SIEMENS

Information
and Communication
Networks

IBIS, current status (4.1) and some notes on IBIS4.0 parameters

Eckhard Lenski

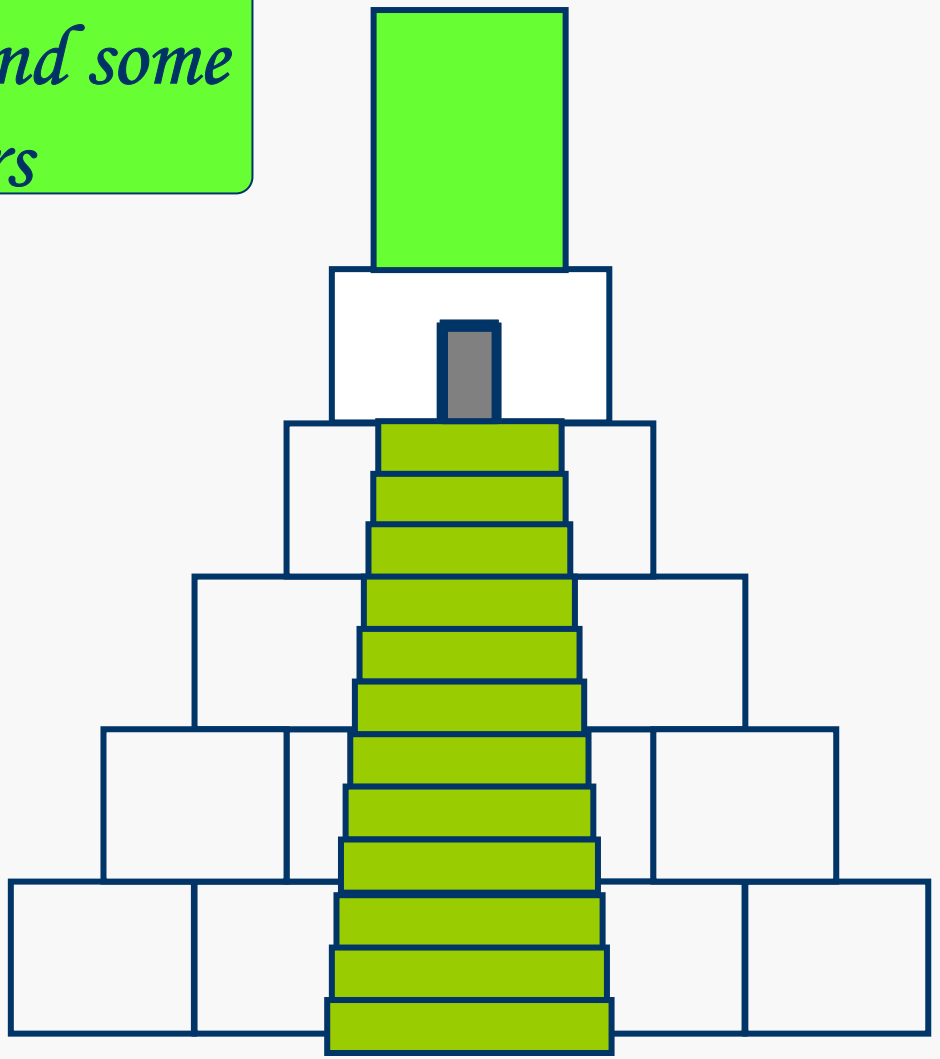
ICN M&L TDC CE TC3

IBIS summit DATE 2004 20th Feb. 2004

Overview

IBIS, current status (4.1) and some notes on IBIS4.0 parameters

- *questions*
- *statements*
- *parameters*
- *new tools*
- *current status*



Current status

IBIS 4.1

Includes now external models:

VHDL AMS

Verilog AMS

SPICE (3F5)

New Keywords

Current status

Keywords

[External Model]
[End External Model]

Uses connectivity and IBIS-Parameters like VinH, VinL from [Model] Keyword

[External Circuit]
[End External Circuit]
[Node Declarations]
[End Node Declarations]
[Circuit Call]
[End Circuit Call]

Connectivity and measurement parameters are defined inside ‚external circuit‘ (e.g. Inputs with 4 Thresholds)

New model types

4 new model types

- I/O_diff
- Output_diff
- 3-state_diff
- Input_diff

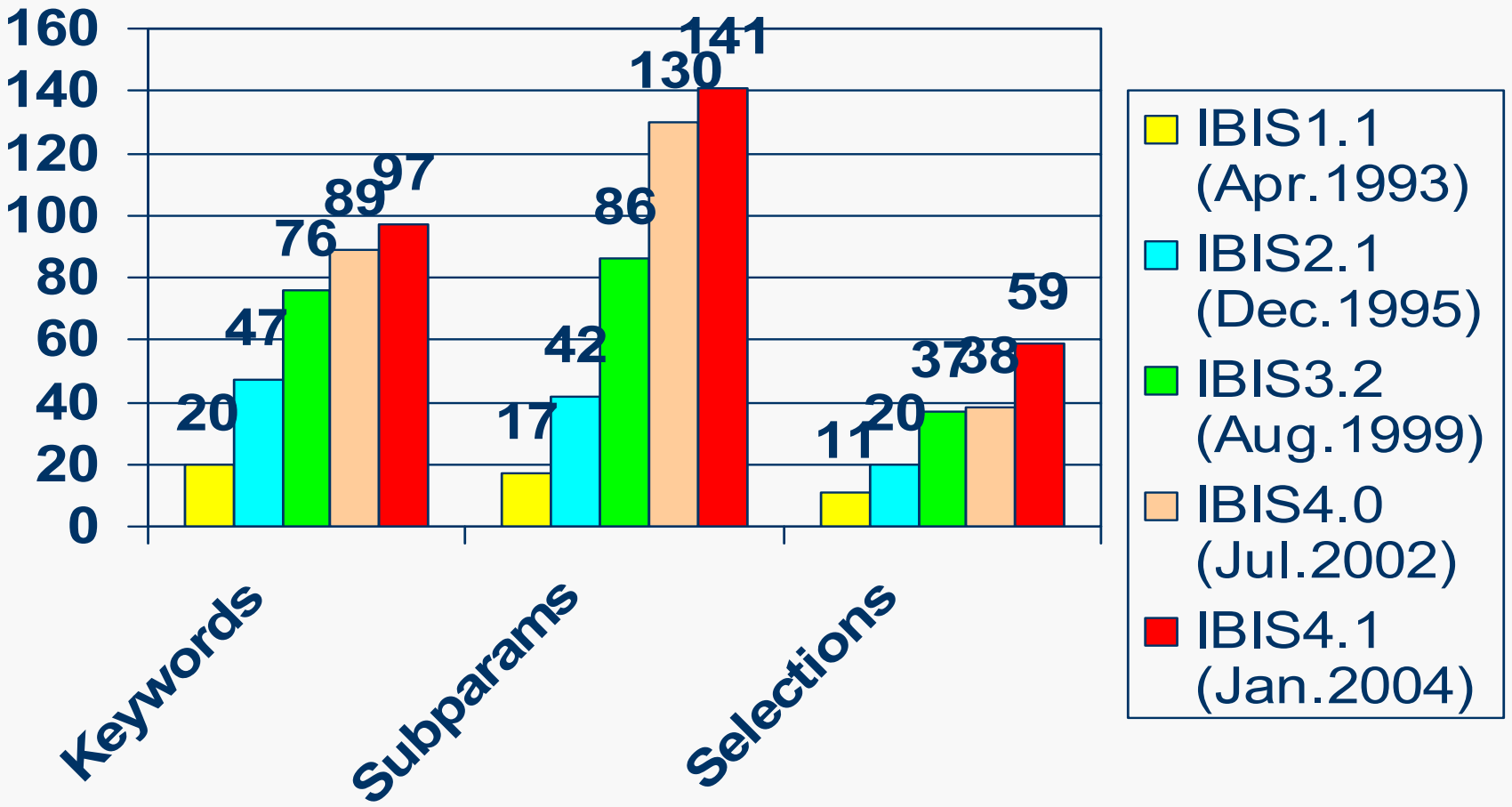
2 new sub parameters

- Rref_diff
- Cref_diff

clarifications of many keyword descriptions

A living standard

Current status



ICM v1.0 IBIS InterConnect Modeling Specification

Current status

Coupling per section possible

Conductance added as a parameter

S-Parameters

Touchstone Format

Not frequency dependent, -> next version

New free tools on the IBIS homepage

s2ibis3

- Java
- series MOSFETs
- better convergence with HSPICE

Ibischeck 4.0

- Check the file depending on the version in the keyword
  [IBIS Ver] 4.0
- Monotonicity of V-I-tables
  ver 4.0 : with summation of V-I-tables
  ver 3.2 : without summation (each table alone)

IBIS4.0 parameters explained

Keyword: [Receiver Thresholds]

Sub-Params: Vth, Vth_min, Vth_max,
Vinh_ac, Vinh_dc, Vinl_ac, Vinl_dc,
Threshold_sensitivity, Reference_supply,
Vcross_low, Vcross_high, Vdiff_ac, Vdiff_dc,
Tslew_ac, Tdiffslew_ac

Receiver thresholds single ended

Receiver thresholds differential

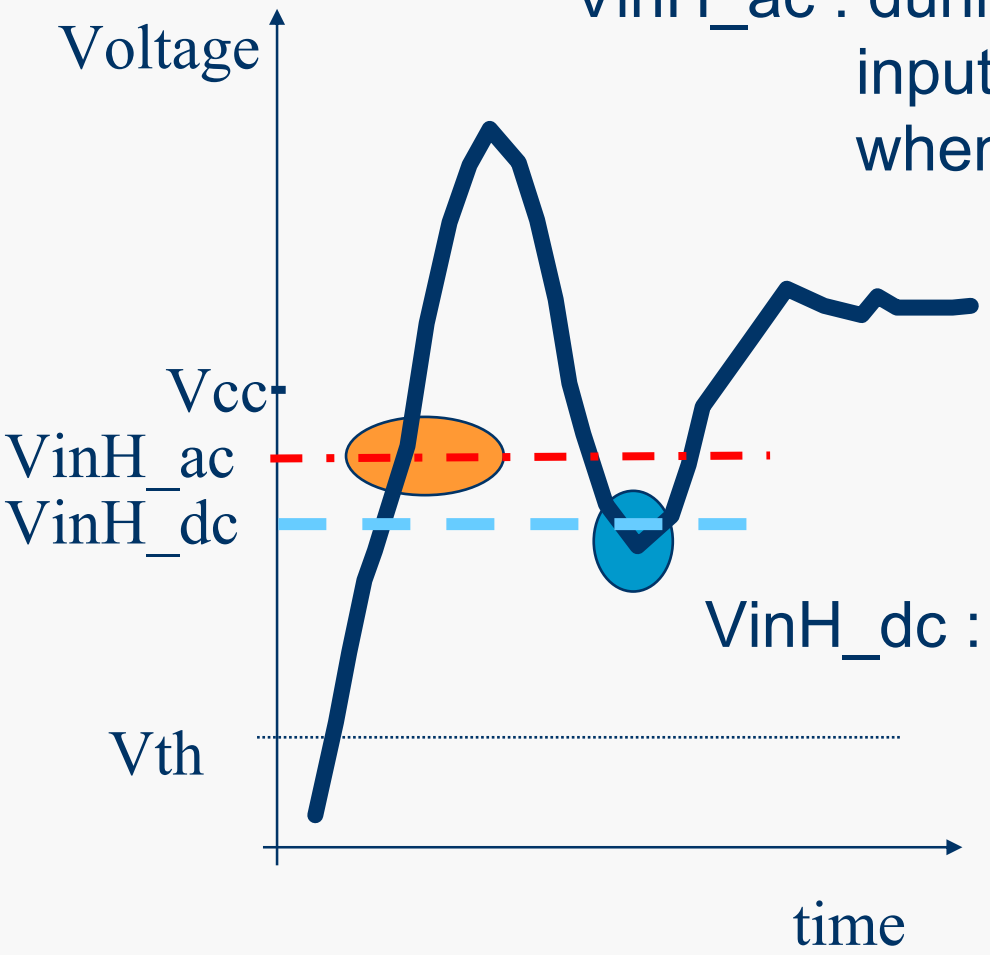
Vth, Vth-min, Vth-max

New Receiver thresholds

- VinL_ac, VinL_dc is offset to Vth , no min max values
- VinH_ac, VinH_dc is offset to Vth , no min max values
- Vth has got reference supply, with min max values
- Reference_supply for Vth
- Threshold_sensitivity dependent on reference supply
- Vcross_low, vcross_high is referenced to gnd, no min max values
- Vdiff_ac, Vdiff_dc , no min max values

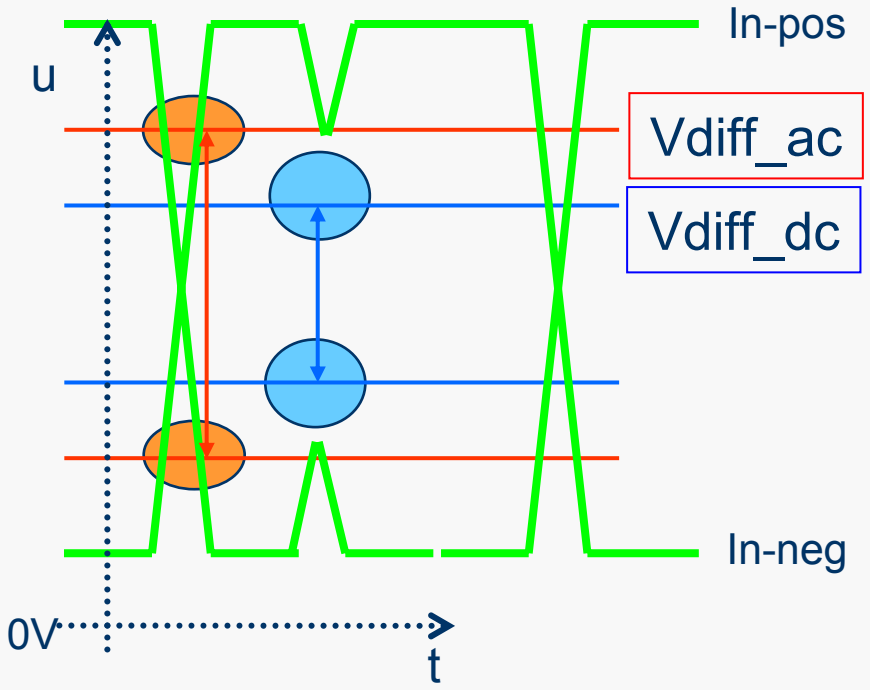
Single ended parameters

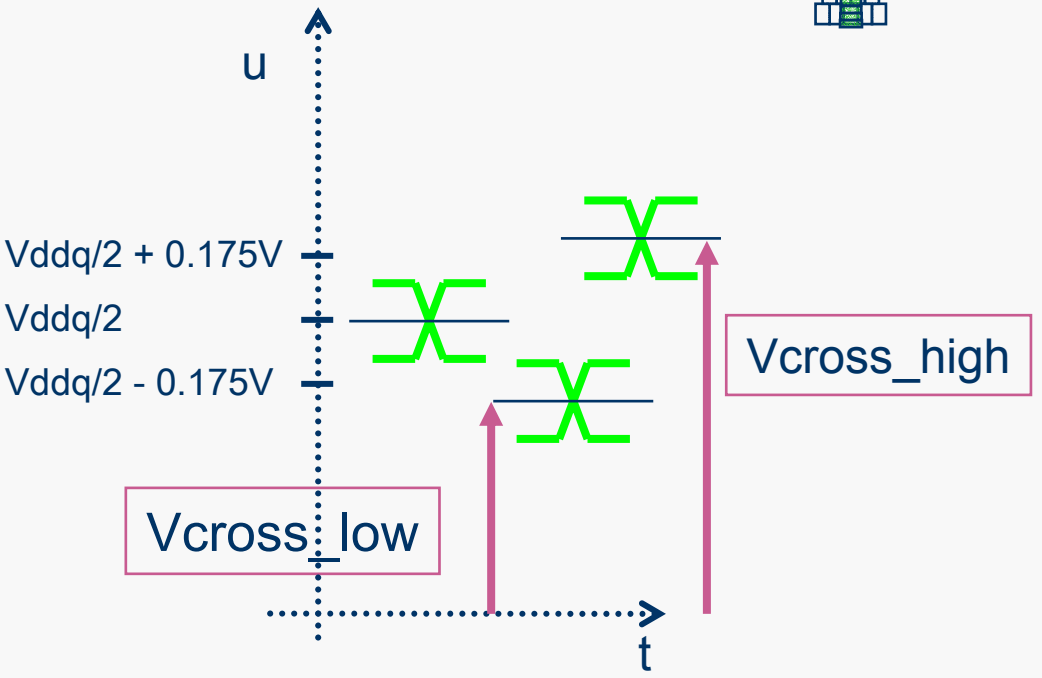
VinH_ac : during a transition from L -> H,
input will state change,
when crossing Vinh_ac



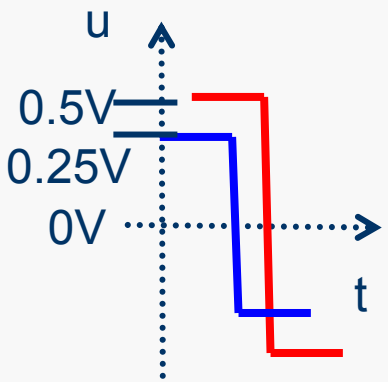
VinH_dc : after a transition from L -> H,
input will not change the new state,
if above Vinh_dc

differential parameters





Differential signal:

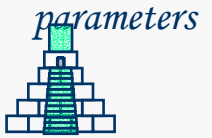


Threshold voltage Vth

- Vth is for typical values only
- Vth_min, Vth_max are values for typical conditions
- No explicit values for min-max-condition Models
- These will be calculated using the equation
- Vth(min/max) =

Vth **+** (Threshold sensitivity **X** change in supply voltage)

Threshold example part 1



Vcc 3.3V 3.0V 3.6V

Vth 1.65V 1.5V 1.8V

Threshold sense = (VthMAX-VthMIN) / (VsupplyMAX-VsupplyMIN)

= (1.8V – 1.5V) / (3.6V –3.0V) = (0.3V) / (0.6V)

= 0.5

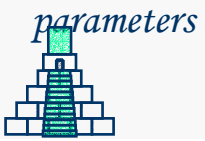
Vth and threshold sense must come from the IC-Manufacturer

Threshold example part 2

Typ		Min		Max	
Vth	1.5v	VthMIN	xxx	VthMAX	yyy
Vthmin	1.45v	VthMINmin	xx	VthMAXmin	yy
Vthmax	1.53v	VthMINmax	x	VthMAXmax	y

Threshold sensitivity 0.45

Ref. Supply	Power clamp reference		
Powerclamp	3.3V	3.15V	3.45V



Threshold example part 3 calculation

SIEMENS

typ		min		max	
Vth	1,5	VthMIN	1,4325	VthMAX	1,5675
Vthmin	1,45	VthMINmin	1,3825	VthMAXmin	1,5175
Vthmax	1,53	VthMINmax	1,4625	VthMAXmax	1,5975
Thres sense	0,45				

Ref. Supply Power clamp reference

Powerclamp	3,3	3	3,45
VthMINtyp = Vthtyp + 1.4325V		0.45 *	(3.15V -3.3V)
VthMAXtyp= Vthtyp + 1.5675V		0.45 *	(3.45V - 3.3V)
VthMINmin= Vthmin + 1.3925V		0.45 *	(3.15V -3.3V)
VthMINmax= Vthmax + 1.4625V		0.45 *	(3.15V - 3.3V)
VthMAXmin= Vthmin + 1.5175V		0.45 *	(3.45V -3.3V)
Vthmaxmax= Vthmax + 1.5975V		0.45 *	(3.45V - 3.3V)

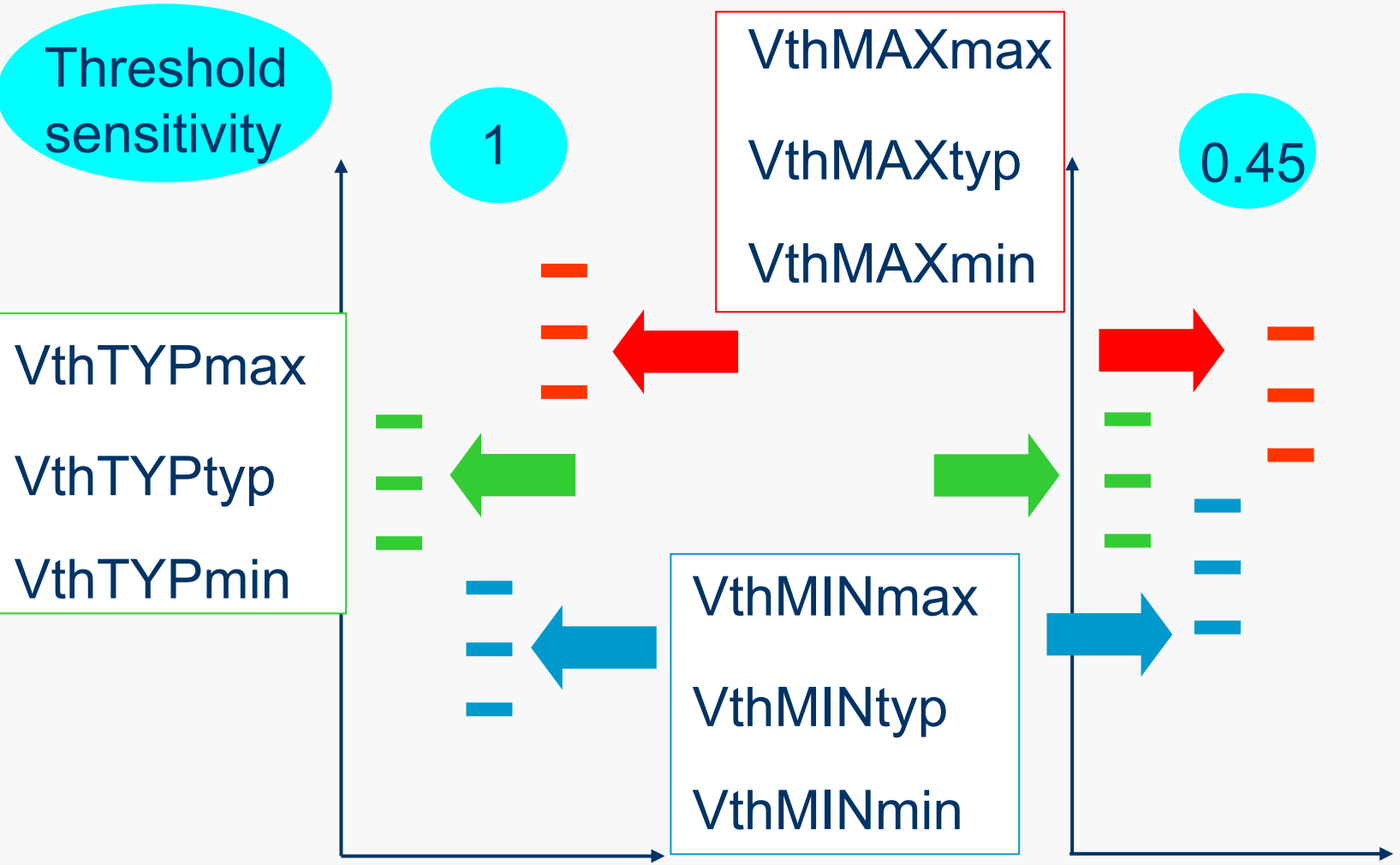
typ		min		max	
Vth	1,5	VthMIN	1,35	VthMAX	1,65
Vthmin	1,45	VthMINmin	1,3	VthMAXmin	1,6
Vthmax	1,53	VthMINmax	1,38	VthMAXmax	1,68
Thres sense	1				

Ref. Supply Power clamp reference

Powerclamp	3,3	3,15	3,45
VthMINtyp = Vthtyp + 1.35V		1 *	(3.15V -3.3V)
VthMAXtyp= Vthtyp + 1.65V		1 *	(3.45V - 3.3V)
VthMINmin= Vthmin + 1.30V		1 *	(3.15V -3.3V)
VthMINmax= Vthmax + 1.38V		1 *	(3.15V - 3.3V)
VthMAXmin= Vthmin + 1.60V		1 *	(3.45V -3.3V)
Vthmaxmax= Vthmax + 1.68V		1 *	(3.45V - 3.3V)

Threshold example part 4 graph

parameters



Questions and statements

- Few new members in IBIS
- Gurus and beginners
- IBIS 4.1 contains now 140 pages
- ICM contains 50 pages

→ E-roadshows for training & interactions

Increasing issues

Number of IO-models per file

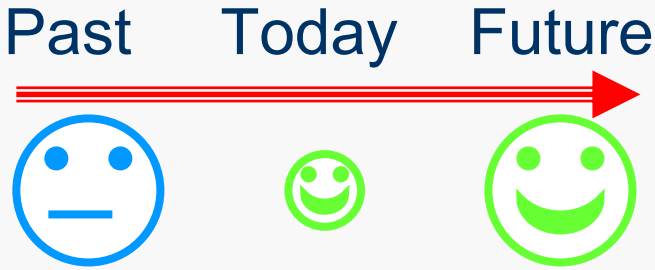
Number of parameters

Gap between current version of IBIS and models you get

Information needed, which tool uses which parameters

IBIS is a standard ANSI/EIA 656-A

statements



Model availabilty

Model quality

Good accuracy with short simulation time

Tool independent

PVT : Process, Voltage, Temperature

Model class	δVcc	Tj	Process
1	± 5%	0 – 110	± 2σ
2	± 5%	0 – 110	± 3σ
3	± 5%	m40 – 125	± 2σ
4	± 5%	m40 – 125	± 3σ
5	± 10%	0 – 110	± 2σ
6	± 10%	0 – 110	± 3σ
7	± 10%	m40 – 125	± 2σ
8	± 10%	m40 – 125	± 3σ

± 2σ means 95,5% of all shipped parts fulfill these limits
± 3σ means 99,7% of all shipped parts fulfill these limits
δVcc ± 5% means e.g. 3P3V -- 3P15V -- 3P45V
δVcc ± 10% means e.g. 3P3V -- 3P00V -- 3P60V

Questions to IBIS4.1

VHDL-AMS model support

How to check ?
- visual
- syntax
- ???

SPICE 3F5

- How to translate to other SPICE-tools ?
- encrypted SPICE ?

Final

- Acceptance of new IBIS-versions must be higher
- More graphical explanations of parameters
- IC vendors must support new parameters faster
- Tool vendors must support new parameters faster
- E-roadshows sounds good