 1mV
- $V_{dd} = 1V$
- $A_v > 1V / 1mV = 1000$ in < 250ps!

Operational Amplifier?

$$f_{cut} = \frac{f_{op}}{A_v} = \frac{2}{3} \frac{1}{T_{in}}$$

$$f_v = \frac{2A_v}{3T_{in}} = \frac{1000}{3 \times 250 \text{ps}} = 1.33 \text{THz}$$

Flash Converter

- Fast: one clock cycle per conversion
- High complexity: $2^n - 1$ comparators
- High input capacitance

Open-Loop Amplifier Cascade
Cascaded Amplifier

- Simplified bandwidth analysis:
  - Open-circuit time constants
  - (Not most accurate, but leads to nearly the right answer for design optimization)

Power Consumption

Bandwidth/Gain Optimization

Regenerative Latch

Bandwidth/Gain Optimization

CML Comparator (Latch)
StrongArm Latch

Hysteresis

Overdrive Recovery

Kickback

Kickback cont’d

Kickback cont’d