Using Mixed Signal Analysis to address IoT design challenges

setting up a virtual prototype

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CB Distribution

Facts

- Cadence Channel Partner Netherlands, Belgium, Luxembourg, Spain and Portugal
- Located in Hengelo (Netherlands) and Madrid (Spain)
- Sales and Support of
  - Cadence IC design tools
    - Virtuoso, Incisive, Encounter
  - Dassault
    - Enovia DDM/PLM environment
  - Cadence PCB, Simulation and Packaging-Tools
    - OrCAD, PSpice, Allegro
  - WISE GerbTool
  - Nextra three-dimensional PCB design

CB Distribution

IoT Design Challenges

Sensing a complex environment

Multiple connectivity options

Wi Fi

6LoWPAN

Bluetooth SMART

Power is critical

Security is a must

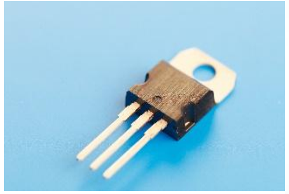
The IoT is complex

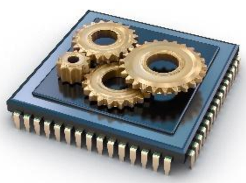
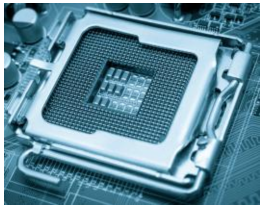
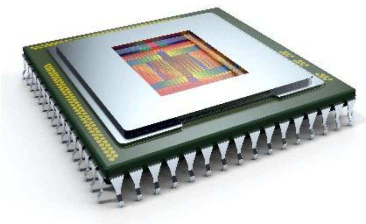
Connecting to the cloud

Source: Texas Instruments

System Integration

Discrete Devices → Basic Integration → Mixed-Signal Technologies → Mixed-Signal Electro-Mechanical → SoC Integration → Package Integration



Electronic systems trending to large devices for
lower power, higher reliability, and increased functionality in smaller package

HDL-level simulation in PCB systems, with multiple large ICs, is prohibitively slow

SPICE Models → Mixed-Signal Models → System Models

Higher abstraction and lower accuracy and lower simulation time

SMPS Designs

S/W algorithm Controlled Power Supply

Digital controllers enabled Power Supplies

↓

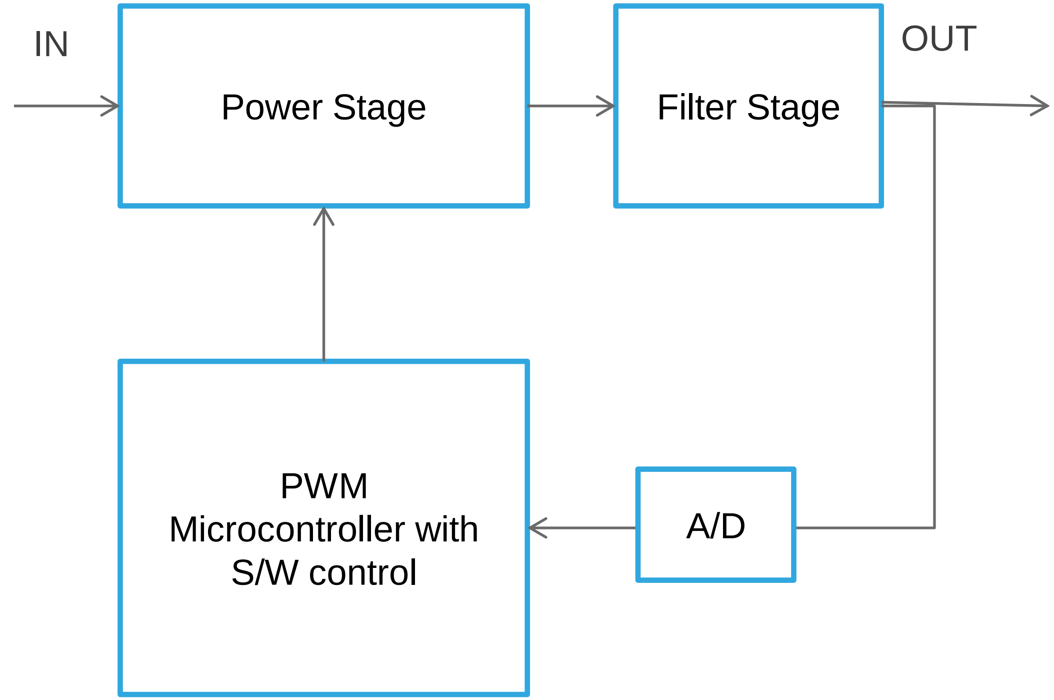
Advanced control algorithm (non-linear control, improved transient)

↓

Enable easy management of multiple control loops

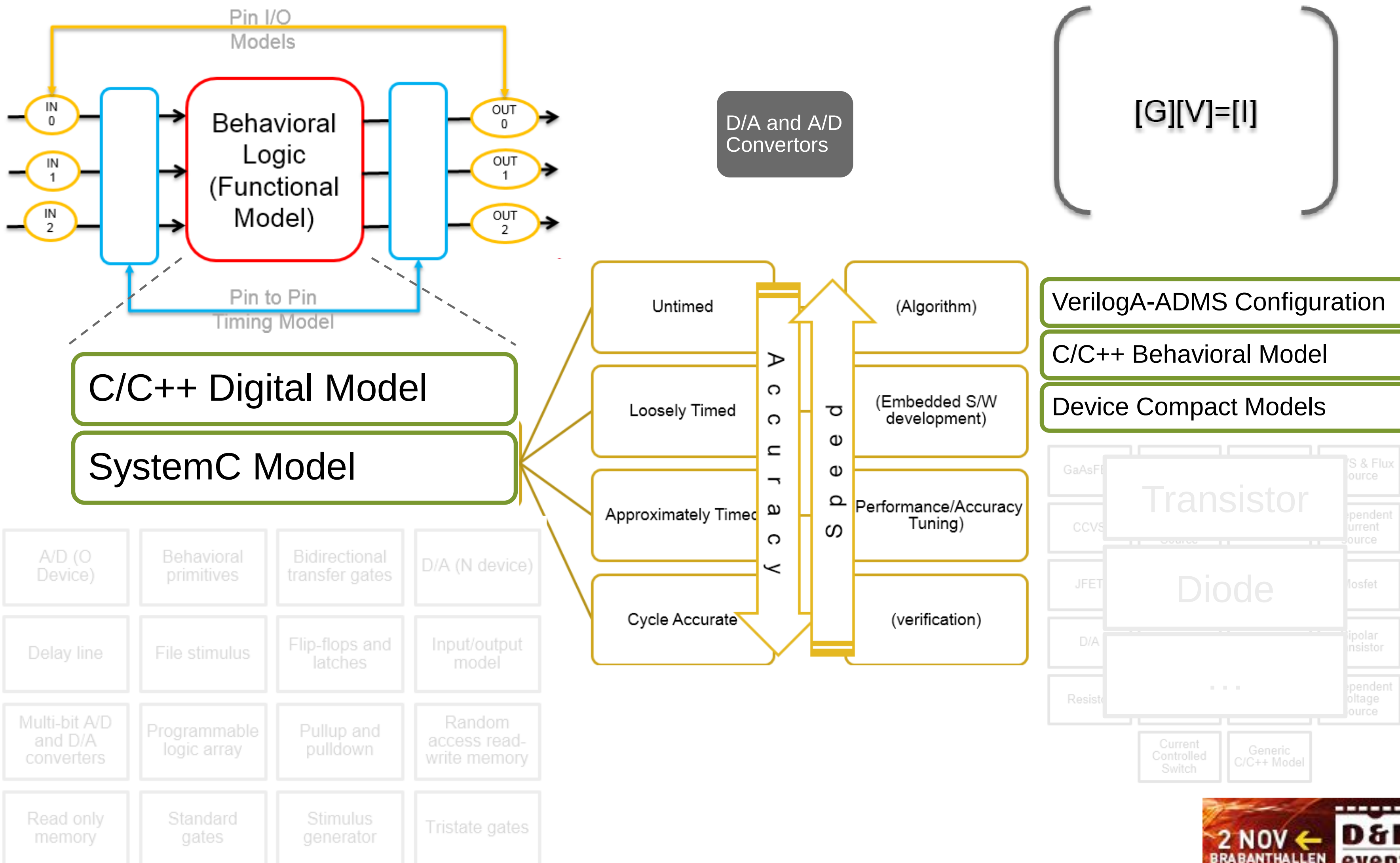
↓

Better precision tolerance to aging, temperature effects, etc.



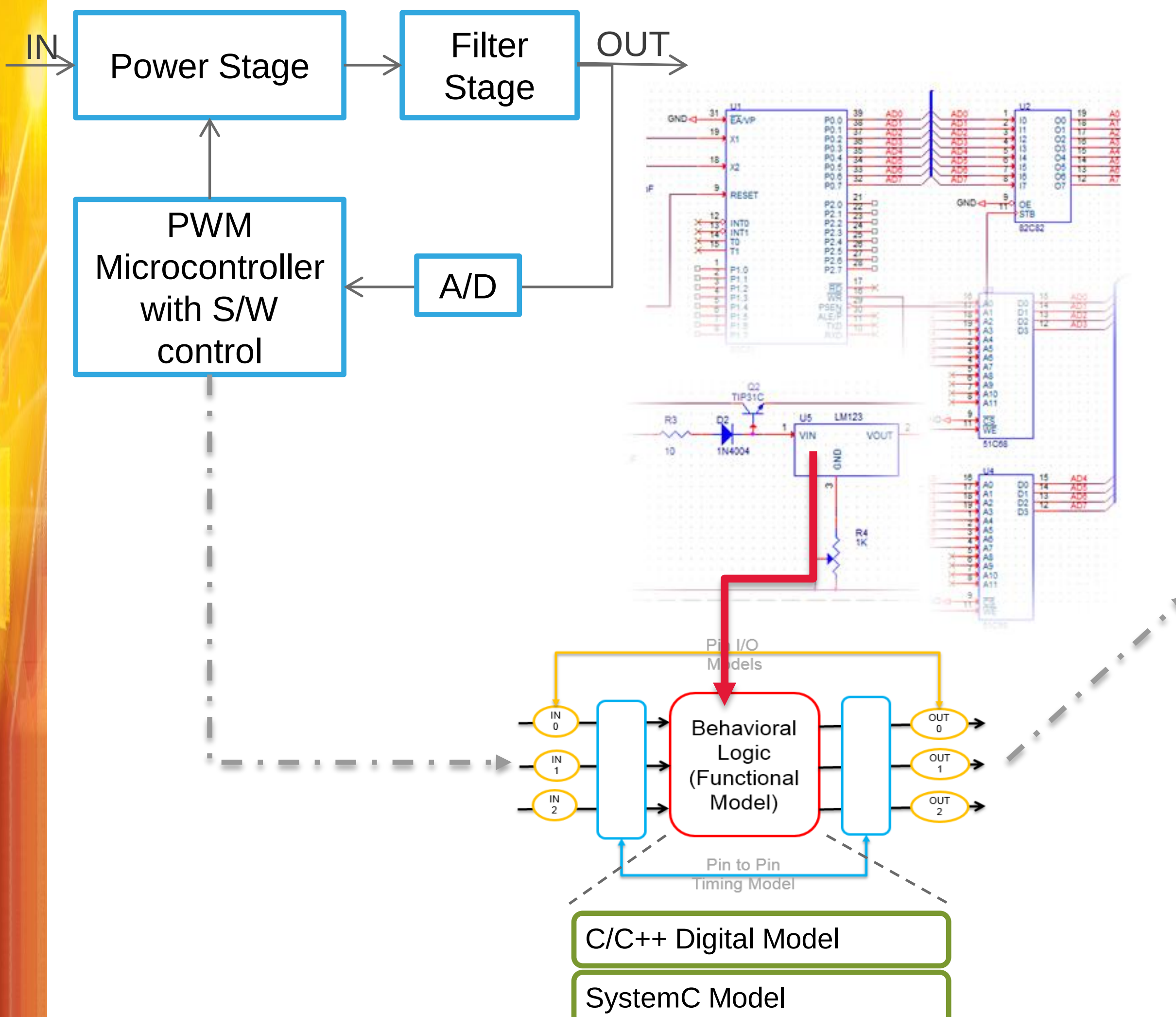
PSpice mixed-signal macro model

C/C++/SystemC extensions



Example

Software algorithm-controlled PWM in power supply



Develop and test MCU targeted algorithms in PSpice models

Get Interface values

```
for (int i = 0; i < 8; i++) {
    FB[i] = pVectorSt
}
for (int i = 0; i < 8;
    REF[i] = pVectorStates[16 - i].getLevel();
}
oldPW=PW = pVectorStates[17].getLevel();

pspBits2Int(FB, FBInt, 8);
pspBits2Int(REF, REFInt, 8);
```

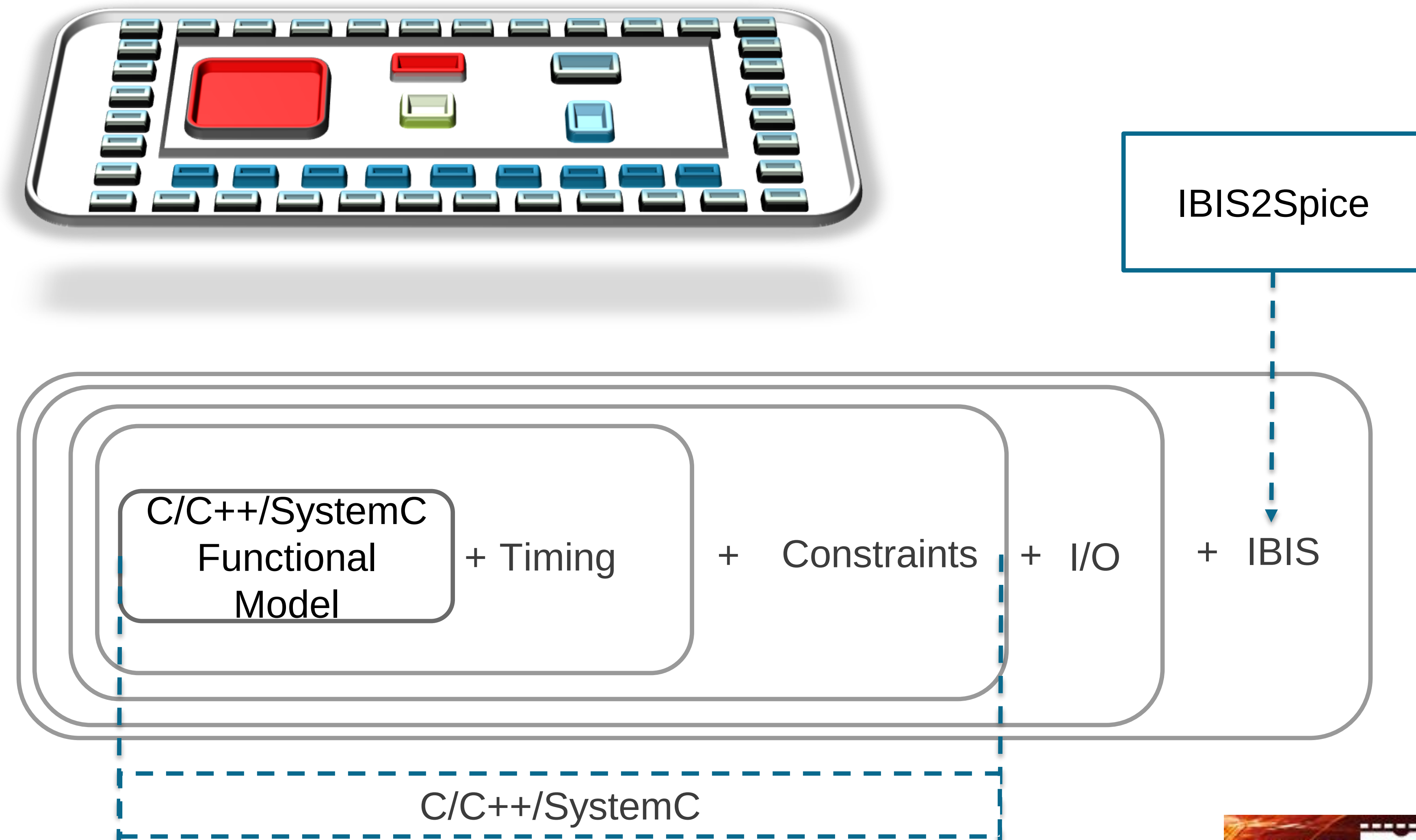
PWM S/W Control Code

```
if (mCurrentCLKCount<= 0) {
    mCurrentCLKCount = mPER;
}

if (mCurrentCLKCount > mDuty
    mPWStatus = false;
else
    mPWStatus = true;
```

Set Interface values

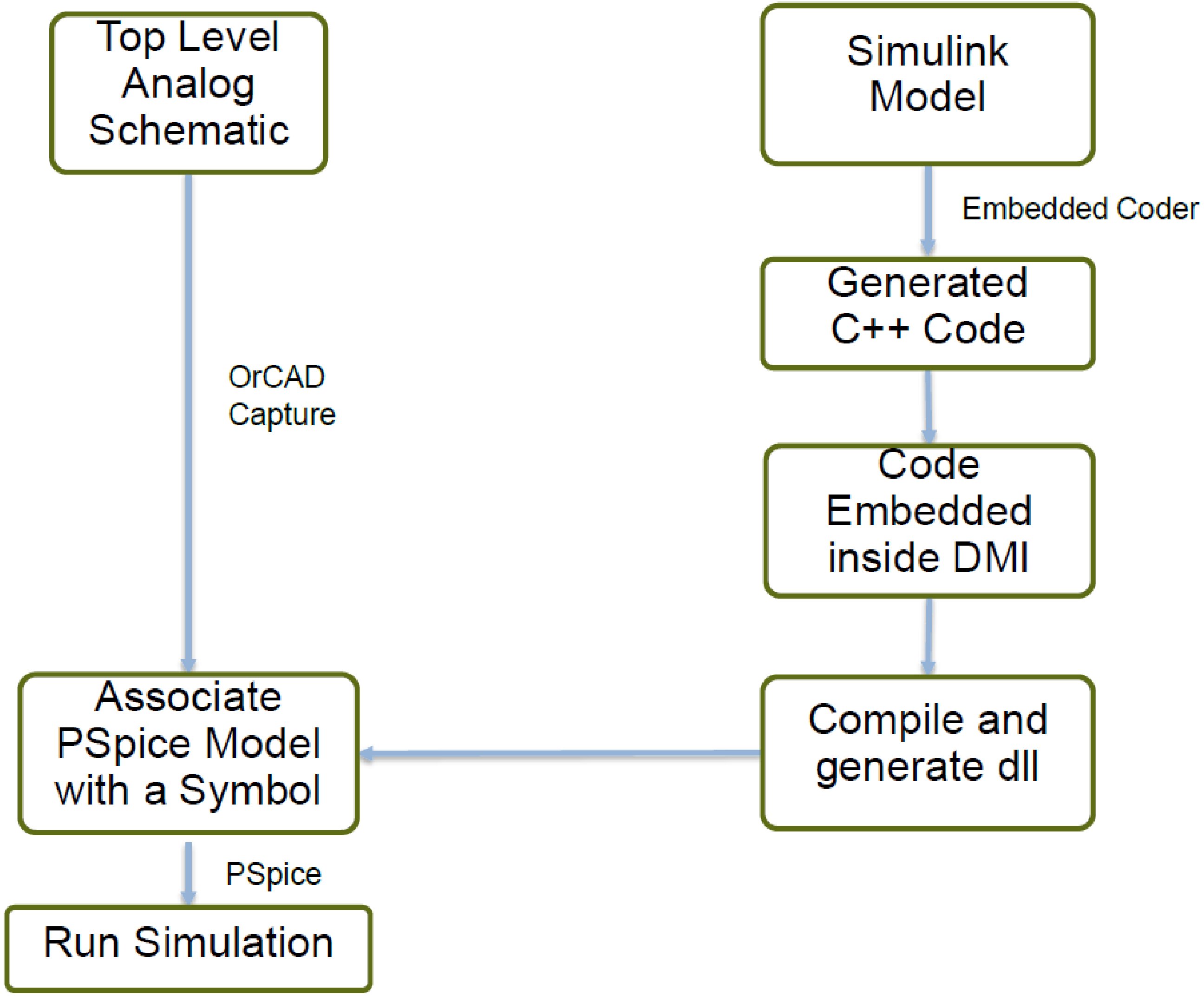
```
if (mPWStatus==true && (int)PW != 1){
    PW = pspBit::HI;
}
else if (mPWStatus == false && (int)PW != 0){
    PW = pspBit::LO;
}

if ((char)oldPW!=(char)PW) {
    PSpiceState lState = (pVectorStates)[0];
    lState = PW;
    fp_SetState(mRef, 0, &lState, NULL);
}
```

Digital Block Model Implementation



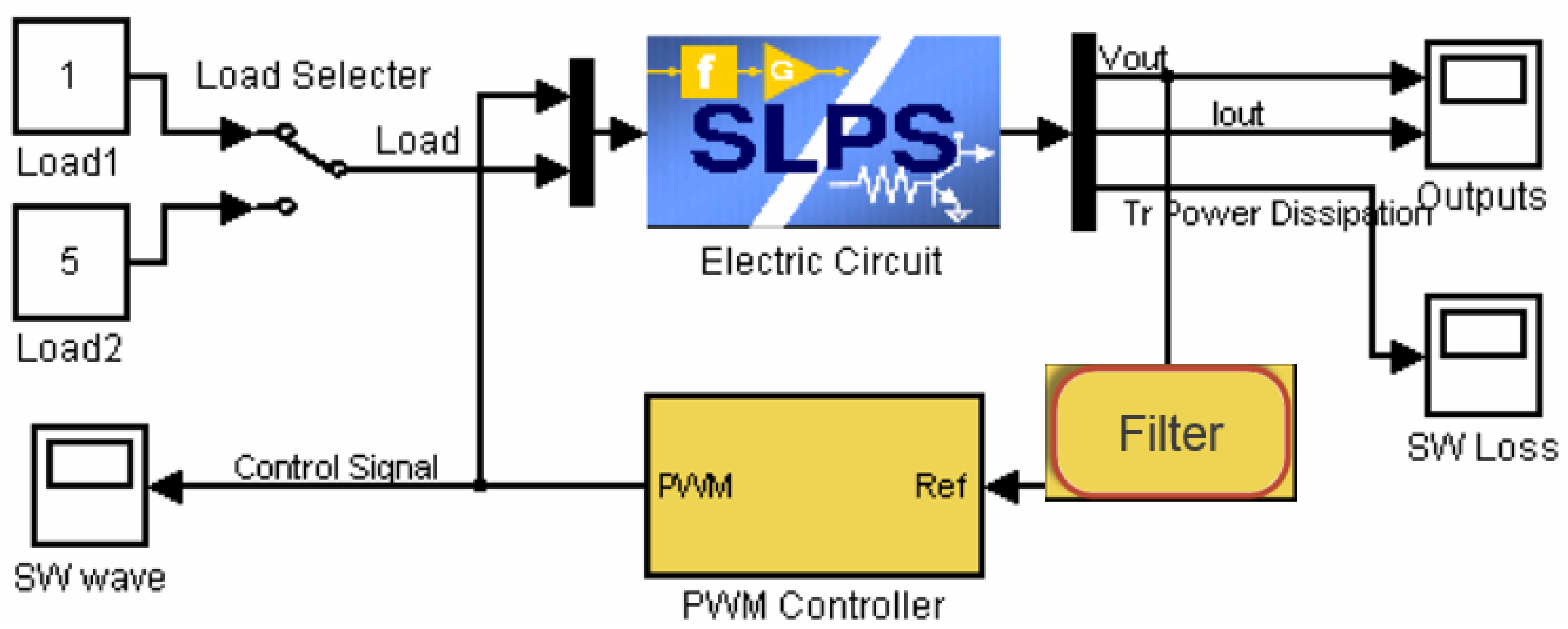
Matworks interface Top-Down

Embed Simulink/MATLAB Generated Code in PSpice

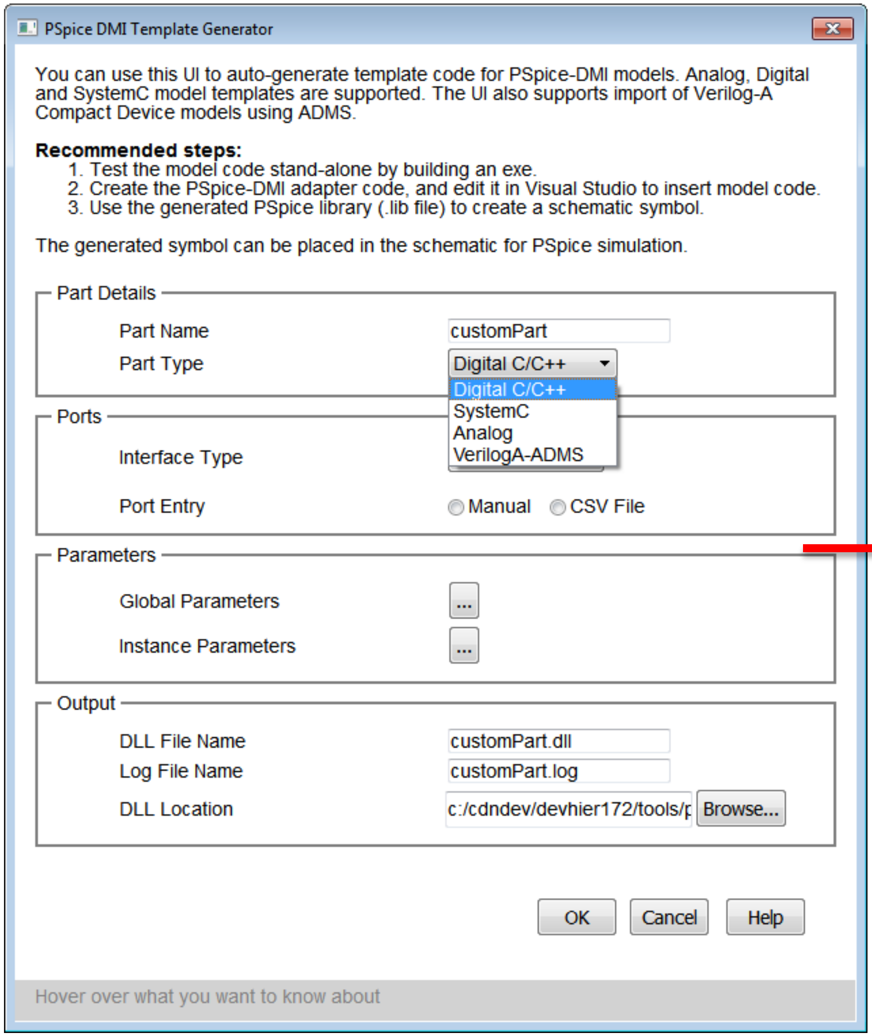


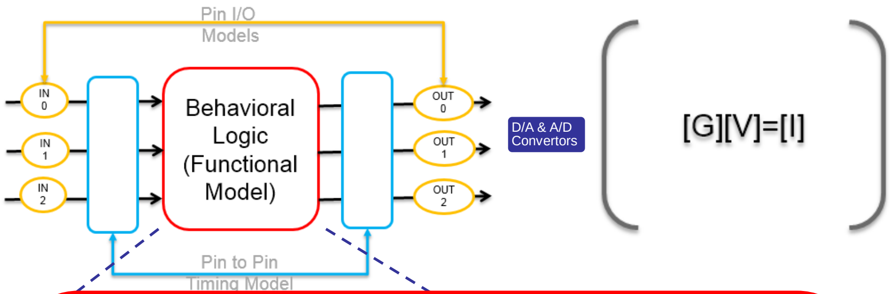
Matworks interface Bottom-Up

Co-simulation Pspice and Simulink/MATLAB



PSpice Model Code Generator



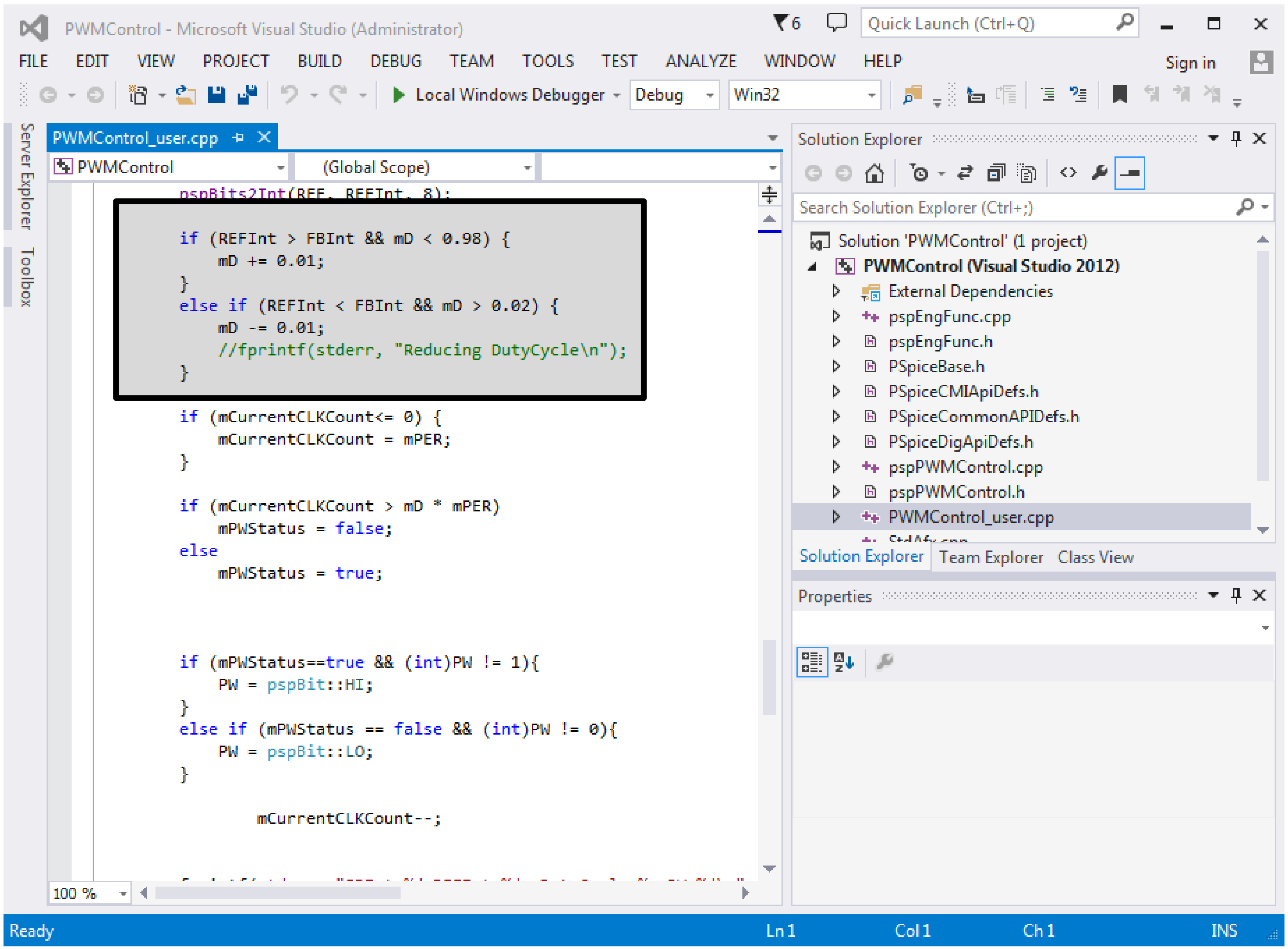


Model Plug-in Code

User Code
C/C++/SystemC

Microsoft Visual Studio

Complete, Compile, Link and debug the user code



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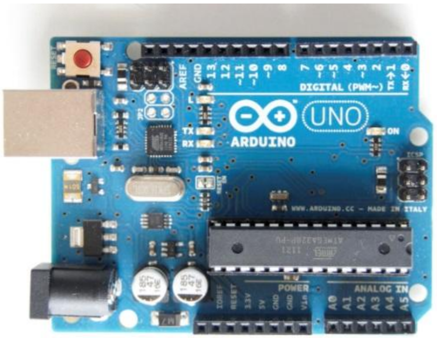
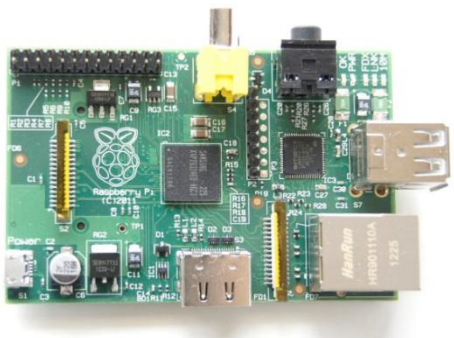
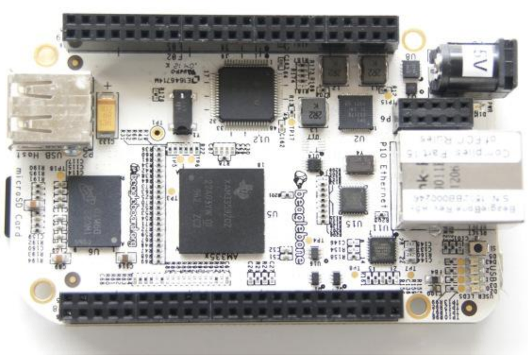
IoT

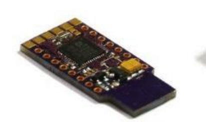
Hardware Platforms







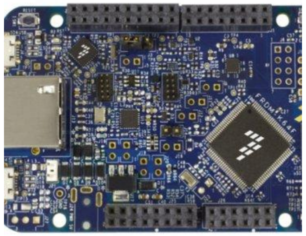
ESP8266



Espruino Pico

Name	Arduino Uno	Raspberry Pi	BeagleBone
Model Tested	R3	Model B	Rev A5
Price	$29.95	$35	$89
Size	2.95"x2.10"	3.37"x2.125"	3.4"x2.1"
Processor	ATMega 328	ARM11	ARM Cortex-A8
Clock Speed	16MHz	700MHz	700MHz
RAM	2KB	256MB	256MB
Flash	32KB	(SD Card)	4GB(microSD)
EEPROM	1KB		
Input Voltage	7-12v	5v	5v
Min Power	42mA (.3W)	700mA (3.5W)	170mA (.85W)
Digital GPIO	14	8	66
Analog Input	6 10-bit	N/A	7 12-bit
PWM	6		8
TWI/I2C	2	1	2
SPI	1	1	1
UART	1	1	5
Dev IDE	Arduino Tool	IDLE, Scratch, Squeak/Linux	Python, Scratch, Squeak, Cloud9/Linux
Ethernet	N/A	10/100	10/100
USB Master	N/A	2 USB 2.0	1 USB 2.0
Video Out	N/A	HDMI, Composite	N/A
Audio Output	N/A	HDMI, Analog	Analog

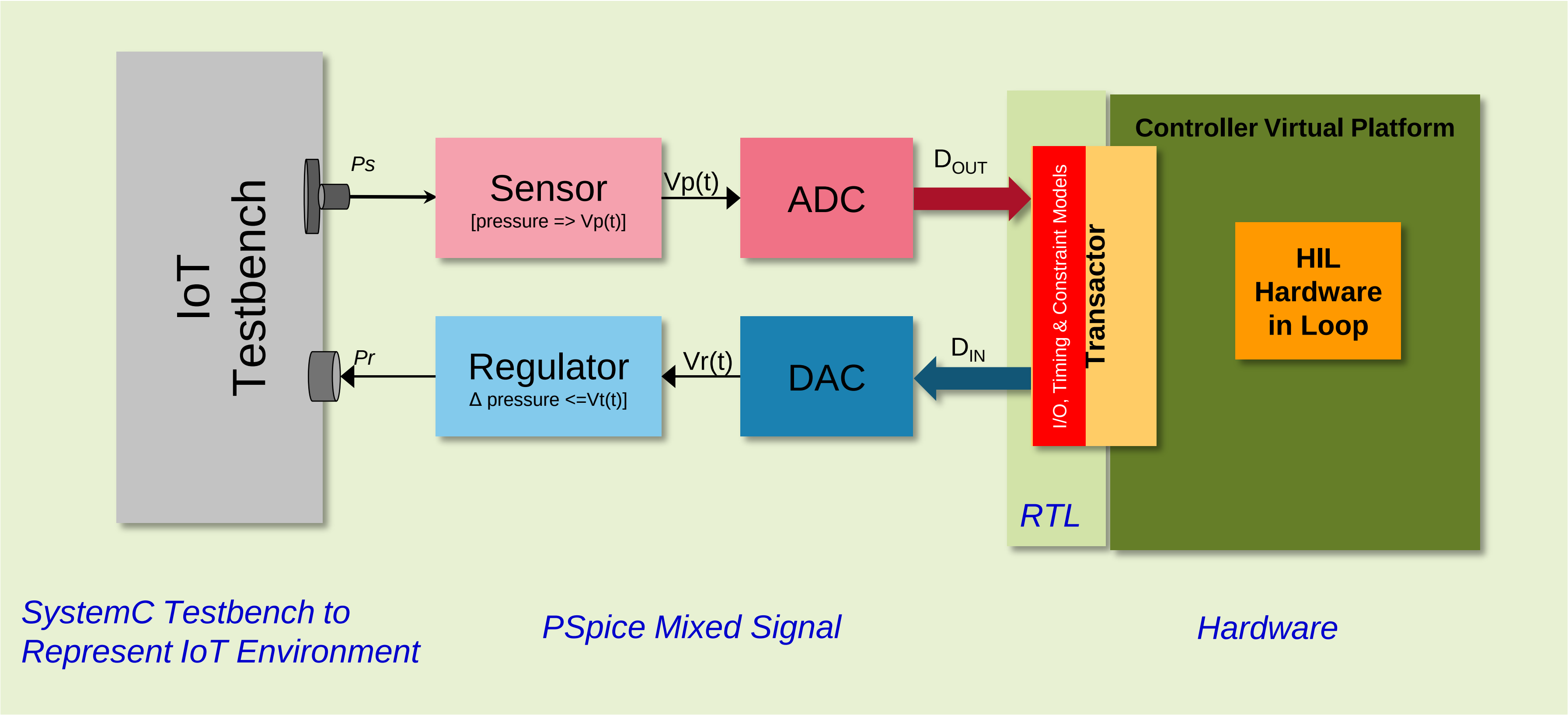
Comparing the three platforms.



FRDM-K64F

CC3200

IoT Design with PSpice



Minimal Modeling Effort

Reliability

PSpice Simulation

- Identify the design performance parameters in terms of measurements

Sensitivity Analysis

- Critical Components
- Identify the component values that are having maximum impact on design performance
- Cost impact

Optimizer

- Performance
- Optimize design performance with real component values

Monte Carlo

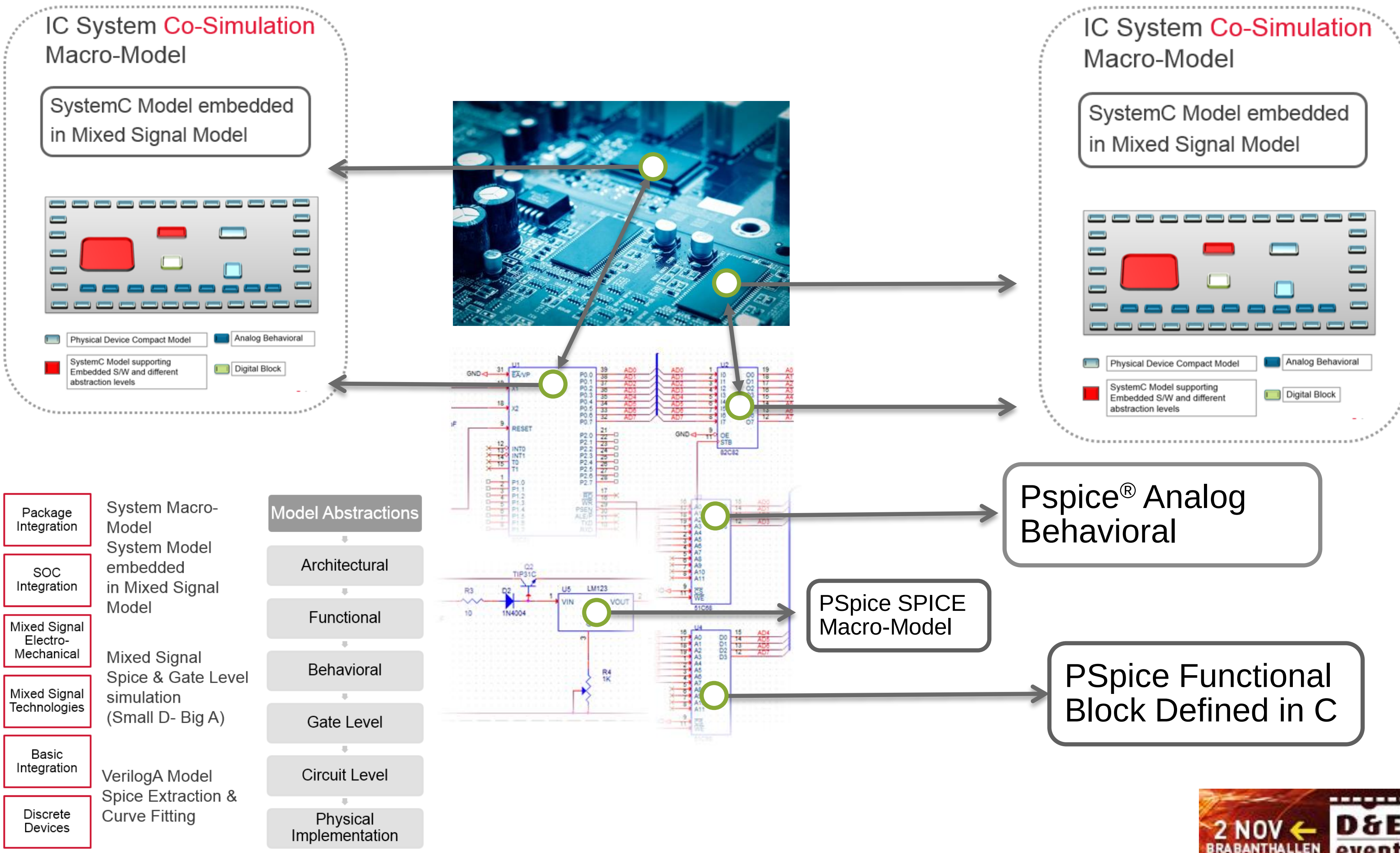
- Yield
- Verify Yield for component tolerances

Smoke

- Reliability
- Stress Check with derating

Parametric Plotter

PSpice virtual prototyping PCB systems



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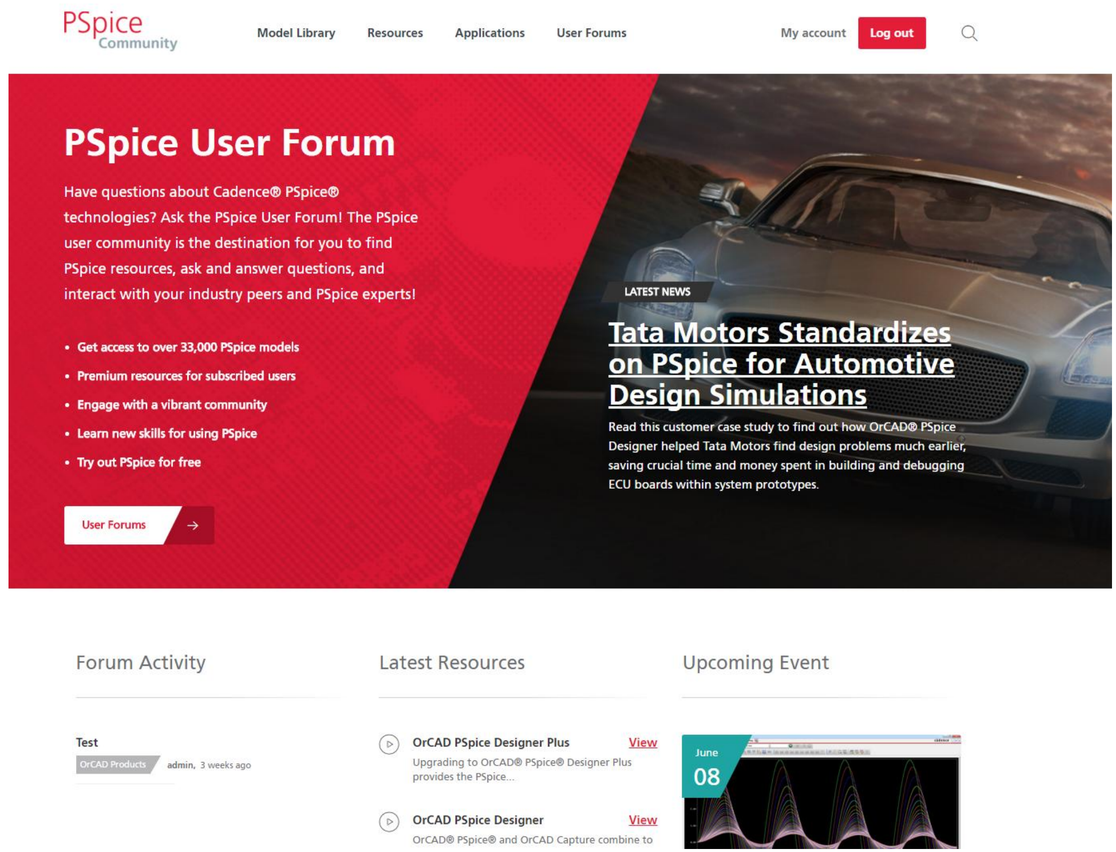
PSpice.com

New website for PSpice

- One-stop-shop for all PSpice resources and information
- Model library
- Forum



Announcement

Cadence and Mathworks Collaboration

- Provide system-level simulation solutions
- For customers using MATLAB/Simulink and PSpice for mixed signal, IoT and Automotive applications
- Thursday, Nov 3rd at MATLAB Expo in San Jose.

Q&A

- For more information visit the CB-Distribution booth, we’re at booth nr. 8