Information
and Communication
Networks

IBIS Basics Tutorial

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European IBIS SUMMIT Meeting DATE 2003

Overview

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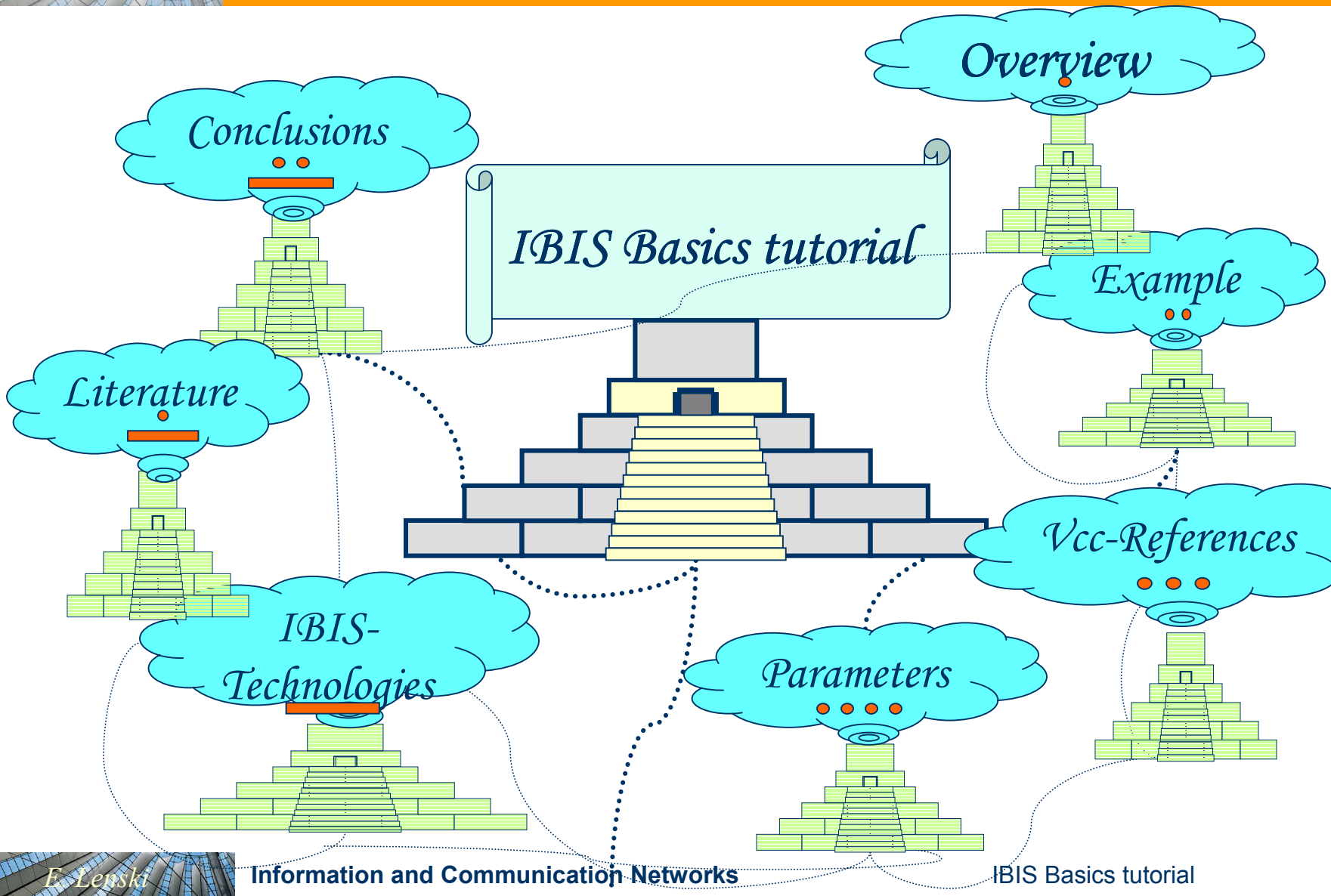
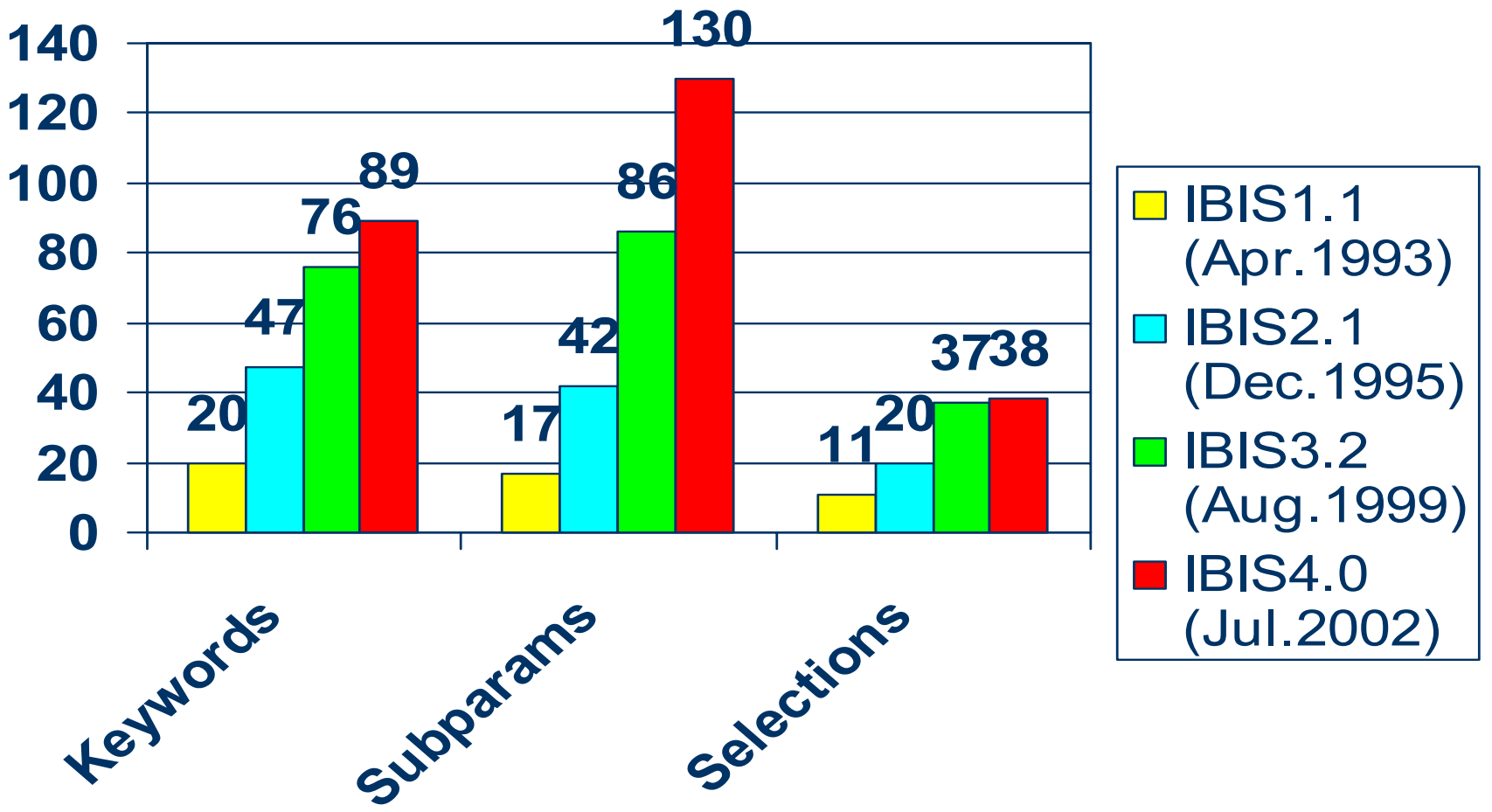
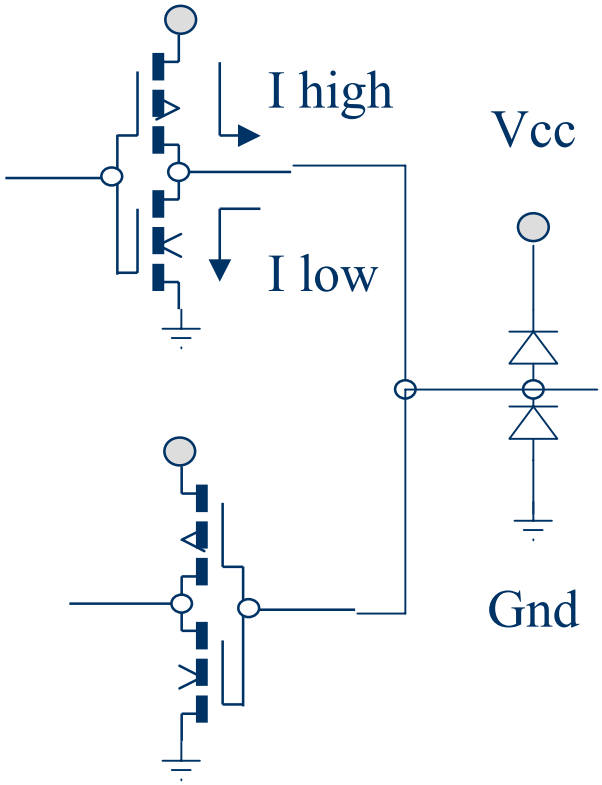


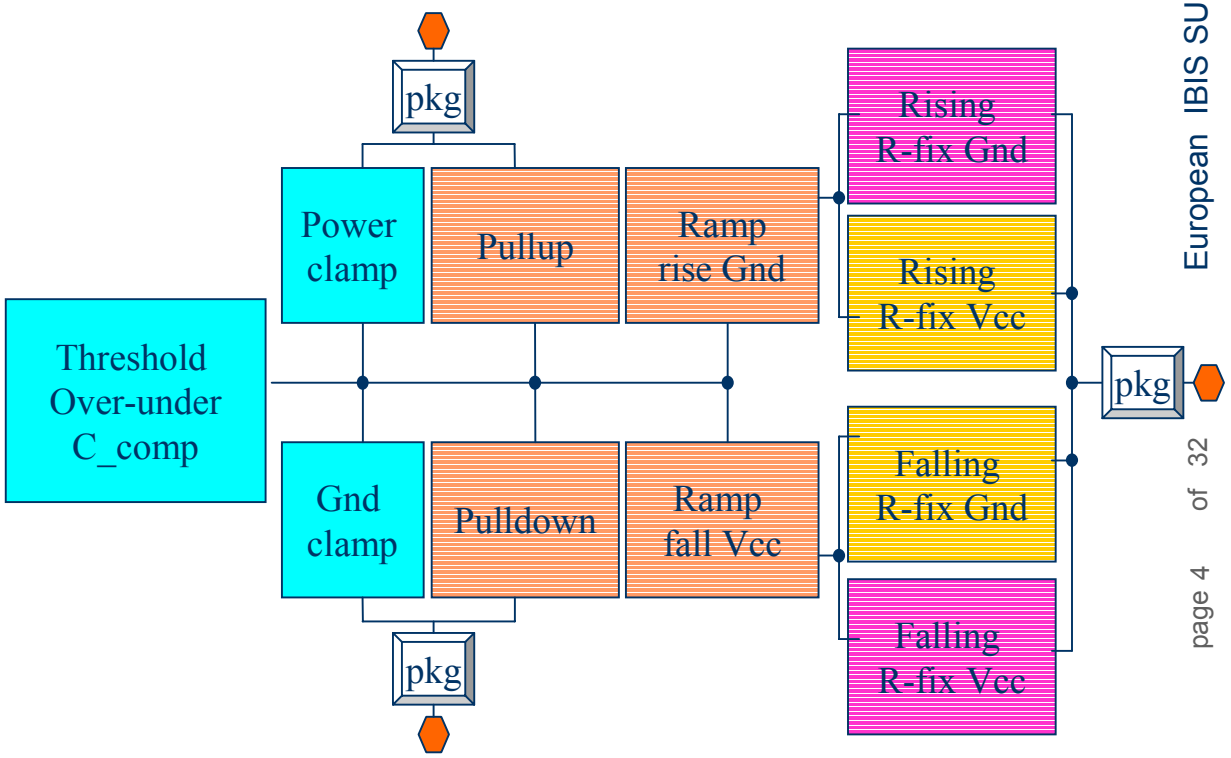
IBIS- Evolution

SIEMENS



Blocks of an basic IBIS-Model





Basic V-I and V-t Curves

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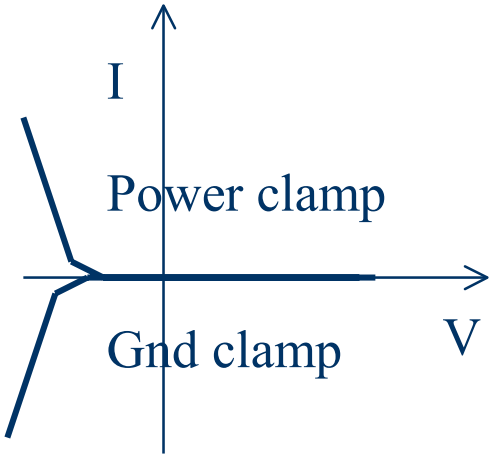
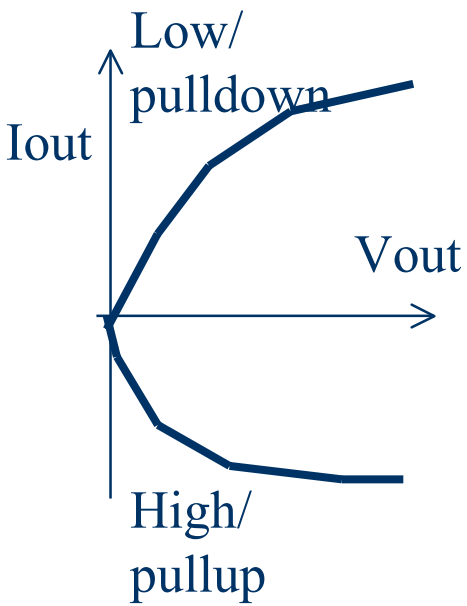
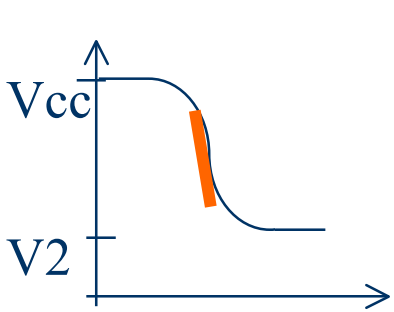
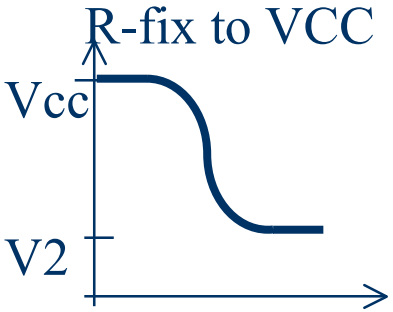
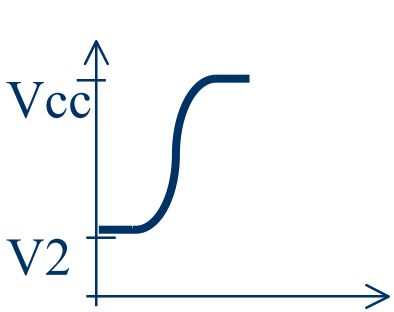
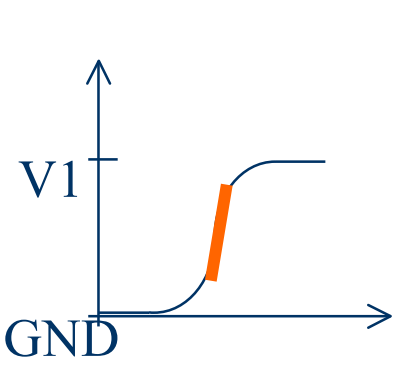


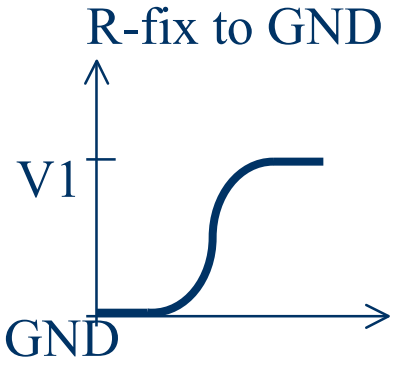


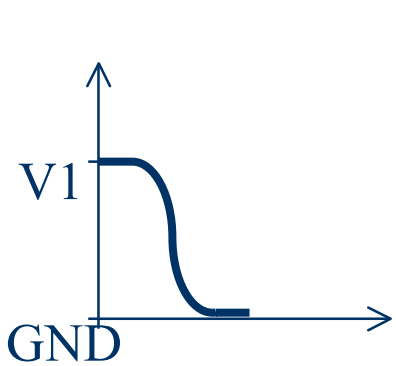




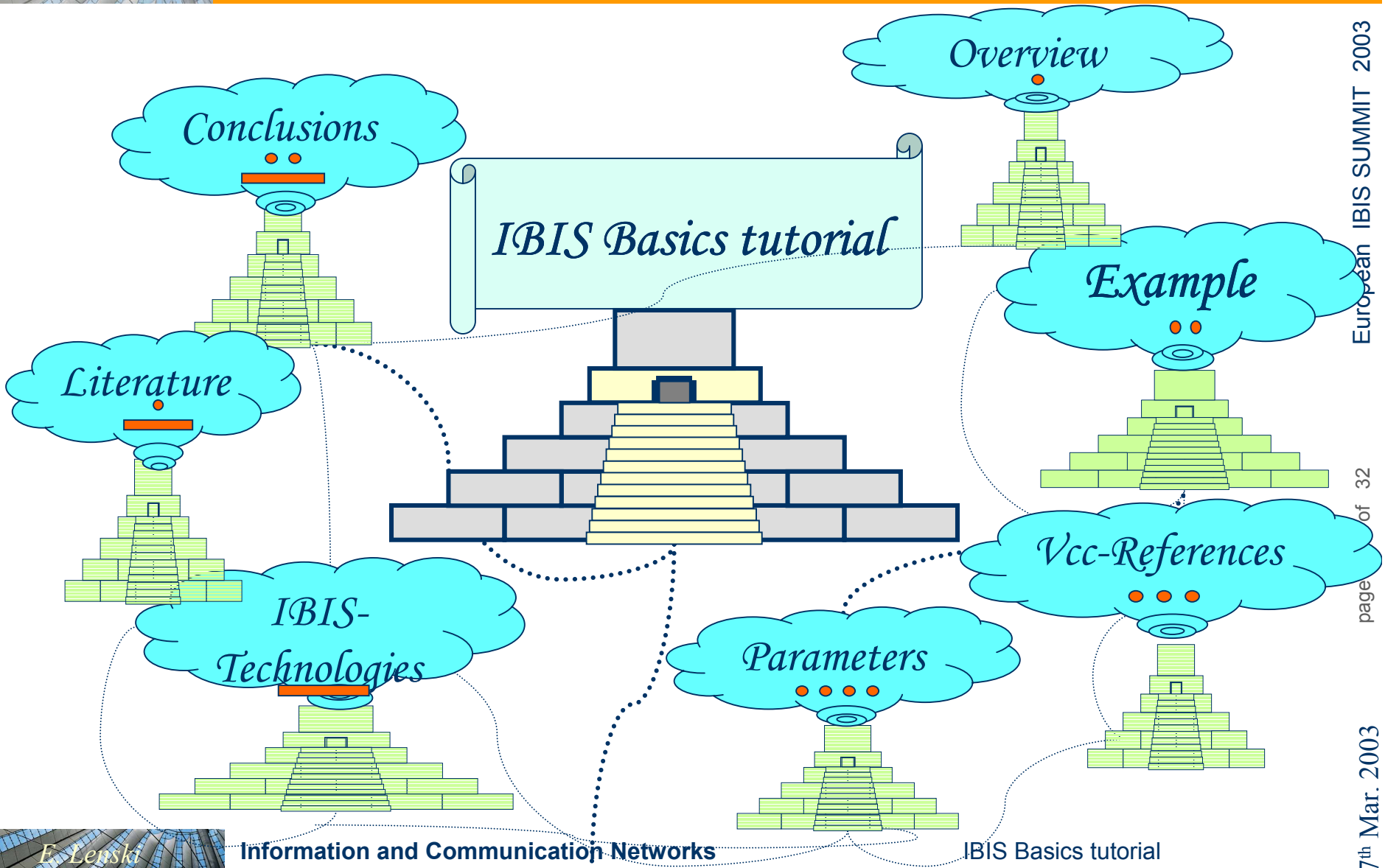








Example


Overview
Conclusions
IBIS Basics tutorial
Example
Literature
Vcc-References
IBIS-
Technologies
Parameters

Pinning and Package

SIEMENS

```
[IBIS Ver]      3.2
[File Name]     ALVCxxxx.ibs
[File Rev]      01.00
[Notes]         HSPICE -> IBIS
[Source]        DOGEN version V1.3-01
[Date]          31.01.2003
[Comment Char]  |_char
[Component]     ALVCxxxx
```

```
[Package]
| variable      typ           min           max
R_pkg           0.100Ohm      0.050Ohm      0.500Ohm
L_pkg           3.380nH       2.050nH       6.010nH
C_pkg           0.309pF       0.140pF       0.610pF
[Manufacturer]  vendor xyz
[Pin] signal_name model_name      R_pin   L_pin   C_pin
1     PRE_L      ALVC_REC-1_IN    0.443   6.43nH  1.56pF
2     SEL0       ALVC_REC-1_IN    0.411   6.11nH  1.43pF
3     1A1        ALVC_IO-1_BI     0.367   5.34nH  1.11pF
4     GND        GND              0.111   2.45nH  2.33pF
..    ..         ..
7     P3V3       POWER            0.145   3.49nH  1.67pF
8     NC         NC               0.151   3.19nH  2.67pF
9     NC         No-model         0.155   3.99nH  0.67pF
```


Parameters

SIEMENS

```
[Model]     ALVC_3P3V_IO-XXX-1_BI
Model_type  I/O
Vinh          =    2.V
Vinl          =    0.800V
Cref          =   50.pF
Rref          =  500.Ohm
Vref          =    0.V
Vmeas           =    1.500V
| variable      typ       min       max
C_comp        5.pF      4.5pF     5.5pF
[Model Spec]
Vinh          1.9V      1.8V      2.0V
Vinl          0.9V      0.8V      1.5V
Vmeas         1.5V      1.4V      1.6V
```

S_overshoot_high	3.3V	3.1V	3.4V
S_overshoot_low	-0.5V	-0.5V	-0.5V
D_overshoot_high	4.1V	3.9V	4.2V
D_overshoot_low	-0.9V	-0.9V	-0.9V
D_overshoot_time	5.ns	5.ns	5.ns
[Voltage Range]	3.3V	3.1V	3.4V
[Pulldown Reference]	0.V	0.V	0.V
[Pullup Reference]	3.3V	3.1V	3.4V
[GND Clamp Reference]	0.V	0.V	0.V
[POWER Clamp Reference]	3.3V	3.1V	3.4V
[Temperature Range]	55.	0.	110.

V-I Curves

SIEMENS

[GND Clamp]

Voltage	I(typ)	I(min)	I(max)
-1.64V	-2237.0mA	-1789.6mA	-2684.4mA
-1.22V	-818.8mA	-655.0mA	-982.5mA
...	...	...	...
3.30V	0.0mA	0.0mA	0.0mA
3.46V	0.0mA	0.0mA	0.0mA

[POWER Clamp]

Voltage	I(typ)	I(min)	I(max)
-1.64V	3925.0mA	3140.0mA	4710.0mA
-1.24V	1797.0mA	1437.6mA	2156.4mA
...	...	...	...
-0.40V	0.0mA	0.0mA	0.0mA
3.30V	0.0mA	0.0mA	0.0mA
3.46V	0.0mA	0.0mA	0.0mA

[Pullup]

Voltage	I(typ)	I(min)	I(max)
-0.30V	0.0mA	0.0mA	0.0mA
-0.20V	0.0mA	0.0mA	0.0mA
...	...	...	...
1.94V	-115.3mA	-92.2mA	-138.3mA
3.46V	-131.2mA	-104.9mA	-157.4mA
3.50V	-131.2mA	-104.9mA	-157.4mA

[Pulldown]

Voltage	I(typ)	I(min)	I(max)
-0.400V	-0.0mA	-0.0mA	-0.0mA
-0.300V	-0.0mA	-0.0mA	-0.0mA
...	...	...	...
1.50V	82.6mA	66.0mA	99.1mA
3.46V	87.6mA	70.1mA	105.1mA
3.50V	87.6mA	70.1mA	105.1mA

V-t Curves

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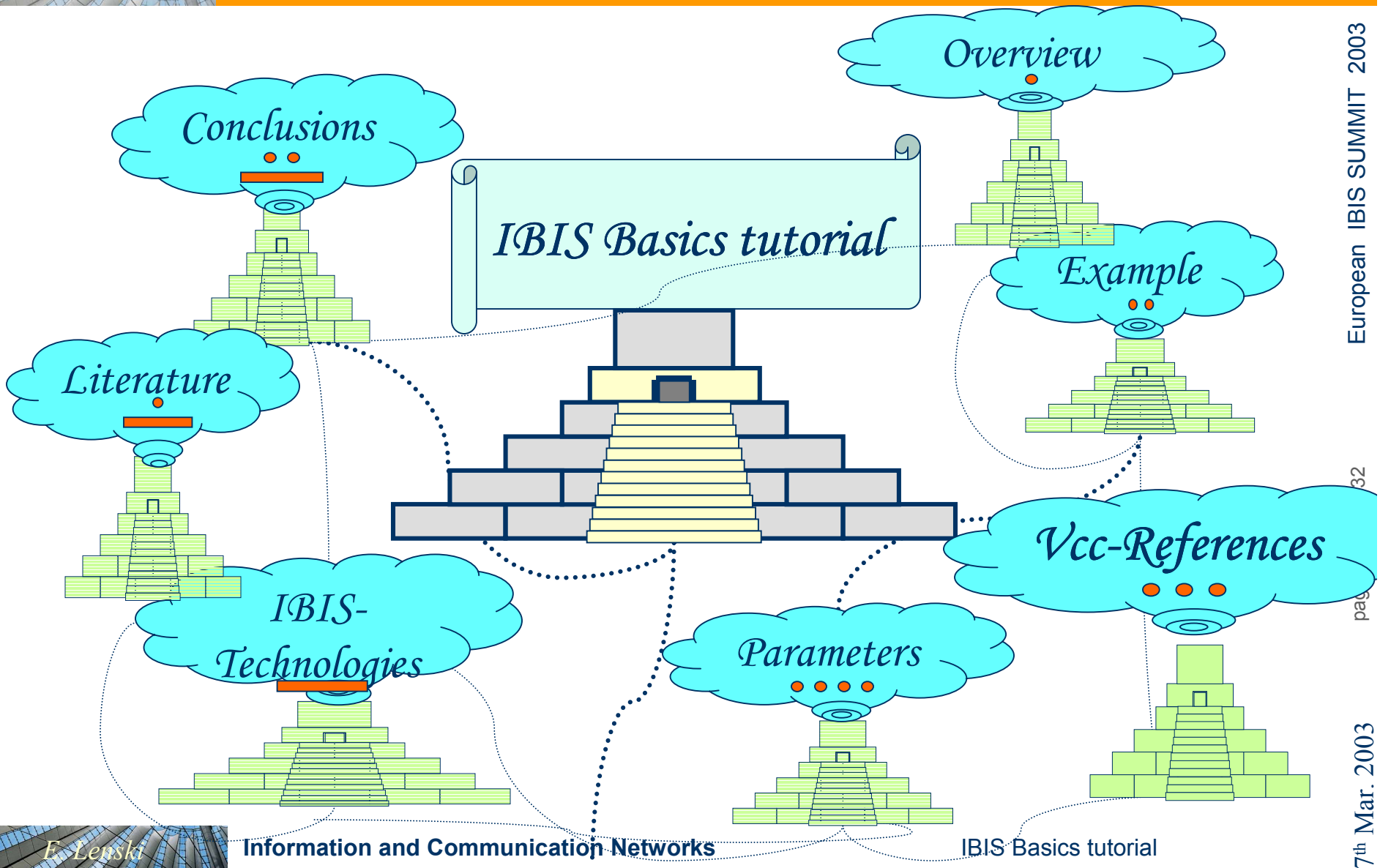
[Ramp]
|variable typ min max
dV/dt_r 1.60V/0.15ns 1.45V/0.21ns 1.74V/0.11ns
dV/dt_f 1.50V/0.17ns 1.42V/0.24ns 1.73V/0.13ns
R_load = 50.000Ohm
[Rising Waveform]
R_fixture = 50.000Ohm
V_fixture = 0.000V
|Time V(typ) V(min) V(max)
0.00ns -0.000V 0.000V 0.000V
... ...
2.40ns 2.677V 2.420V 2.908V
[Falling Waveform]
R_fixture = 50.000Ohm
V_fixture = 0.000V
|Time V(typ) V(min) V(max)
0.000ns 2.677V 2.420V 2.908V
... ...
1.148ns 0.000V 0.000V 0.000V

[Rising Waveform]
R_fixture = 50.000Ohm
V_fixture = 3.300V
V_fixture_min = 3.135V
V_fixture_max = 3.465V
|Time V(typ) V(min) V(max)
0.00ns 0.65V 0.76V 0.57V
0.48ns 0.66V 0.77V 0.59V
... ...
2.40ns 3.30V 3.13V 3.46V
[Falling Waveform]
R_fixture = 50.000Ohm
V_fixture = 3.300V
V_fixture_min = 3.135V
V_fixture_max = 3.465V
|Time V(typ) V(min) V(max)
0.00ns 3.30V 3.13V 3.46V
0.21ns 3.28V 3.12V 3.43V
... ...
1.14ns 0.65V 0.76V 0.57V

Vcc-References



References for V-I Curves

SIEMENS

	V-I Curves			
Technology	**Gnd Clamp**	**Power Clamp**	**Pulldown**	**Pullup**
Push-pull	Gnd Ref	Power Ref	Pulldown Ref	Pullup Ref
ECL	Gnd Ref	Power Ref	Pulldown Ref	Pullup Ref
Open sink	Gnd Ref	Power Ref	Pulldown Ref	*(Pullup Ref)*
Open source	Gnd Ref	Power Ref	*(Pulldown Ref)*	Pullup Ref

Power Clamp

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Vtable	Vout	Iout
-3.3V	6.6V	5.8V	100mA
-1V	4.3V	3.5V	10mA
-0.5V	3.8V	3.0V	1mA
0.0V	3.3V	2.5V	0mA
3.3V	0.0V	-0.8V	0mA
6.6V	-3.3V	-4.1V	0mA

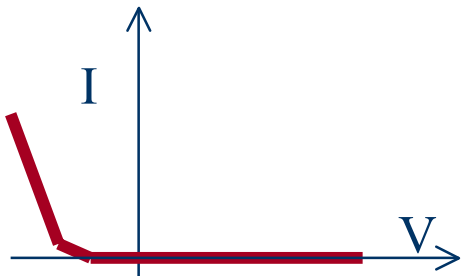
Vcc 3.3V

Vcc 2.5V

Vtable = *Vcc* - Vout

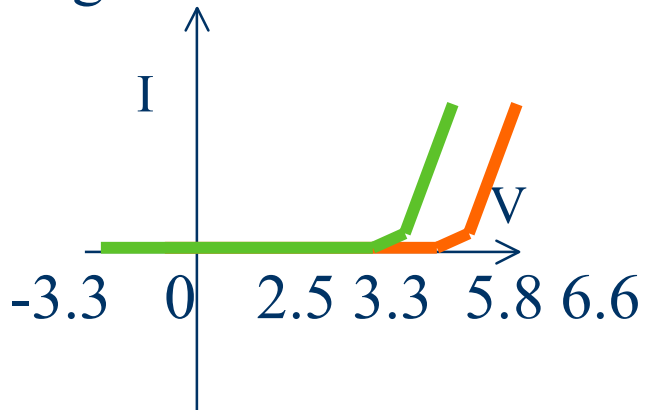
Vout = *Vcc* - Vtable

Vcc-referenced



Vtable	-3.3	0	3.3
Vout	6.6	3.3	0
Vout	5.8	2.5	-0.8

gnd-referenced



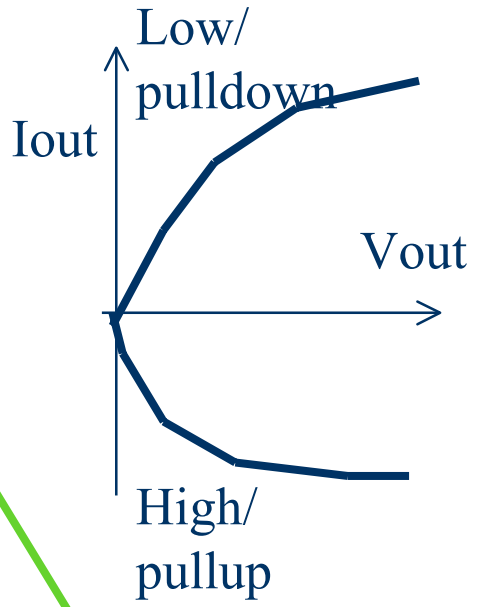
Pullup Curve

SIEMENS

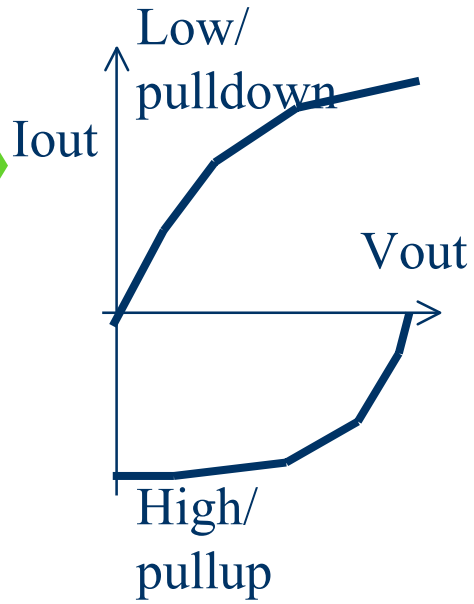
IBIS-Format

Vcc Reference for pullup

Gnd Reference for pulldown



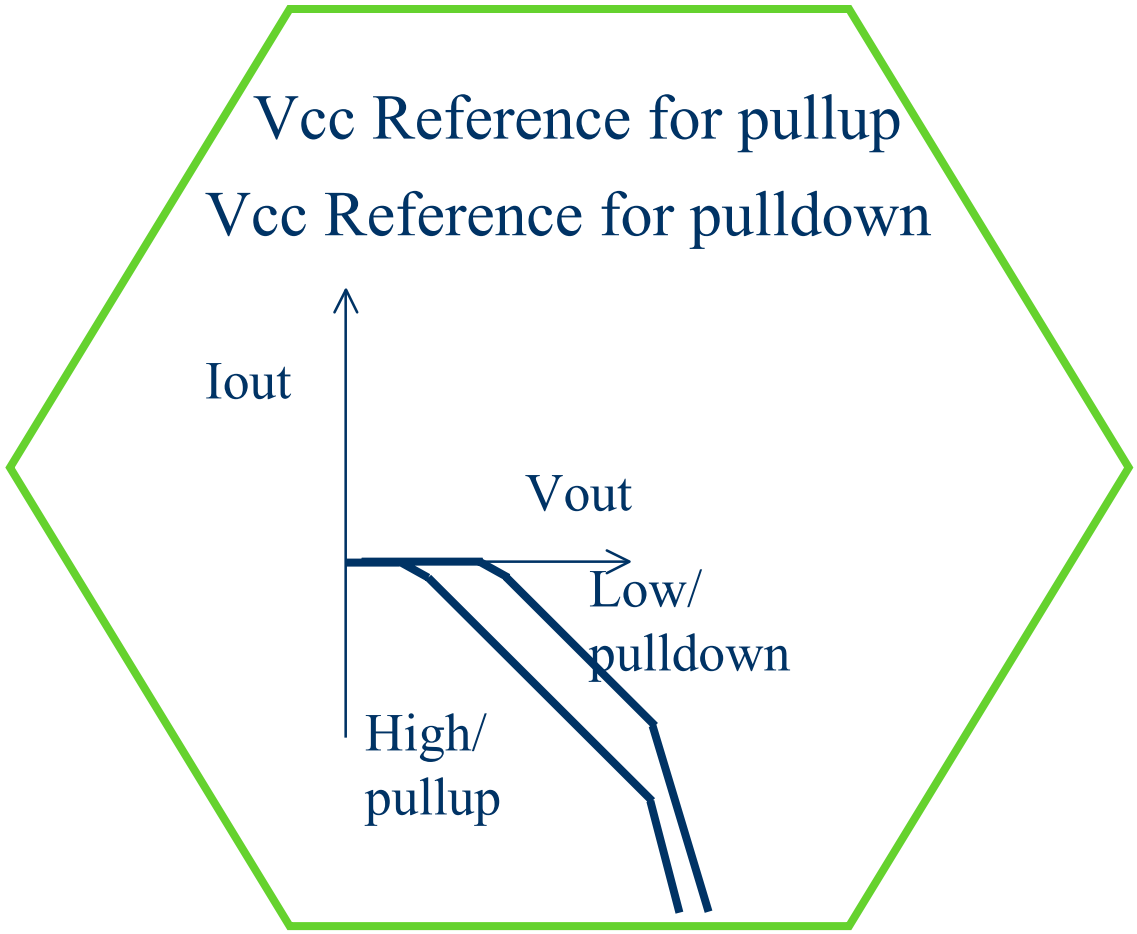
Gnd Reference for pullup & pulldown

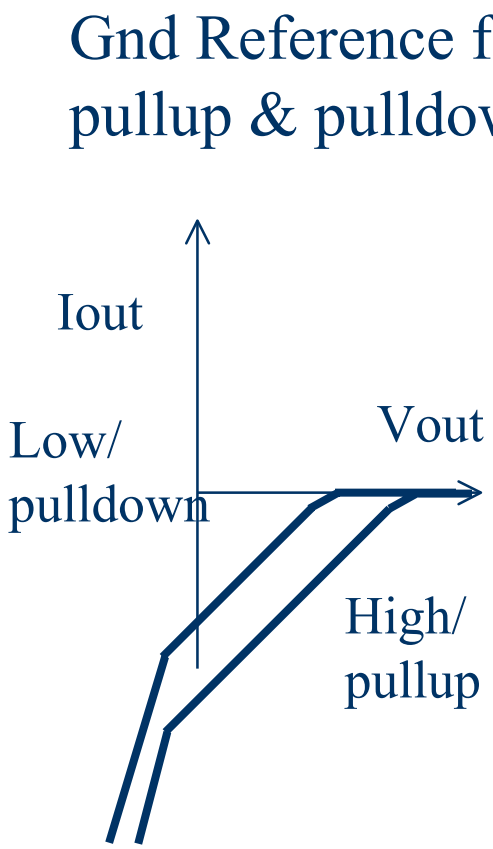


ECL Curves

SIEMENS

IBIS-Format





Parameters

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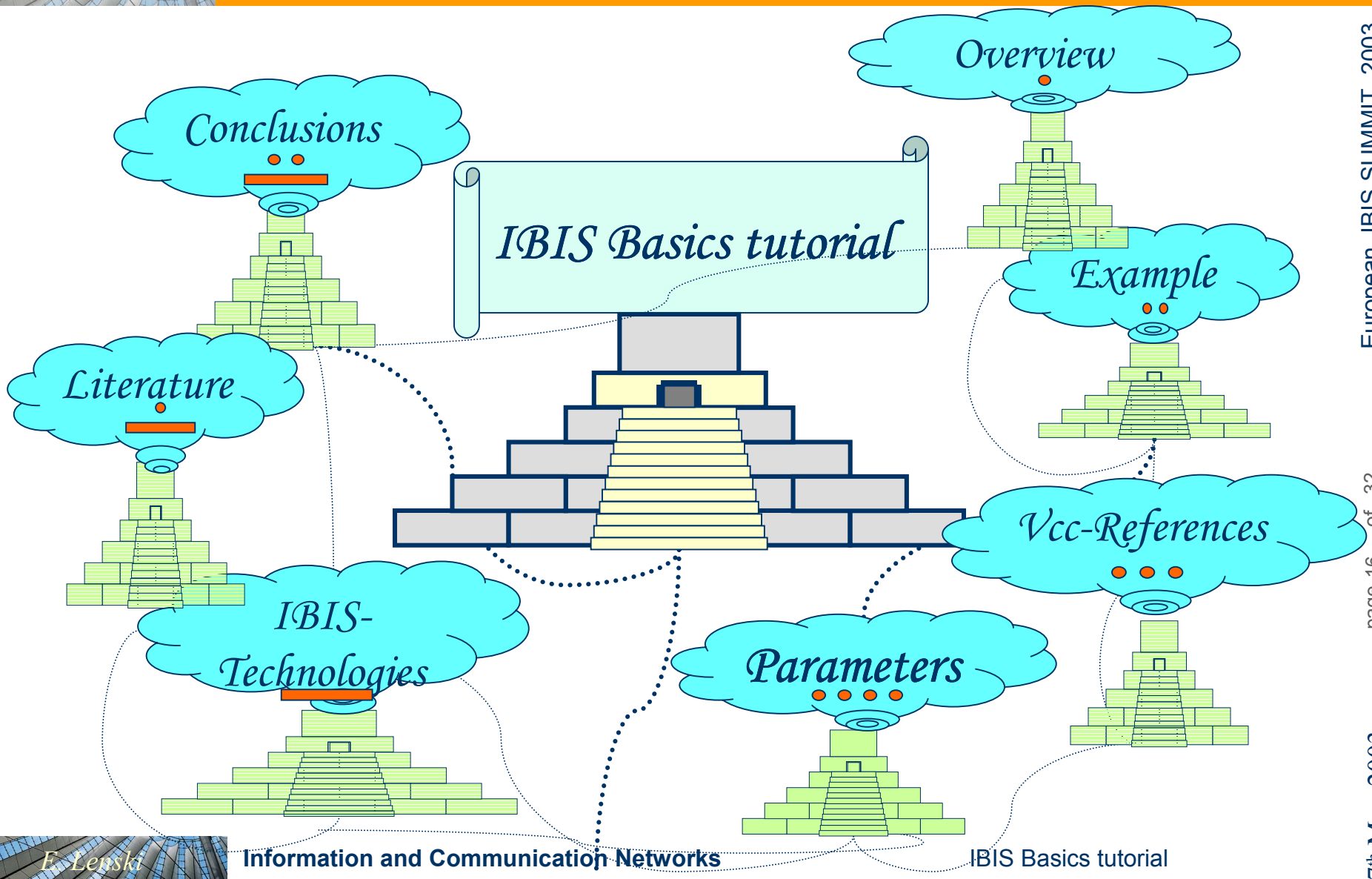

Ramp Calculation

SIEMENS

	Push-pull	ECL	Open sink	Open source	*hints*
Rload	50	50	50	50	*Default*
Vload rise	Gnd	Vcc-2V	Vcc/Vterm	Gnd/Vterm	*Fixed*
Vload fall	Vcc	Vcc-2V	Vcc/Vterm	Gnd/Vterm	*Fixed*

Default: value can be changed (e.g. 75Ohm, 100Ohm)

Fixed: value cannot be changed (assumed by technology)

Ramp Min Max Values

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Push pull

	typ	min	max
Rload	50	50	50
	Vcc	*Vccmin*	*Vccmax*
Vload rise	Gnd	Gnd	Gnd
Vload fall	Vcc	Vccmin	Vccmax

ECL

	typ	min	max
Rload	50	50	50
	Vcc	*Vccmin*	*Vccmax*
Vload	Vcc-2V	Vccmin-2V	Vccmax –2V

Rising / Falling Waveform

SIEMENS

Subparameter	note		Supply conditions
V-fixture	required		typical
V-fixture-min	optional	Default: 0	min
V-fixture-max	optional	Default: 0	max
R-fixture	required		
L-fixture	optional	Default: 0	
C-fixture	optional	Default: 0	
R-dut	optional	Default: 0	
L-dut	optional	Default: 0	
C-dut	optional	Default: 0	

Example Rising Waveform

SIEMENS

Zero-values by default

[Rising waveform]
R-fixture = 50
V-fixture = 3.3
V-fixture-min = 0.0
V-fixture-max = 0.0

|Time	Typ	Min	Max
0ns	2.0	2.2	1.8
1ns	2.2	2.4	2.2
2ns	2.7	2.8	2.9
3ns	3.1	3.0	3.3
4ns	3.2	3.1	3.45
5ns	3.3	3.15	3.45

Correct subparameters

[Rising waveform]
R-fixture = 50
V-fixture = 3.3
V-fixture-min = 3.15
V-fixture-max = 3.45

|Time	Typ	Min	Max
0ns	2.0	2.2	1.8
1ns	2.2	2.4	2.2
2ns	2.7	2.8	2.9
3ns	3.1	3.0	3.3
4ns	3.2	3.1	3.45
5ns	3.3	3.15	3.45

Waveform Time Correlation

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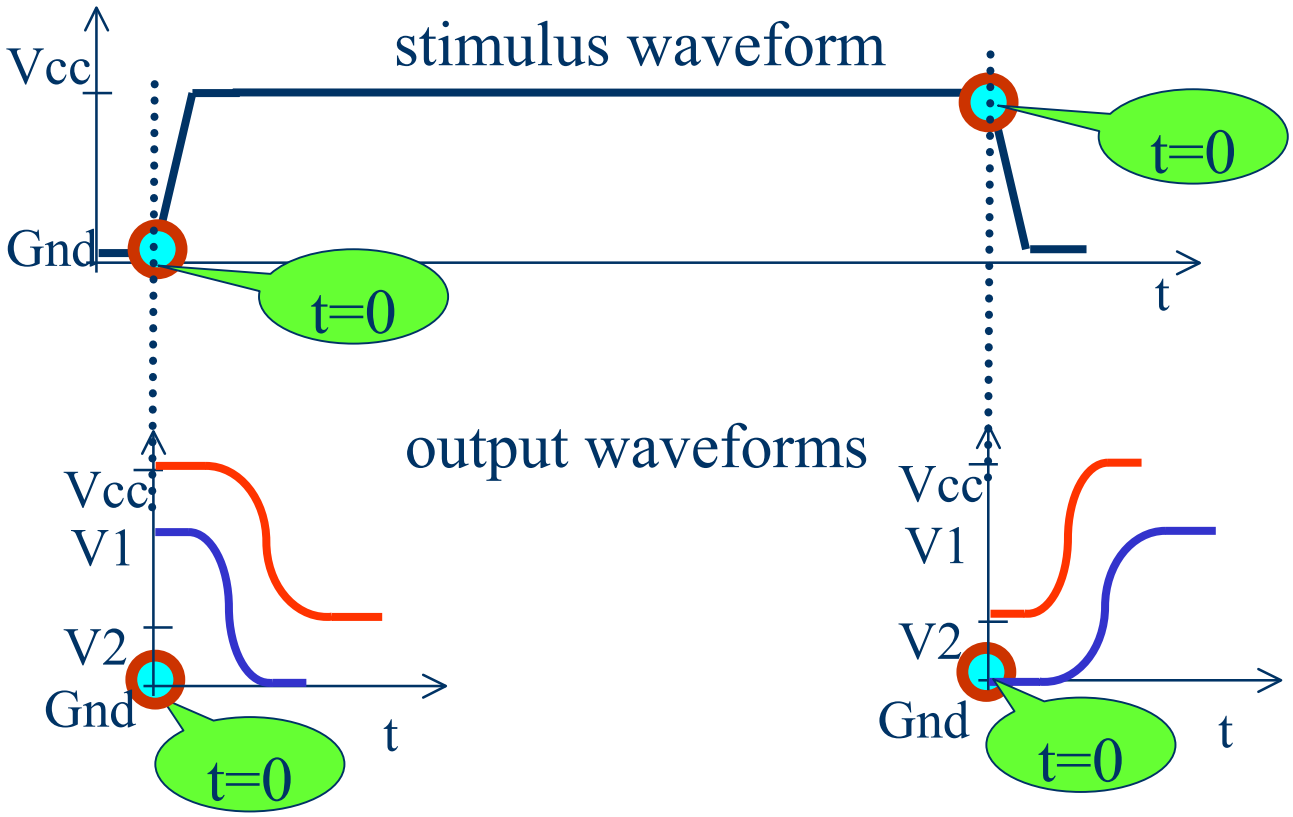

Use common reference point for stimulus waveform

IBIS-Technologies

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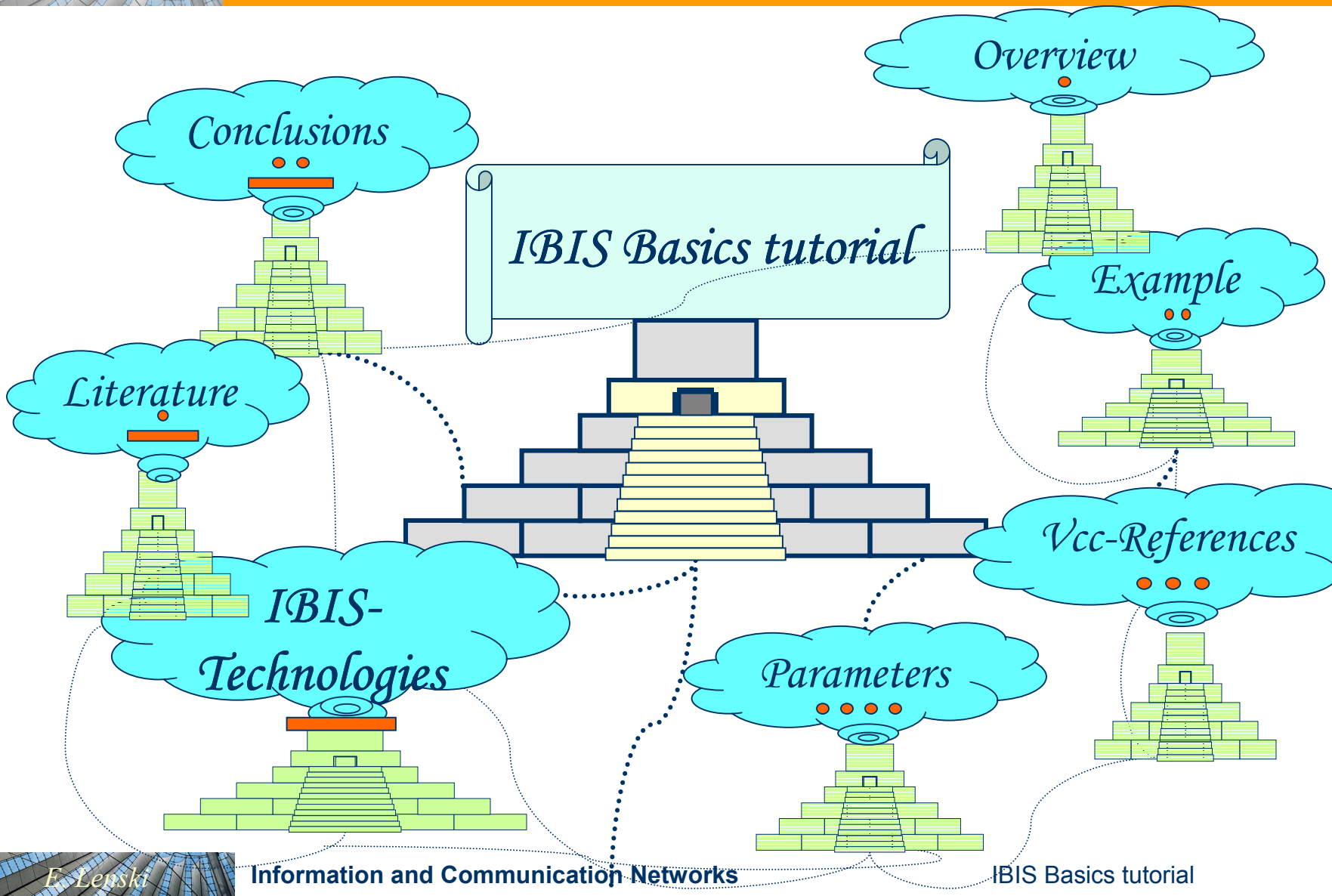
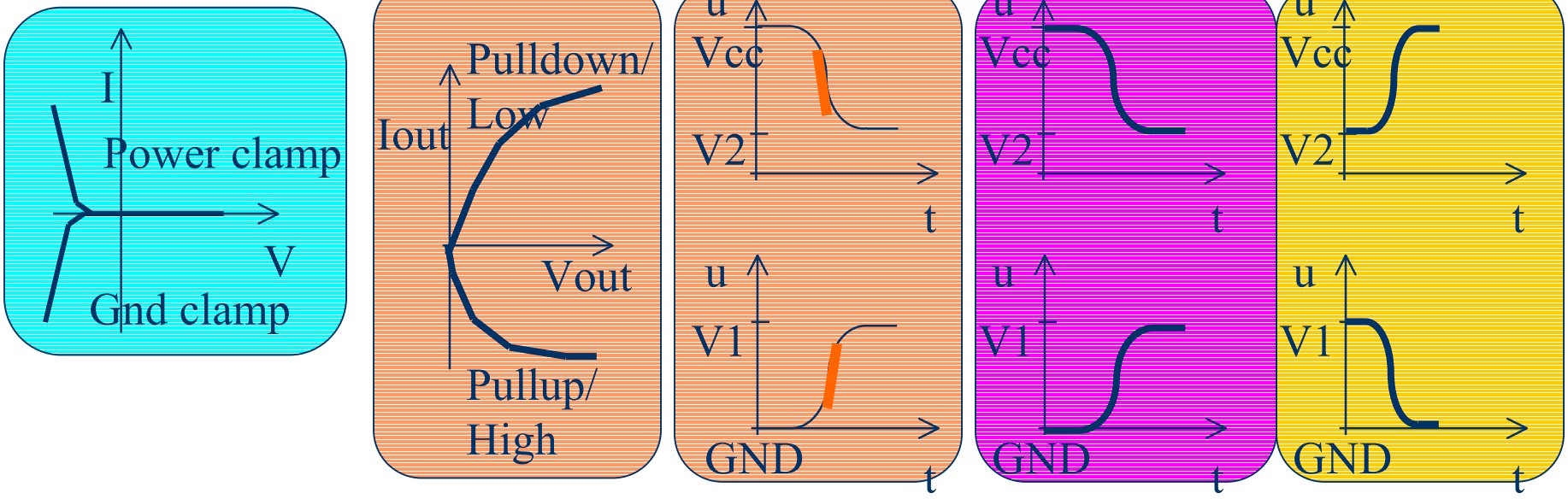
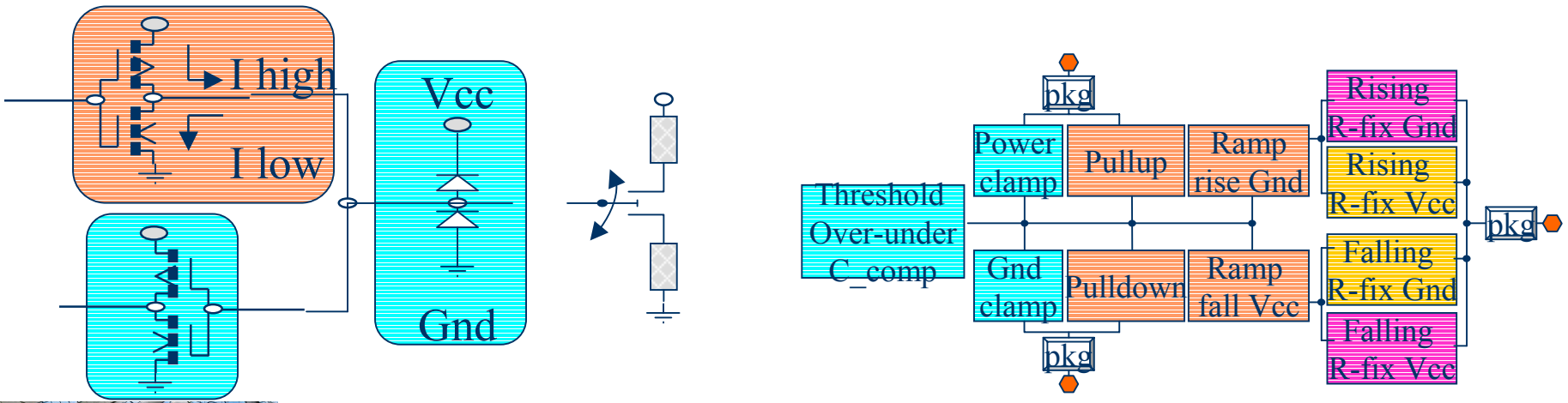


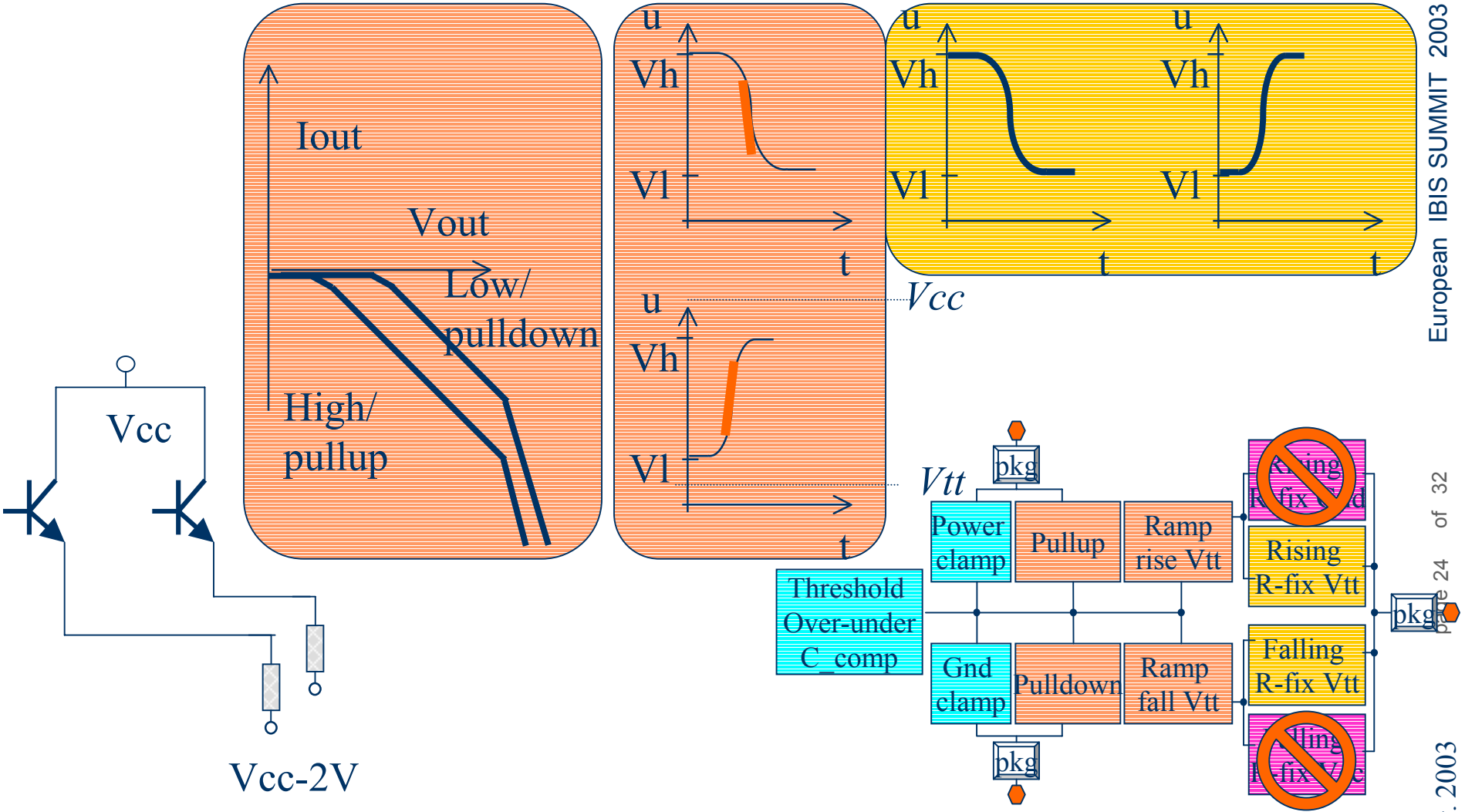
Push Pull (CMOS)

SIEMENS

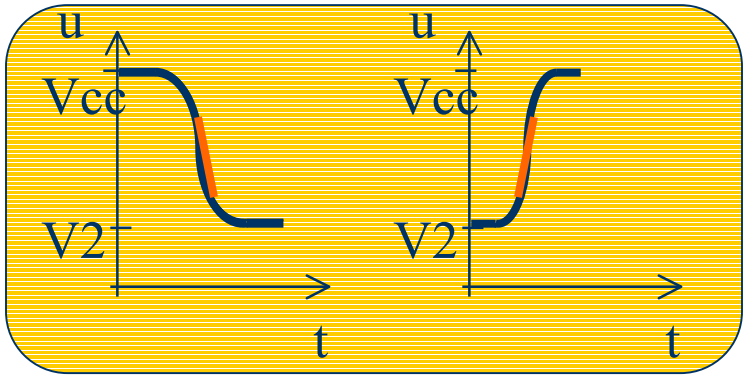


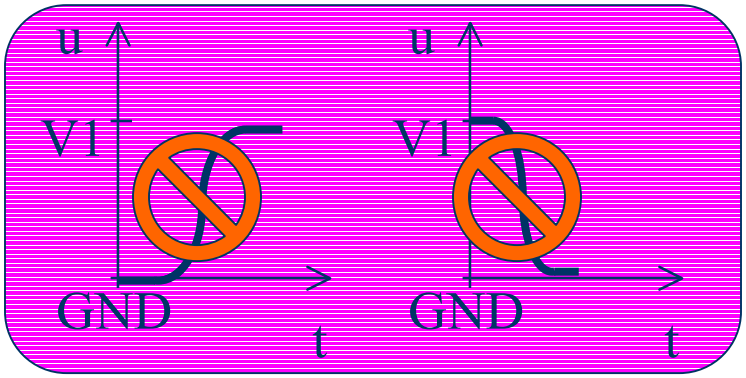


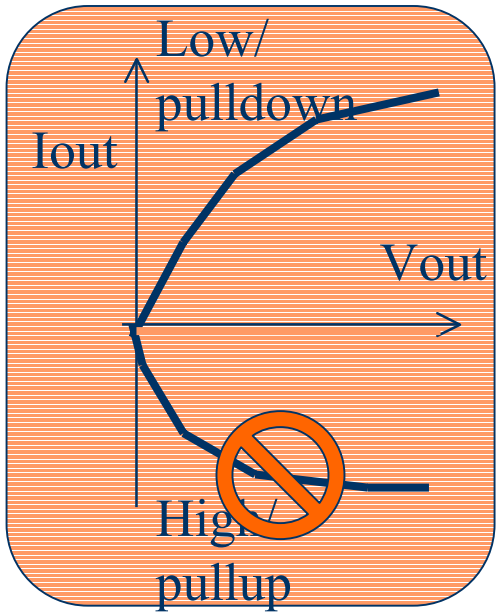
ECL

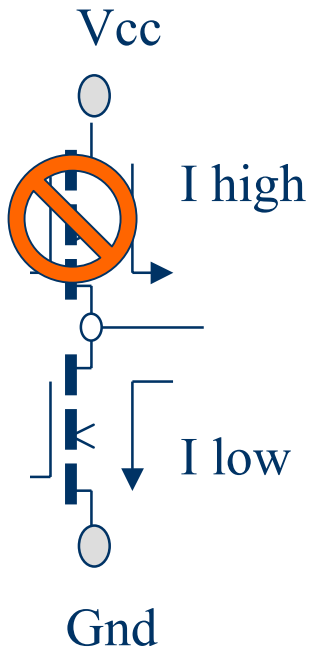

Iout
Vout
Low/
pulldown
High/
pullup
u
Vh
Vl
t
Vcc
Vcc-2V
Vtt
pkg
Power
clamp
Pullup
Ramp
rise Vtt
Rising
R-fix Vtt
Threshold
Over-under
C_comp
Gnd
clamp
Pulldown
Ramp
fall Vtt
Falling
R-fix Vtt

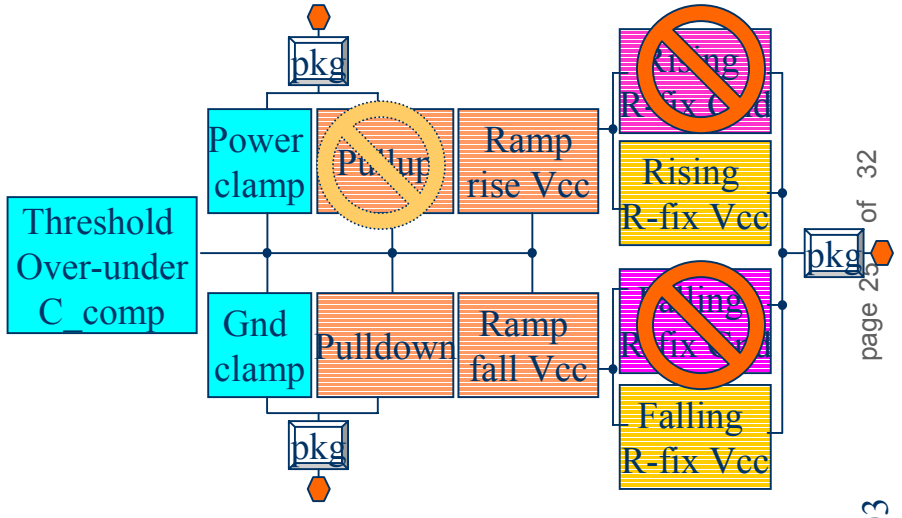
Open Sink / Open Drain











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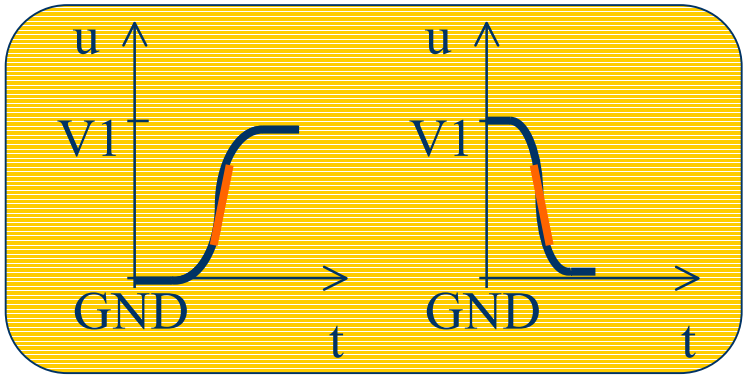
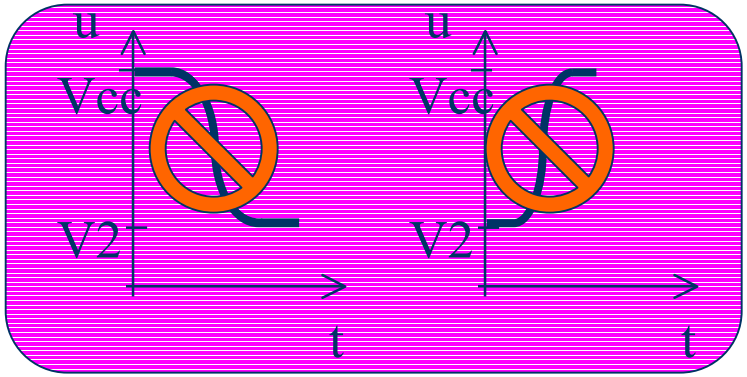
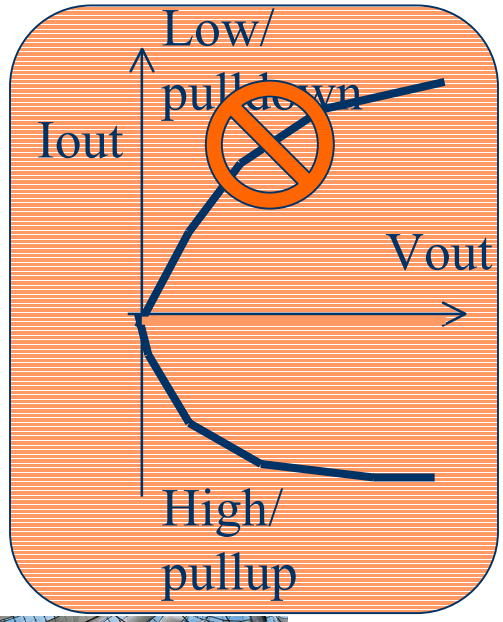
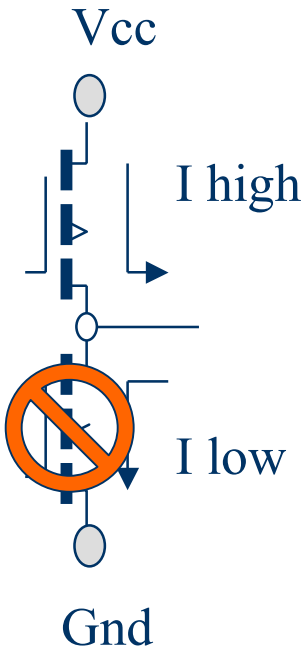
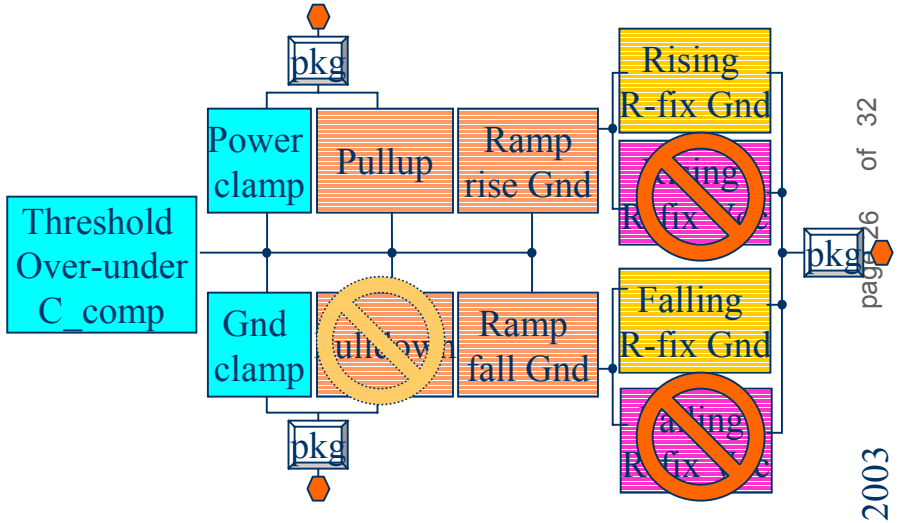

u
V1
GND
t
u
V1
GND
t


u
Vcc
V2
t
u
Vcc
V2
t


Low/
pull down
Iout
Vout
High/
pullup


Vcc
I high
I low
Gnd


pkg
Power clamp
Pullup
Ramp rise Gnd
Rising R-fix Gnd
Threshold Over-under C_comp
Gnd clamp
Ramp fall Gnd
Falling R-fix Gnd
pkg
pkg

Technologies Overview

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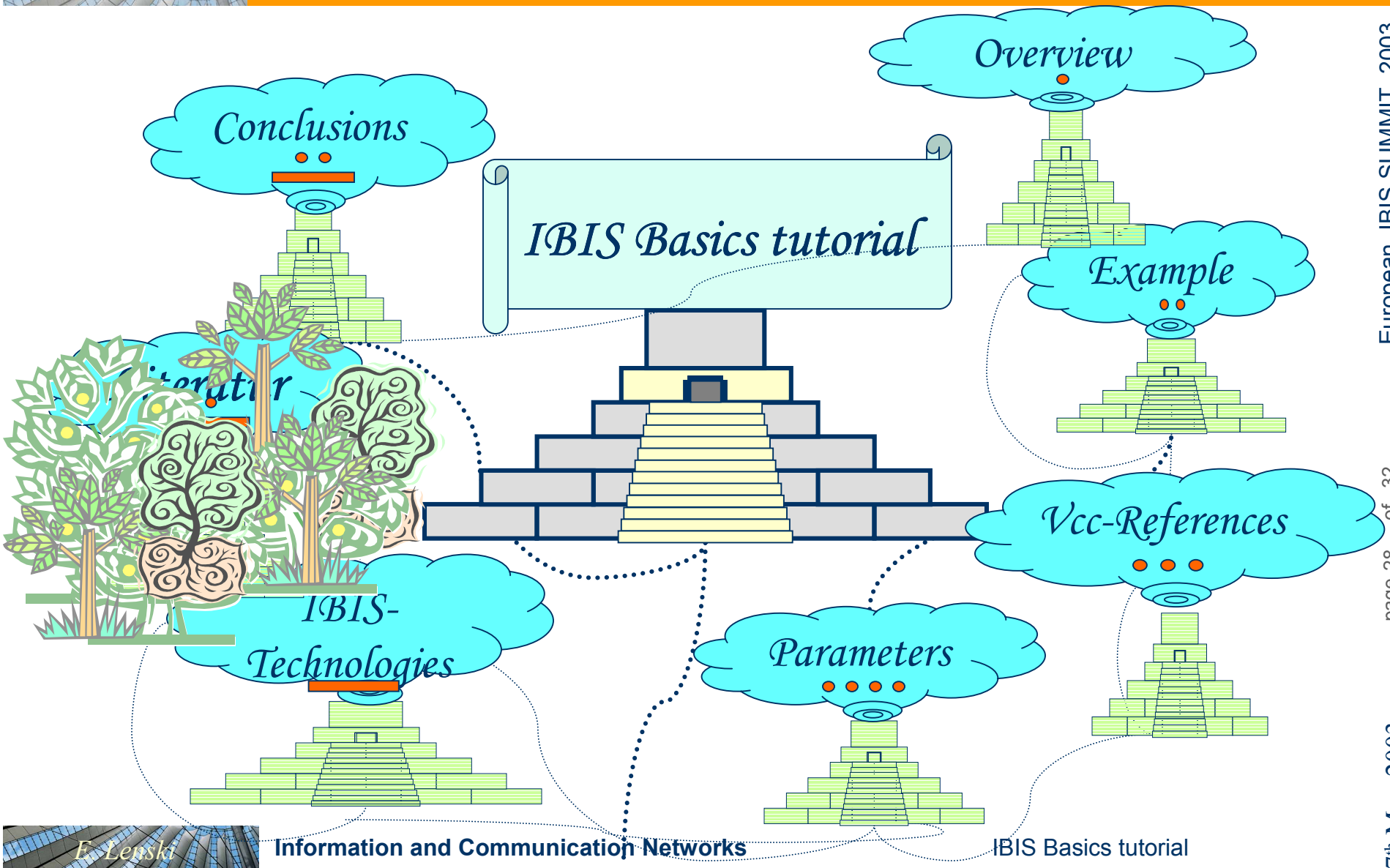
Model-Type / Technologie	Push Pull	ECL	Open Sink	Open Source
TTL	X			
CMOS	X			
PCI	X			
SSTL	X			
ECL		X		
PECL		X		
GTL			X	
GTLP			X	
CML			X	
LVDS	X			
CAN			X	X

Literature


Overview
Conclusions
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Example
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Technologies
Parameters

Literature

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http://www.eigroup.org/ibis/ibis.htm

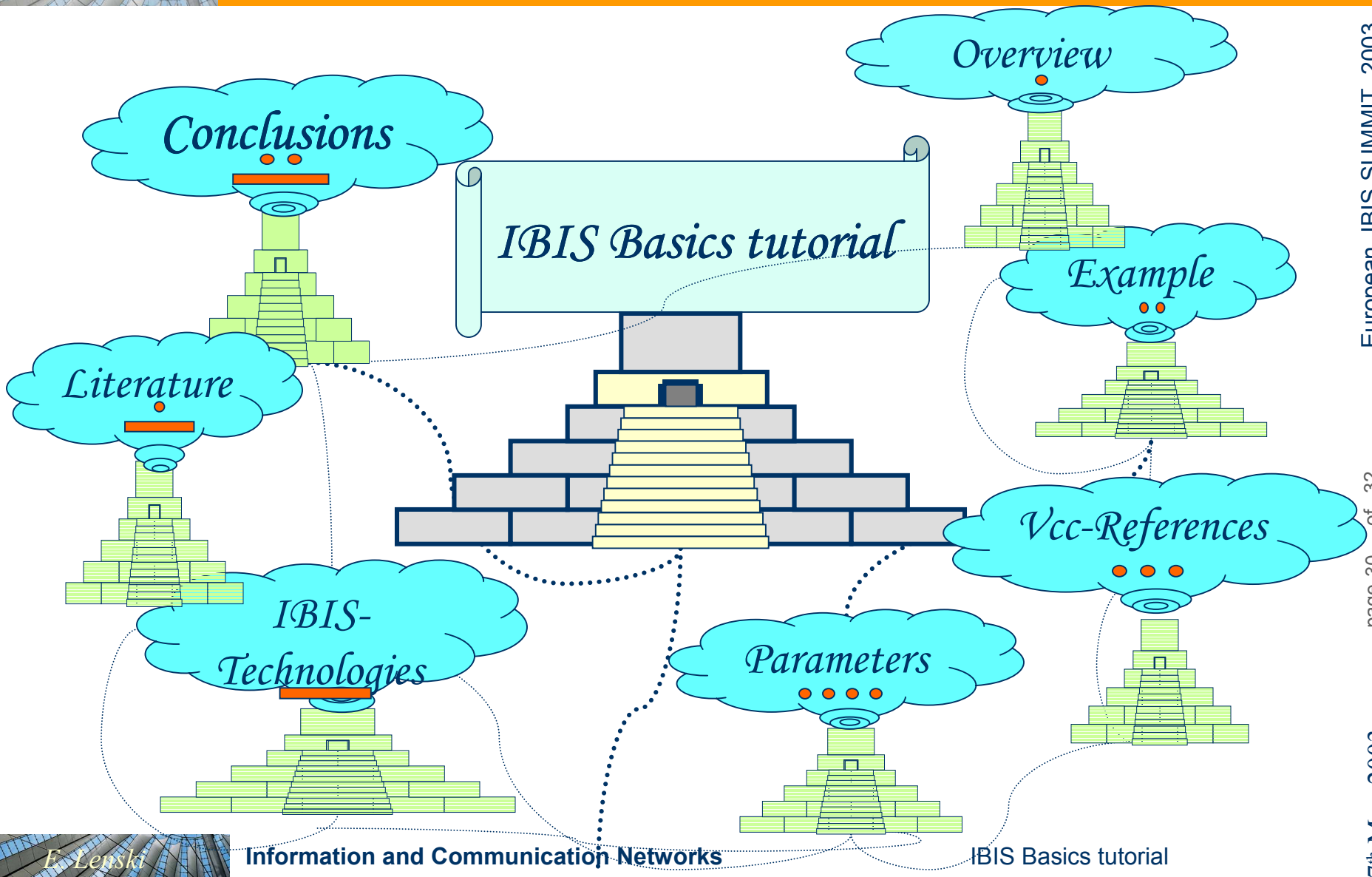
http://www.eigroup.org/ibis/articles.htm
(summits)
http://www.eigroup.org/ibis/tools.htm
(cookbook v2.1)

http://www.eda.org/pub/ibis/training/
(IBIS_class_JEDEC.zip)

ftp://ftp.eda.org/pub/ibis

http://www.sisoft.com/ibis-quality/checklist

Conclusions



Conclusions

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- Take care of conditions for min max

- Include each used parameter if possible

- Use the correct modeltype with the corresponding parameters

- Use the ibis quality checklist (coming soon)

Improvements

SIEMENS

1885

today