Modifying IBIS models

SIEMENS

Overview

- **Motivation**
- **Possible simulation types**
- **considered changes**
  - C_comp
  - U(i): driver strength, clamps
  - U(t), ramp
  - Missing models
- **Conclusion**

Motivation

- **Short time until simulation will start**
- **The quality of delivered models is more than ambigous**

  or
- **No model available**
- **Consideration of available ibis parameter versus datasheet/ technology/ measurement/ experience**
- **Need for a „worst case model“ but what does that mean?**

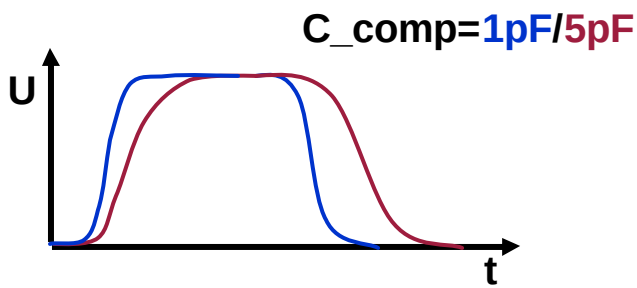
Types of Simulation

- **Signal Integrity**
  - under/overshoots
- **Timing: setup and hold time of clock net**
- **Crosstalk**
- **EMI**
  - radiation

C_comp @ receiver

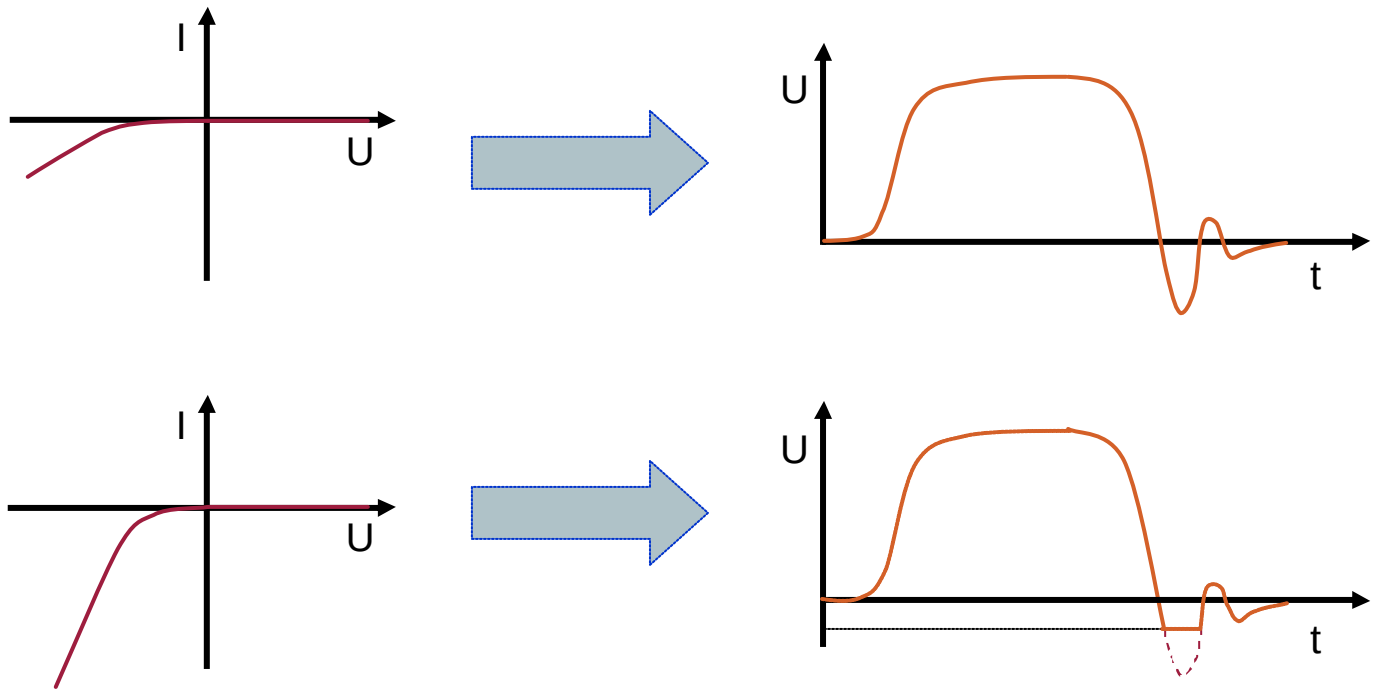
C_comp + C_pkg = Capacitance in Datasheet (min/typ/max)
Normally: C_comp_IO > C_comp_input

Make C_comp smaller => ramp gets faster



Diodes @ receiver

flat gnd-diode => large undershoot
steep gnd-diode => small undershoot



No/wrong PVT-min-max curves -> scaling U(I)

$I_{max} = I_{typ}(1+F)$

$I_{min} = I_{typ}(1-F)$

$F=F_P+F_V+F_T$ (independant variables)

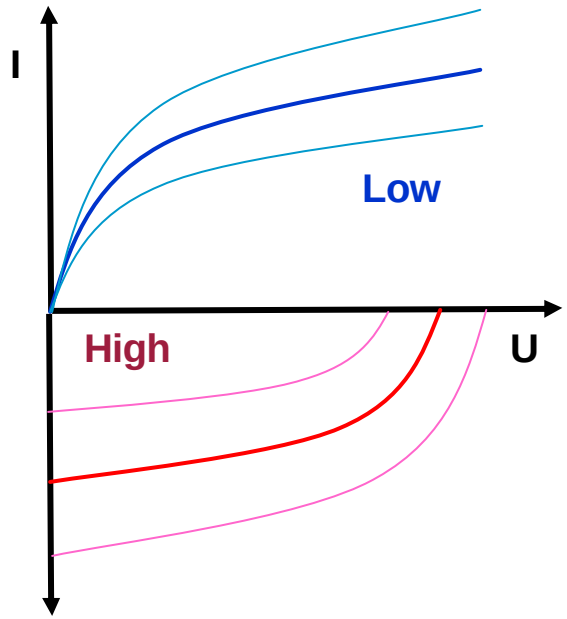
For example CMOS 3.3V:

$F_{process}$ = 0.30 +/- 0.15 (weak/strong 3σ)

$F_{temperature}$ = 0.12 +/- 0.06 (0,55,100C)

F_{vcc} = 0.08 +/- 0.02 (vcc+/- 5%)

would result in F= 0.50 +/- 0.23



No/wrong PVT-min-max curves -> scaling U(t)

$t_{max} = (1+F)*t_{typ}$

$t_{min} = (1+F)*t_{typ}$

Get $U_{max/min}$ out of intersection from $I_{max/min}$

$F=F_P+F_V+F_T$ (independant variables)

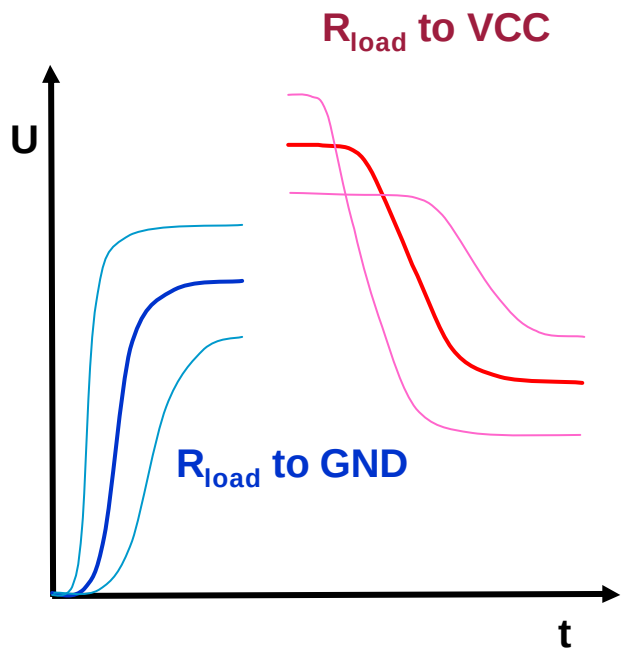
For example CMOS 3.3V:

$F_{process}$ = 0.27 +/- 0.23 (weak/strong 3σ)

$F_{temperature}$ = 0.15 +/- 0.09 (0,55,100C)

F_{vcc} = 0.03 +/- 0.02 (vcc+/- 5%)

would result in F= 0.45 +/- 0.34



Missing Model: e.g. 4mA Driver

- no 4mA-model from vendor
- We have:
  - 1) model from another vendor, other technology, 4mA
  - 2) model from the same vendor, other technology, 4mA
  - 3) model from the same vendor, similar technology, 4mA
- Copy one model from above

Missing model: e.g. Open_drain

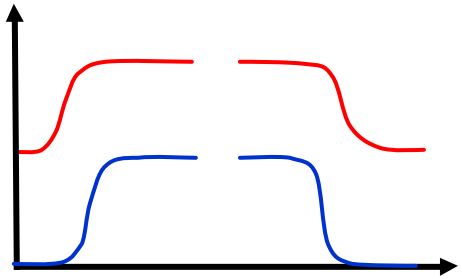
- **No OD-model from vendor**
- **We have:**
  - **1) OD-model from another vendor, other technology**
  - **2) OD-model from the same vendor, other technology**
  - **3) OD-model from the same vendor, similar technology**
  - **4) push-pull model available**
- **conversion of push-pull to open_drain**
  - U(t): simulation from 3-state to low
  - U(I): skip pullup curve

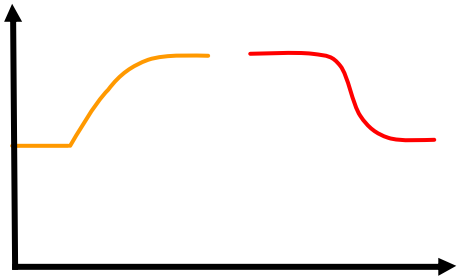
Missing model: Open_drain

Push-pull

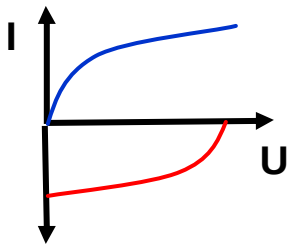
Open_drain

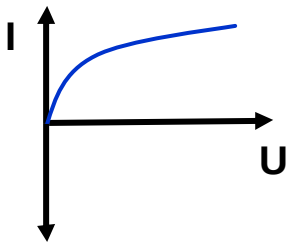
dynamic





static





Discussion of Changes

		Overshoot	t_setup	t_hold	Crosstalk	EMI
C_comp @ REC	**large**	+	-	+	+	+
	small	-	+	-	-	-
Diodes @ REC	**large/steep**	+	+	o	+	+
	small/flat	-	-	o	-	-
Driver Strength	**large**	-	+/-	-	-	-
	small	+	-	+	+	+
Ramp	**large/steep**	-	+	-	-	-
	small/flat	+	-	+	+	+
Missing Models	nothing	no info				
	default OD	great uncertainess				
	default simulated OD	more realistic				

+ = no errors

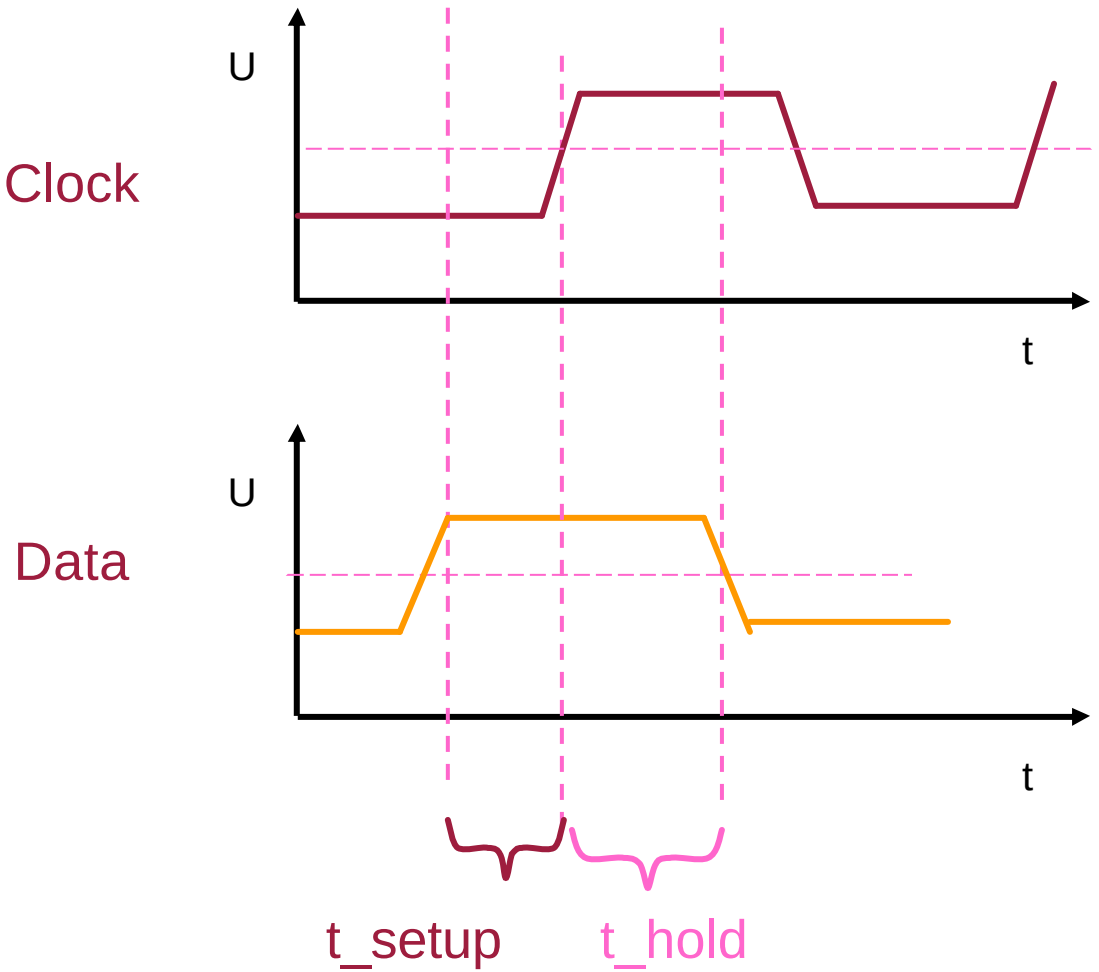
- = errors

o = not relevant

Summary and Conclusion

- **Changing ibis does effect the simulation in a great manner**
- **Changes are in some simulation type more worst case and in an other more best case**
- **Every model „worst case“ ➔NO system design**
- **More and faster cooperation from vendor is needed**
- **IF necessary, better adjustment of scaling parameters**

Timing: Setup and Hold Time



t_setup: the time, the data has to be stable high, until the clk starts rising (stable **before** the CK-edge)

t_hold: the time away from the clk goes high, the data has to be stable high (stable **after** the CK-edge)

t_setup + **t_hold** is the *minimal* **data pulse width**