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From IBIS to Electromagnetic Compatibility Prediction of Integrated Circuits

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http://www.ic-emc.org

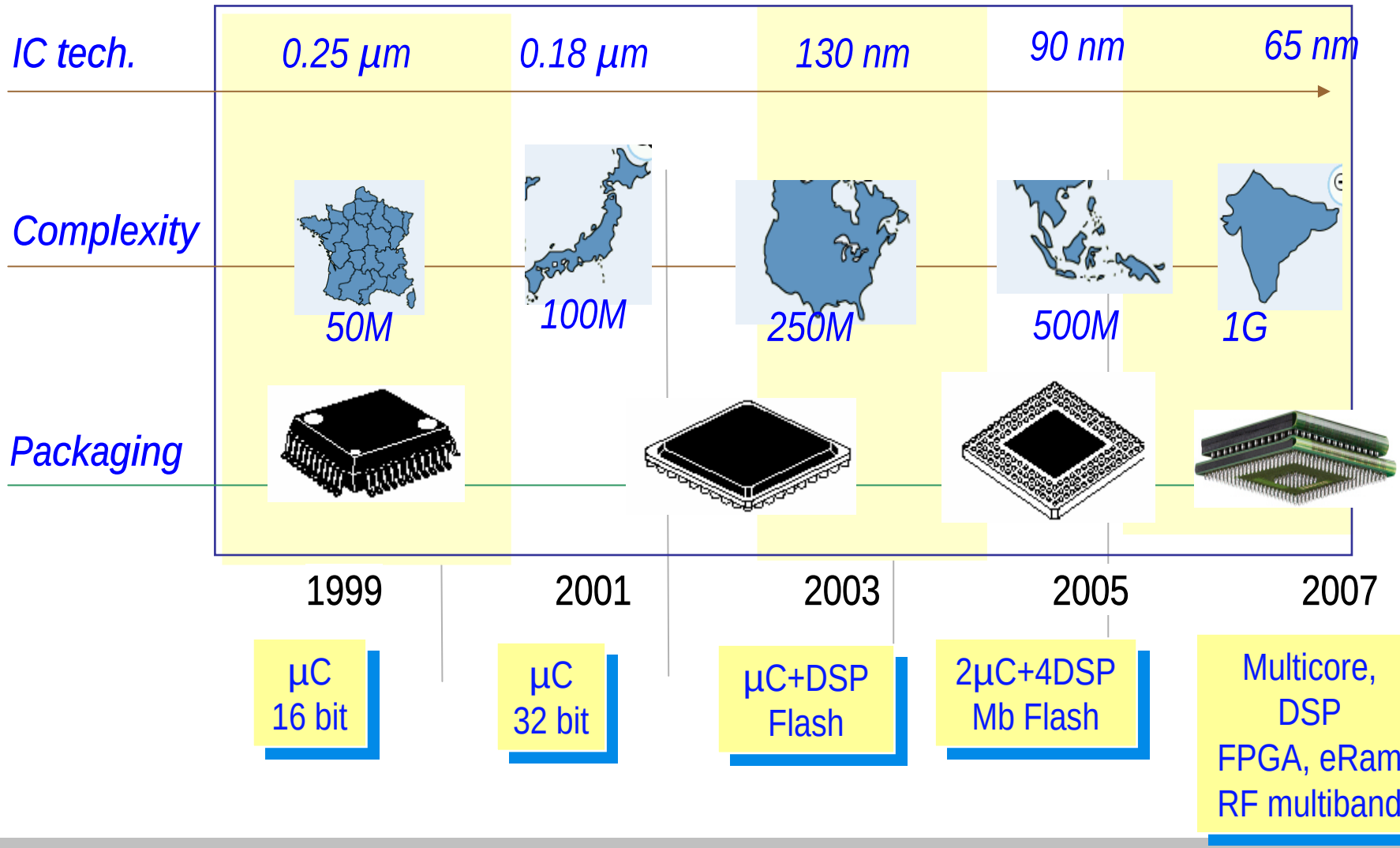
Credits

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

Summary

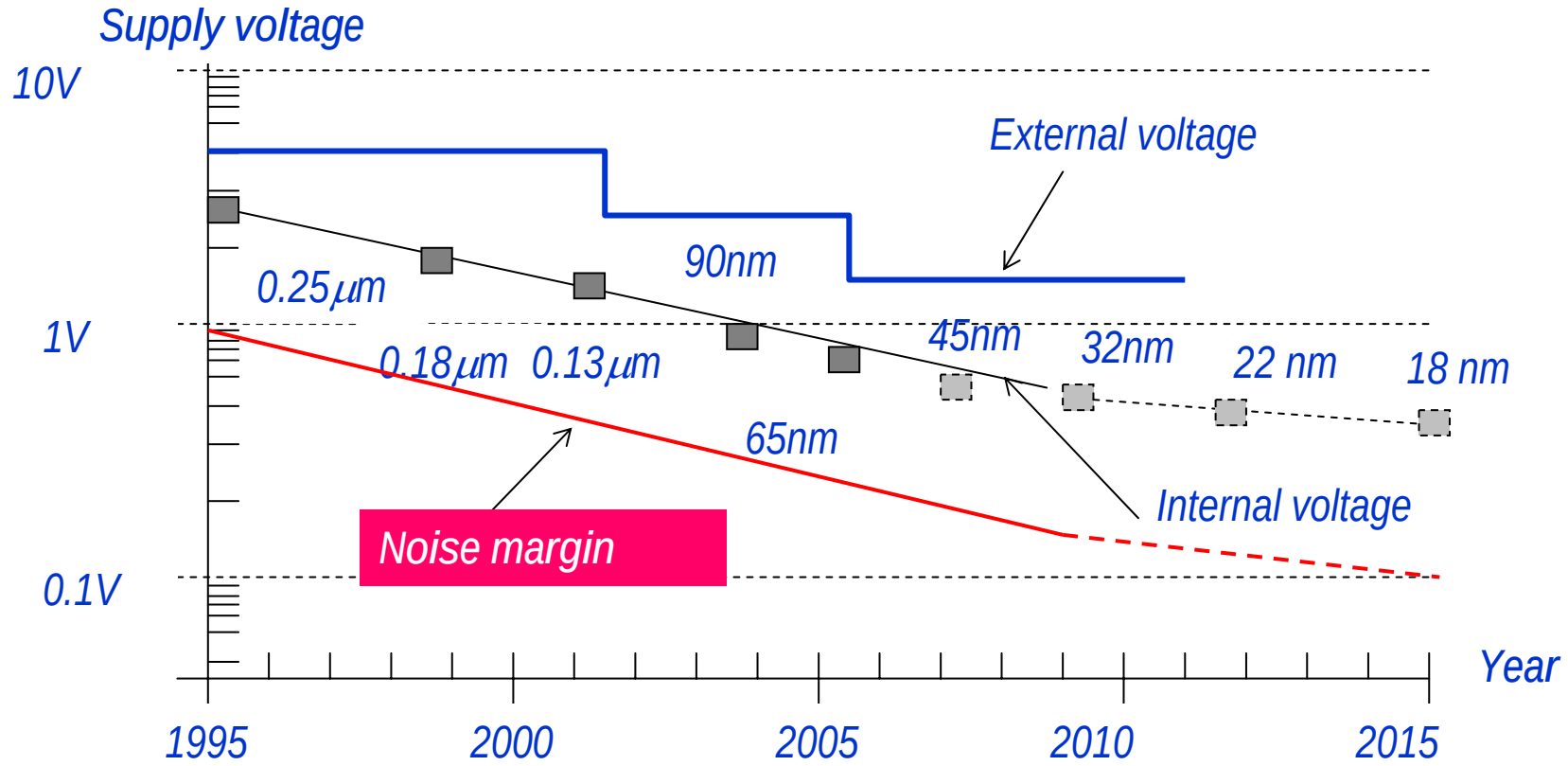
1. Technology Scale Down
2. EMC issues
3. EMC Prediction flow
4. Implementation in IC-EMC
5. EMC Prediction
6. Conclusion

1. Technology Scale Down



2. EMC Issues

Why technology scale down makes things worse – noise margin



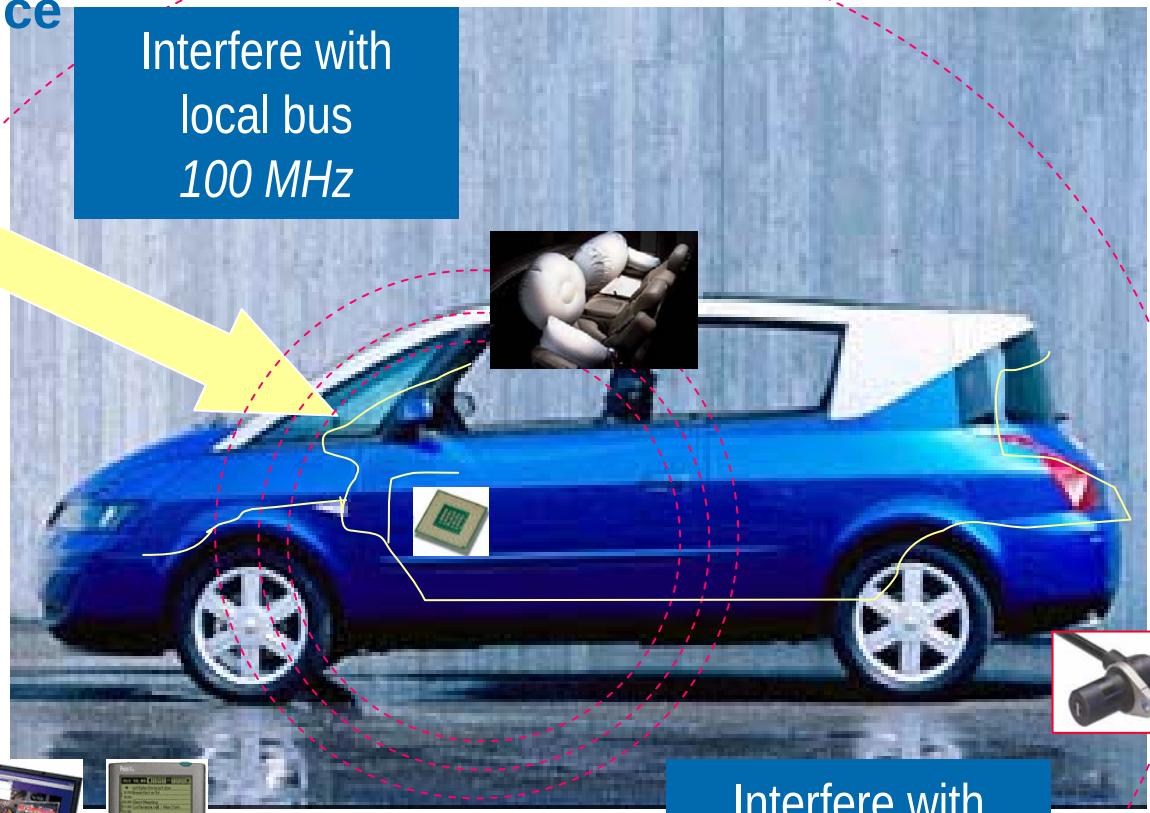
2. EMC Issues

Radiation and Interference

Control CPUs

Interfere with local bus *100 MHz*

Interfere with Mobile *0.9,1.8,1.9 GHz*

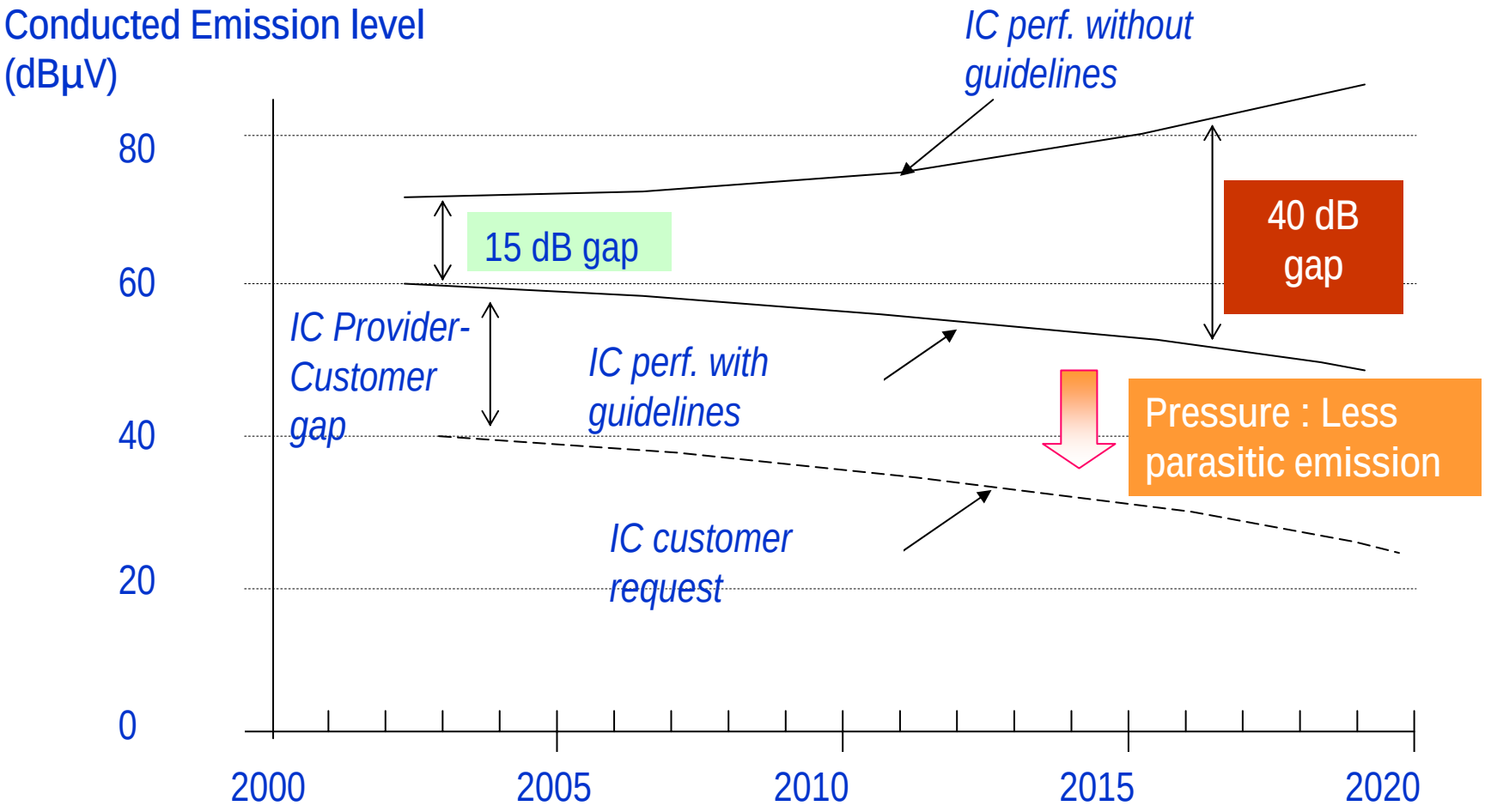


Interfere with Computer *2.5 GHz*

Interfere with local bus *100 MHz*

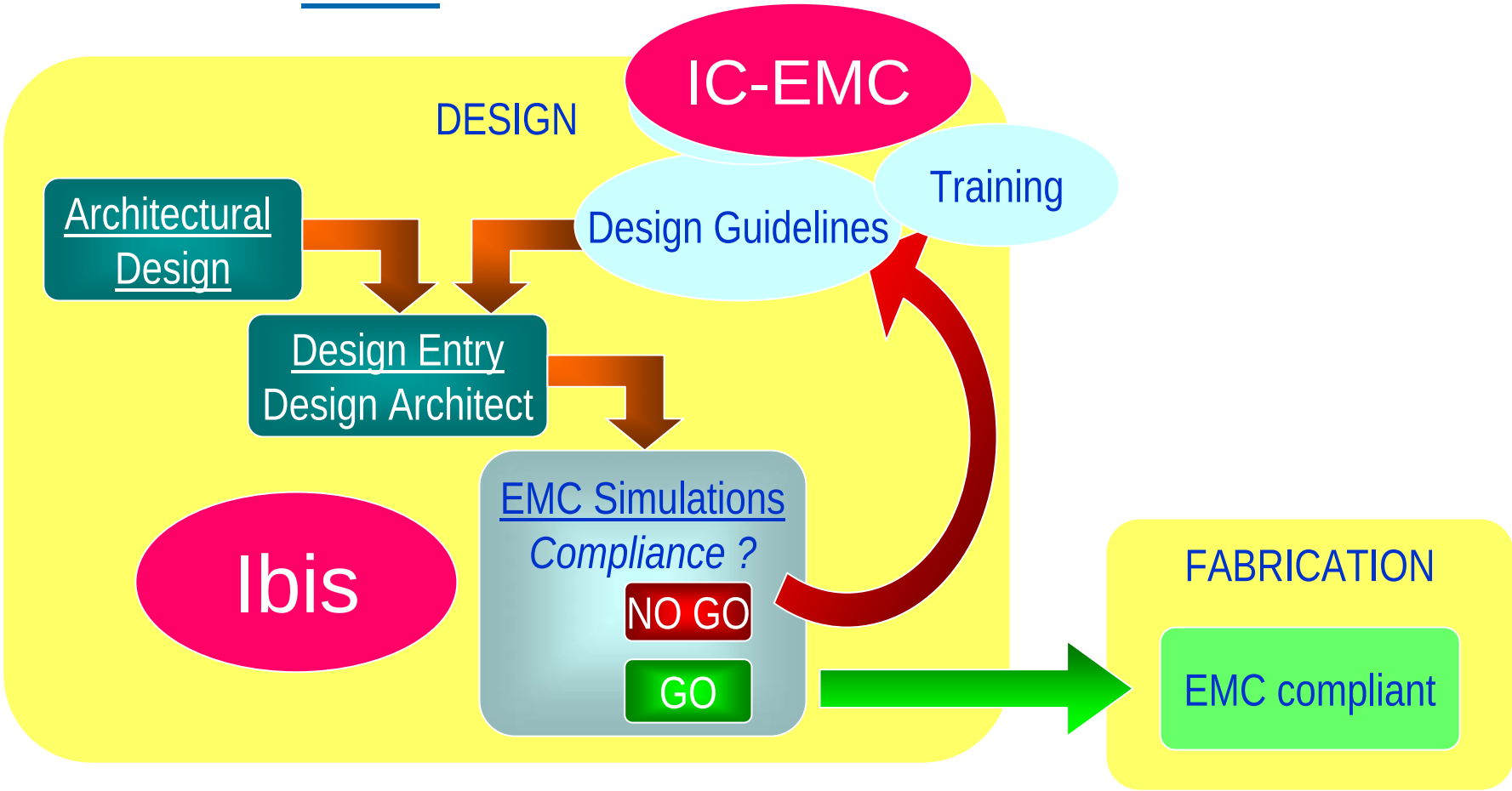
2. EMC Issues

The Design Gap



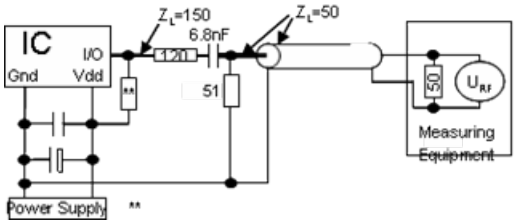
2. EMC Issues

EMC validated before fabrication



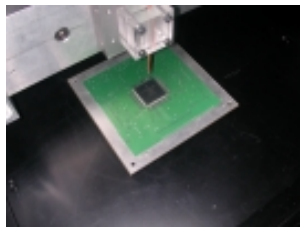
3. EMC prediction flow

Target Measurement Methods



Conducted emission 1/150 Ω

Radiated emission GTEM



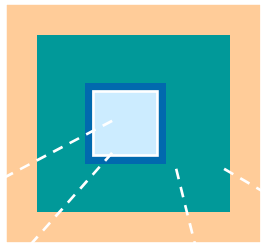
Near-field emission

- **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

Simulations



Core Model

Package Model

Probe Model

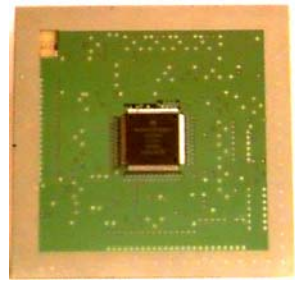
Test board Model

Analog Time Domain Simulation

Fourier Transform

IBIS

Measurements



Frequency measurements

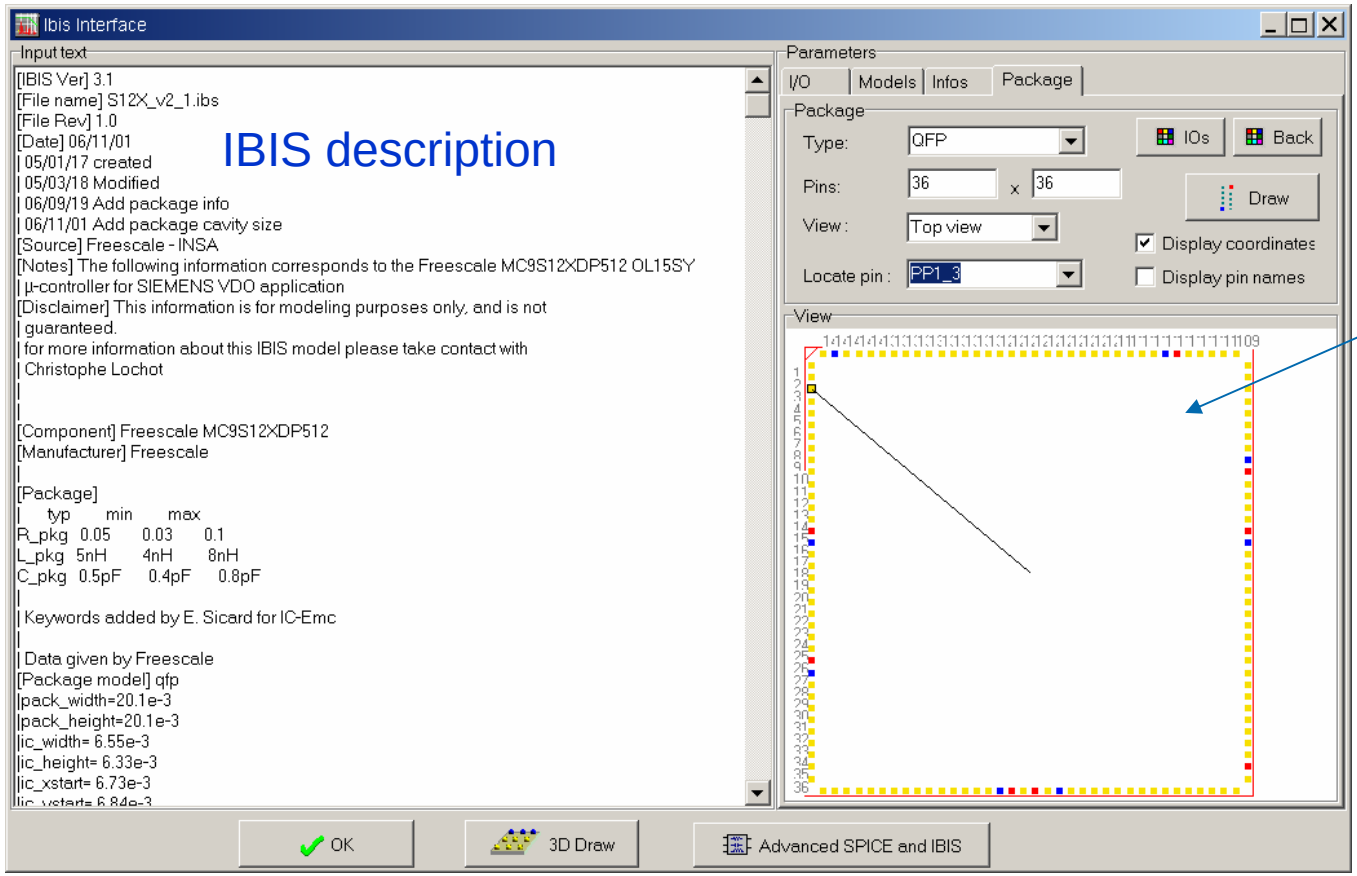
Time-domain measure

Fourier Transform

Compare dBµV vs. frequency

4. Implementation in IC-EMC

IBIS interface in IC-EMC



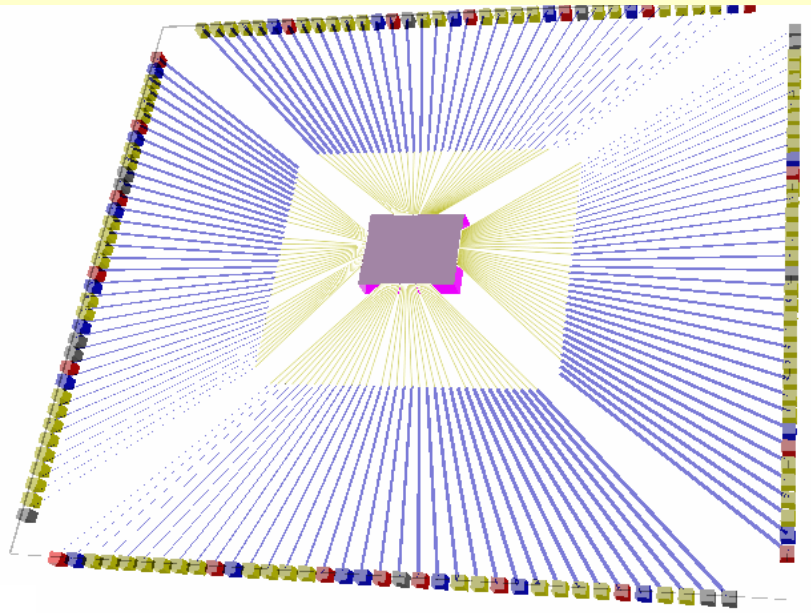
IBIS description

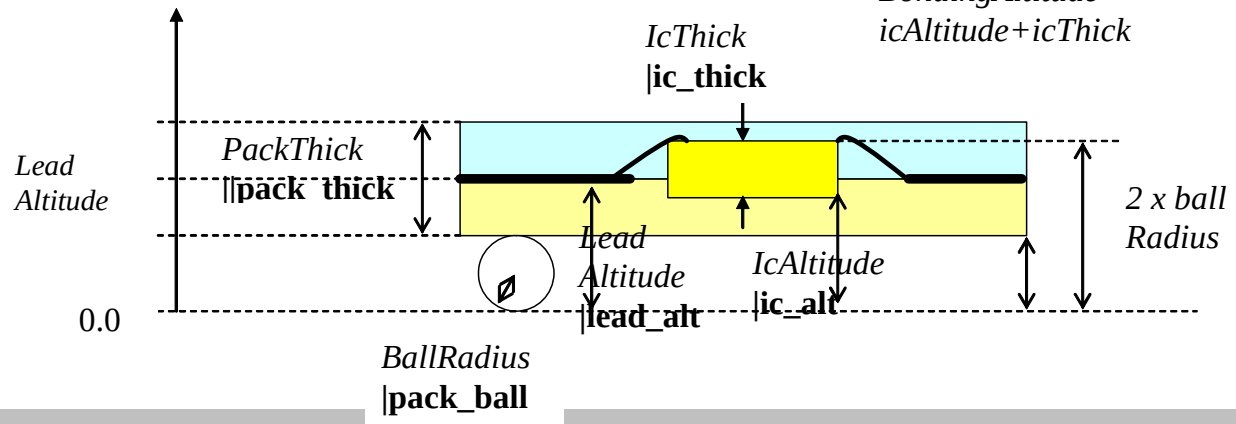
2D-reconstruction of the package

4. Implementation in IC-EMC

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

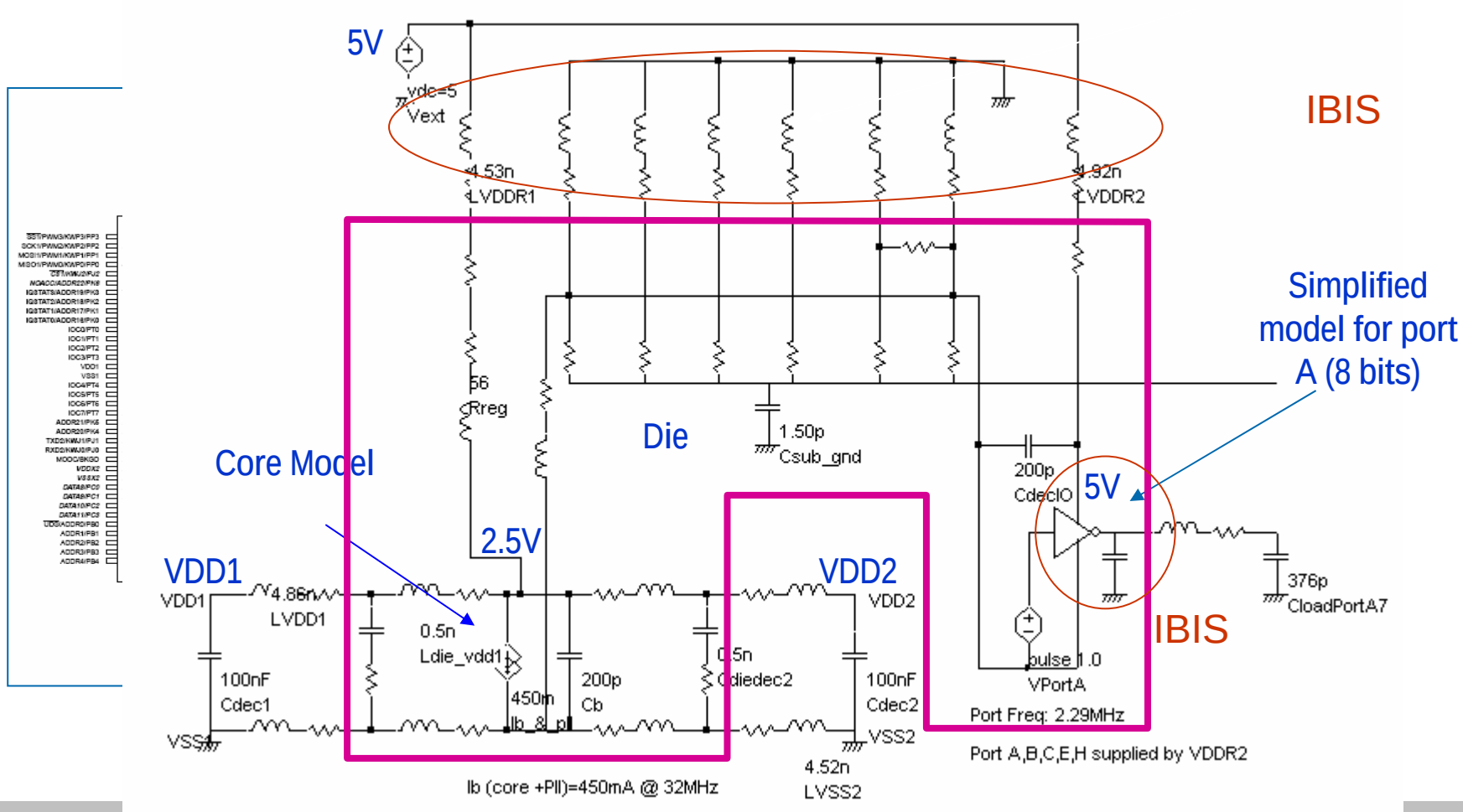
|pack_width=20.1e-3
|pack_height=20.1e-3
|ic_width= 2.7e-3
|ic_height= 2.5e-3
|ic_xstart= 9.2e-3
|ic_ystart= 9.2e-3
|pack_cavity=8.5e-3
|pack_pitch=0.5e-3
|pack_xstart=23.1e-3
|pack_ystart=24.1e-3
|ic_altitude=0.8e-3





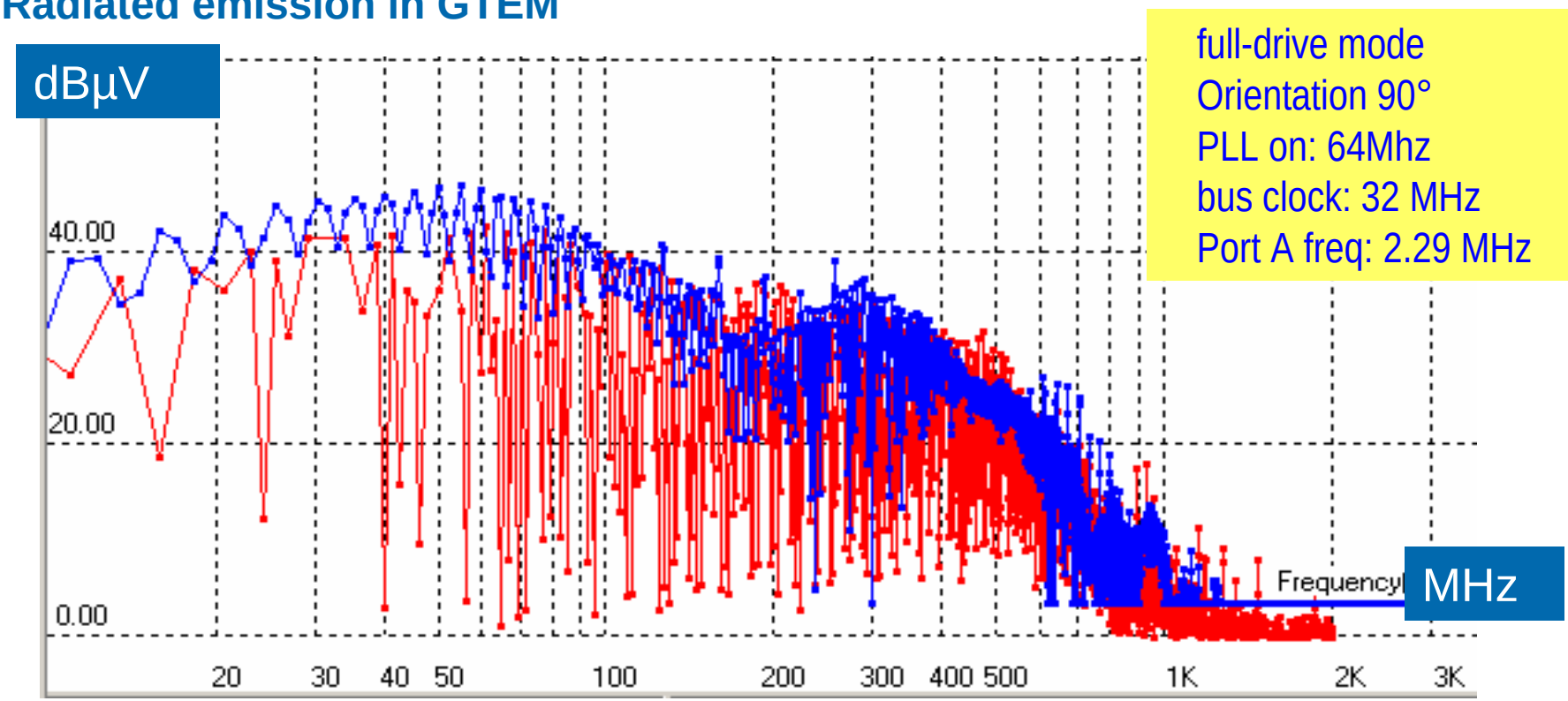
5. EMC prediction

IC model



5. EMC prediction

Radiated emission in GTEM



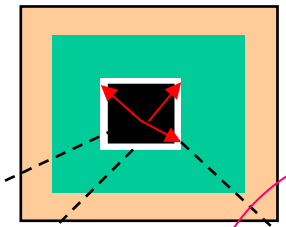
Good correlation between measurement and simulation:

Emission level mainly due to the Port A activity

5. EMC prediction

Near Field Prediction flow

Simulations



IBIS

Core Model

Elec. package Model

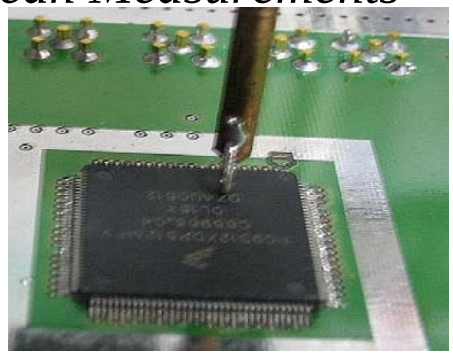
Physical lead coordinates

Analog Time Domain Simulation

Fourier Transform of I(t)

H[x,y,z] of I(f)

Scan Measurements



Spectrum analyser

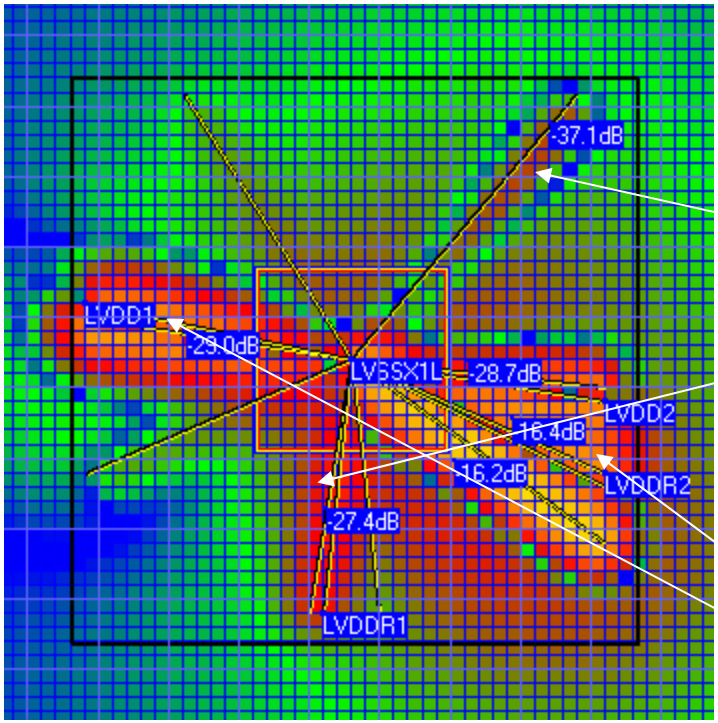
Positionning [x,y]

H[x,y] at given *f*, given *z*

Compare scans

5. EMC prediction

Simulation

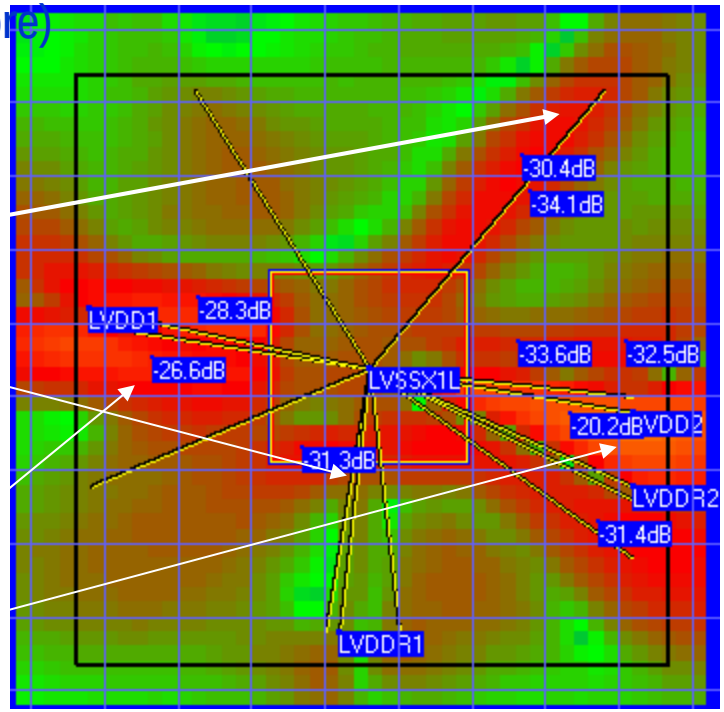


Hy (200µm)
32 MHz (core)

Regulator supply

Core supply

Measurement



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

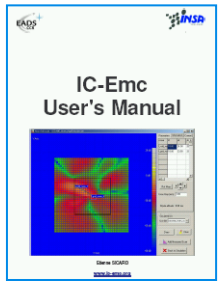
5. EMC prediction – Future of EMC models

Bandwidth	Type	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 www.ic-emc.org
- Demos at IEEE EMC 07 Hawaii, EmcCompo 07, EMC Hambourg 08

www.springer.com



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