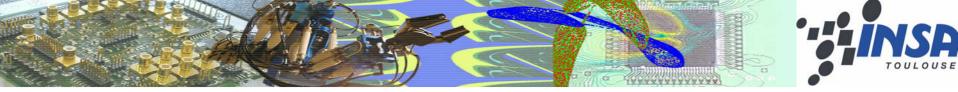


European Ibis Summit Apr 19th, 2007

From IBIS to Electromagnetic Compatibility Prediction of Integrated Circuits

Etienne SICARD <u>etienne.sicard@insa-toulouse.fr</u> http://www.ic-emc.org

European IBIS summit APR 19th, 2007 at DATE 07 - etienne.sicard@insa-toulouse.fr - www.ic-emc.org

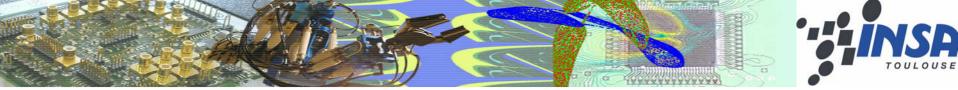


Credits

- European project MEDEA+ "Parachute" (2005-2007)
- European project PIDEA+ "EMCPack" (2006-2008)

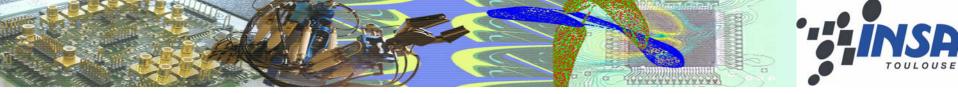




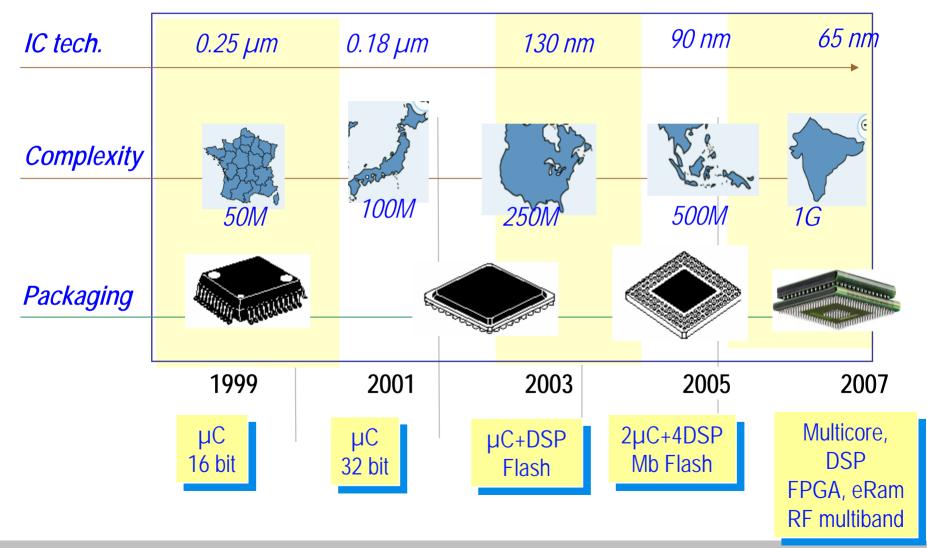


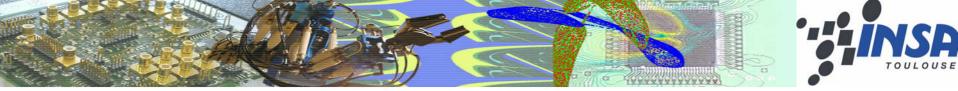
Summary

- 1. Technology Scale Down
- 2. EMC issues
- **3. EMC Prediction flow**
- **4. Implementation in IC-EMC**
- **5. EMC Prediction**
- 6. Conclusion

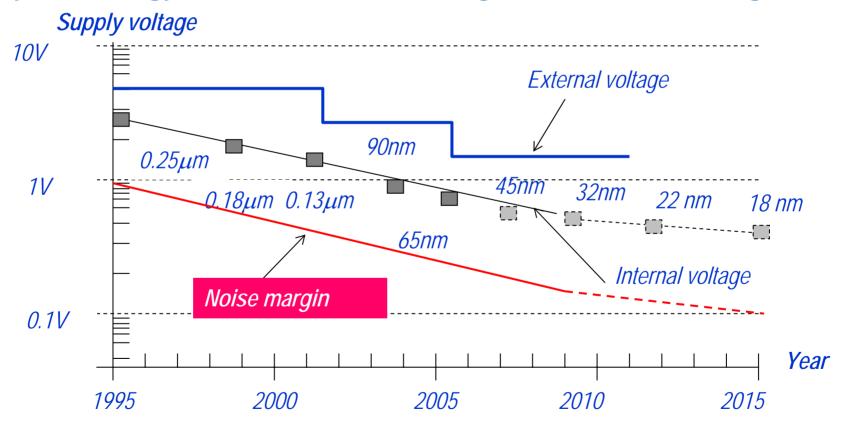


1. Technology Scale Down

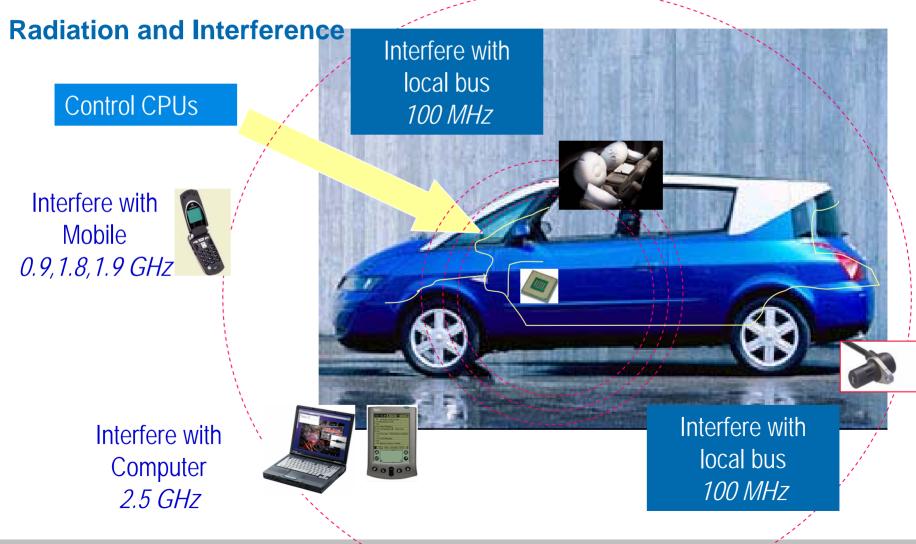


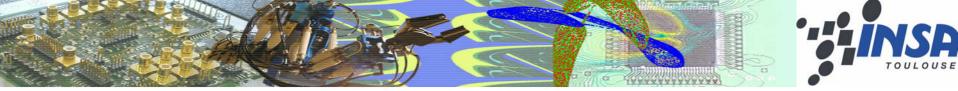


Why technology scale down makes things worse – noise margin

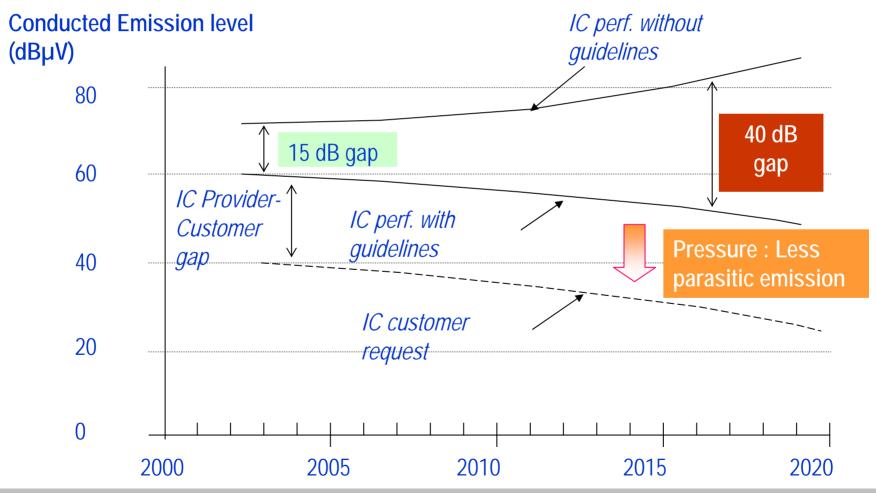




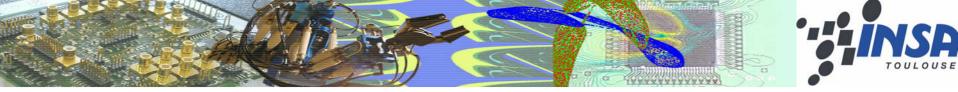


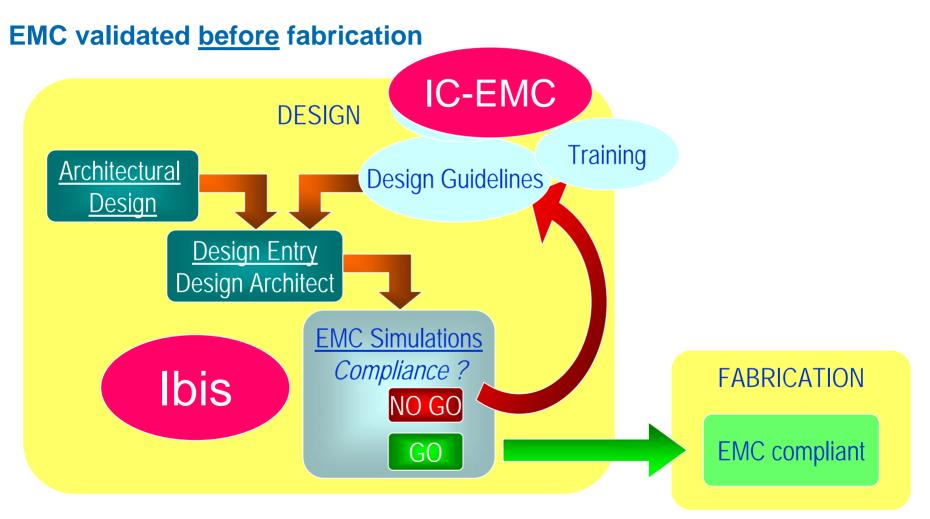


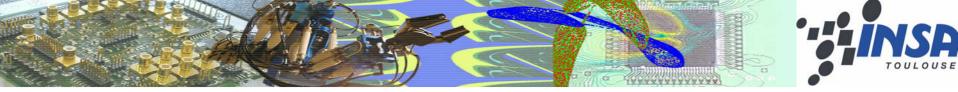
The Design Gap



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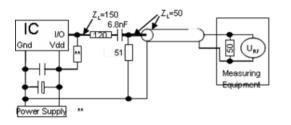




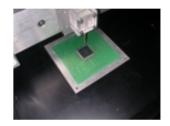


3. EMC prediction flow

Target Measurement Methods





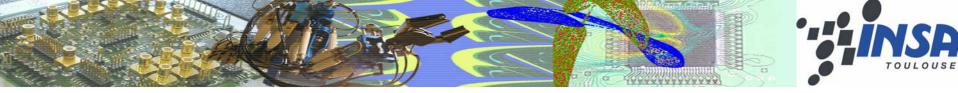


Conducted emission 1/150 Ω

Radiated emission GTEM

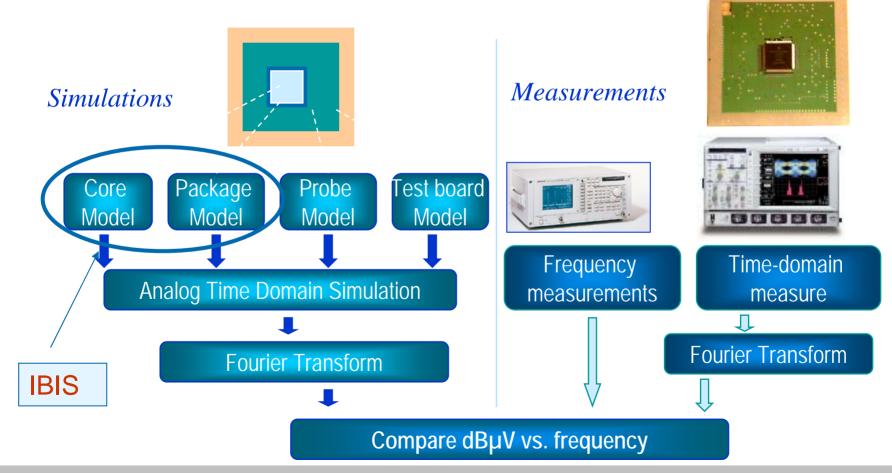
Near-field emission

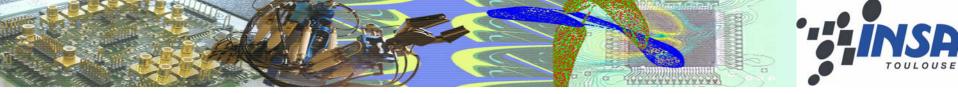
- Should predict conducted mode, radiated and near-field emission
- Should use one single core and IO model for all methods
- Should be non-confidential and based on standards
- IC-EMC was developed as a demonstration freeware to handle measurement/simulation comparisons



3. EMC prediction flow

IBIS involved in Package and Core model

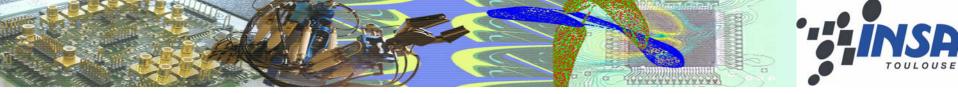




4. Implementation in IC-EMC

IBIS interface in IC-EMC

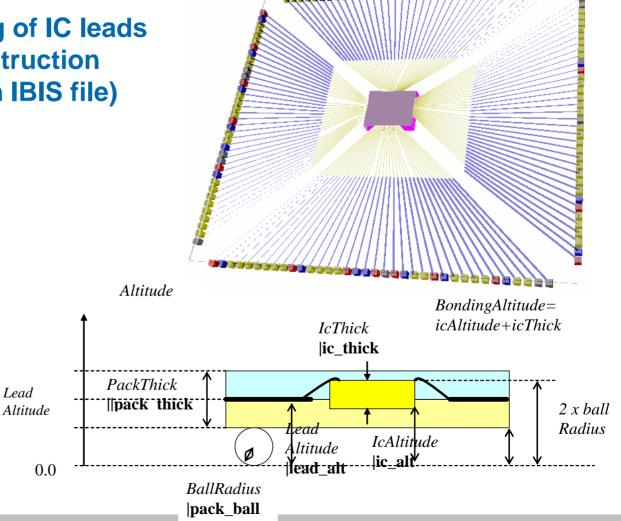
🌃 Ibis Interface					
Input text		Parameters			
[IBIS Ver] 3.1		I/O Models Infos	Package		
[File name] S12X_v2_1.ibs		Package			
[File Rev] 1.0					
Date] 06/11/01 105/01/17 created IBIS description		Type: QFP	-	🗄 IOs 🛛 🔠 Back	
					2D-
05/03/18 Modified		Pins: 36	× 36		
06/09/19 Add package info				Draw	no o o o tur rottor
06/11/01 Add package cavity size		View: Top view	-		reconstructior
[Source] Freescale - INSA				🔽 Display coordinates	
[Notes] The following information corresponds to the Freescale MC9S12XDP512 OL15SY		Locate pin : PP1_3	-	Display pin names	of the
μ-controller for SIEMENS VDO application				Display plit fidities	of the
[Disclaimer] This information is for modeling purposes only, and is not		View			
guaranteed.				111111111111111111100	nackada
for more information about this IBIS model please take contact with		144444000000000			package
Christophe Lochot		1			
		3			
				🖌 🚦 📲	
[Component] Freescale MC9S12XDP512					
[Manufacturer] Freescale		l é <mark>:</mark>			
		12		•	
[Package]					
typ min max					
R_pkg 0.05 0.03 0.1		12			
Lpkg 5nH 4nH 8nH		15	\mathbf{i}		
C_pkg 0.5pF 0.4pF 0.8pF		l iś <mark>s</mark>	\sim		
		20			
Keywords added by E. Sicard for IC-Emc		21		-	
· · · · · · · · · · · · · · · · · · ·		23			
 Data given by Freescale		25			
[Package model] gfp		2F		-	
pack_width=20.1e-3		28			
pack_might=20.1e-3		30			
ic_width= 6.55e-3		32			
lic_height= 6.33e-3		9 11 11 11 11 11 11 11 11 11 1			
lic_xstart= 6.73e-3		35			
lic votart= 6.84o-3	-	35			
🖌 OK 🛛 🏧 3D Draw	HA III	Ivanced SPICE and IBIS			

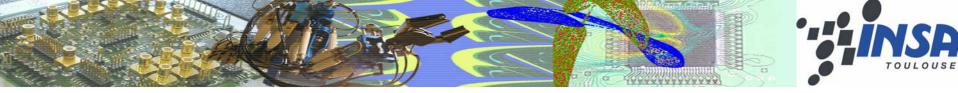


4. Implementation in IC-EMC

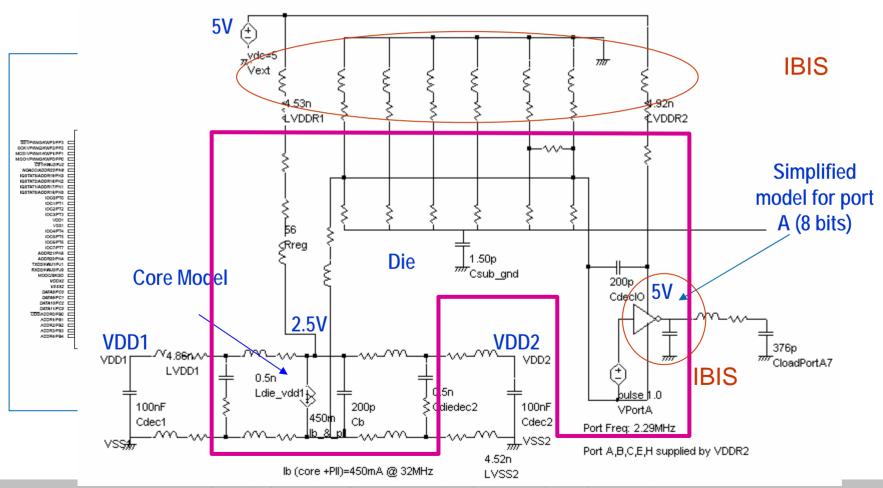
Physical positioning of IC leads thanks to 3D reconstruction (hidden keywords in IBIS file)

|pack_width=20.1e-3 |pack_height=20.1e-3 |ic_width= 2.7e-3 |ic_height= 2.5e-3 |ic_xstart= 9.2e-3 |ic_ystart= 9.2e-3 |pack_cavity=8.5e-3 |pack_cavity=8.5e-3 |pack_pitch=0.5e-3 |pack_xstart=23.1e-3 |pack_ystart=24.1e-3 |ic_altitude=0.8e-3

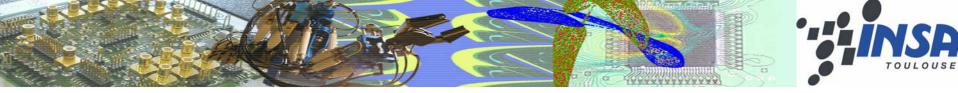




IC model

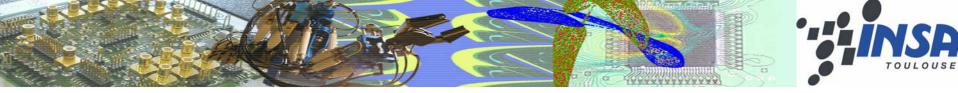


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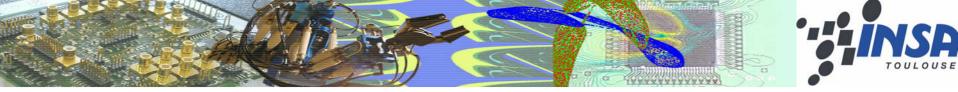
Radiated emission in GTEM full-drive mode dBµV Orientation 90° PLL on: 64Mhz bus clock: 32 MHz 40.00 Port A freq: 2.29 MHz 20.00 Frequency MHZ 0.00 20 100 1K 30 50 300 400 500 2K ЗK 40 200

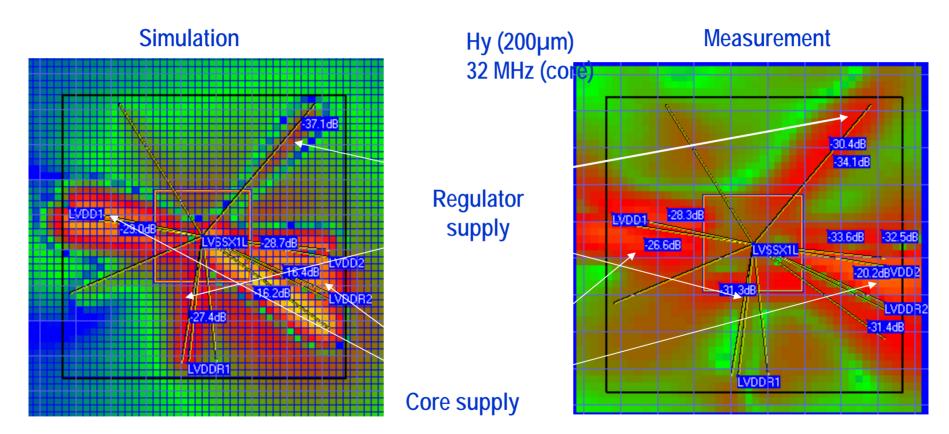
Good correlation between measurement and simulation: Emission level mainly due to the Port A activity



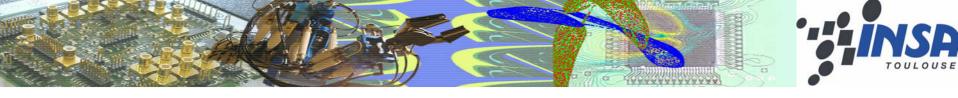
Near Field Preduction flow Scan Measurements **IBIS Simulations** Elec. package Physical lead Core er begentle spesorer er aller berent coordinates Model Model Spectrum Positionning analyser [x,y] Analog Time Domain Simulation H[x,y] at given *f*, Fourier Transform of I(t) given z H[x,y,z] of I(f)Compare scans

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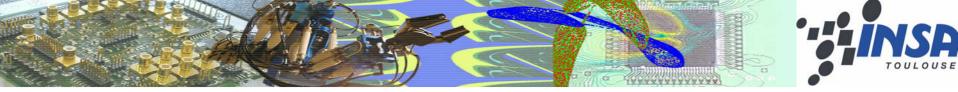


Good correlation between measurement and simulation for the core and regulator supplies. Important feedback for designers.



5. EMC prediction – Future of EMC models

Bandwidth	Туре	2005	2010	2015	2020
Below 3 GHz	Conducted	Ind. Use (ICEM)			
	Radiated	Sol. Exist (ICEM- radiated, dipole)	Ind. Use		
3-10 GHz	Conducted	NOT known	Sol. exists	Ind. Use	
	Radiated	NOT known	Sol. exists	Ind. Use	
10 – 40 GHz	Conducted	NOT known	NOT known	Sol. exists	Ind. Use
	Radiated	NOT known	NOT known	Sol. exists	Ind. Use



Conclusion

- An environment for EMC prediction at IC level has been developed
- The tool uses IBIS information for package and I/O modeling
- Conducted, radiated emission succesfully predicted on several ICs
- □ The demonstration tool and manual are online at <u>www.ic-emc.org</u>
- Demos at IEEE EMC 07 Hawaii, EmcCompo 07, EMC Hambourg 08

