The 7 Aspects of Making **Awesome IoT PCB Design**

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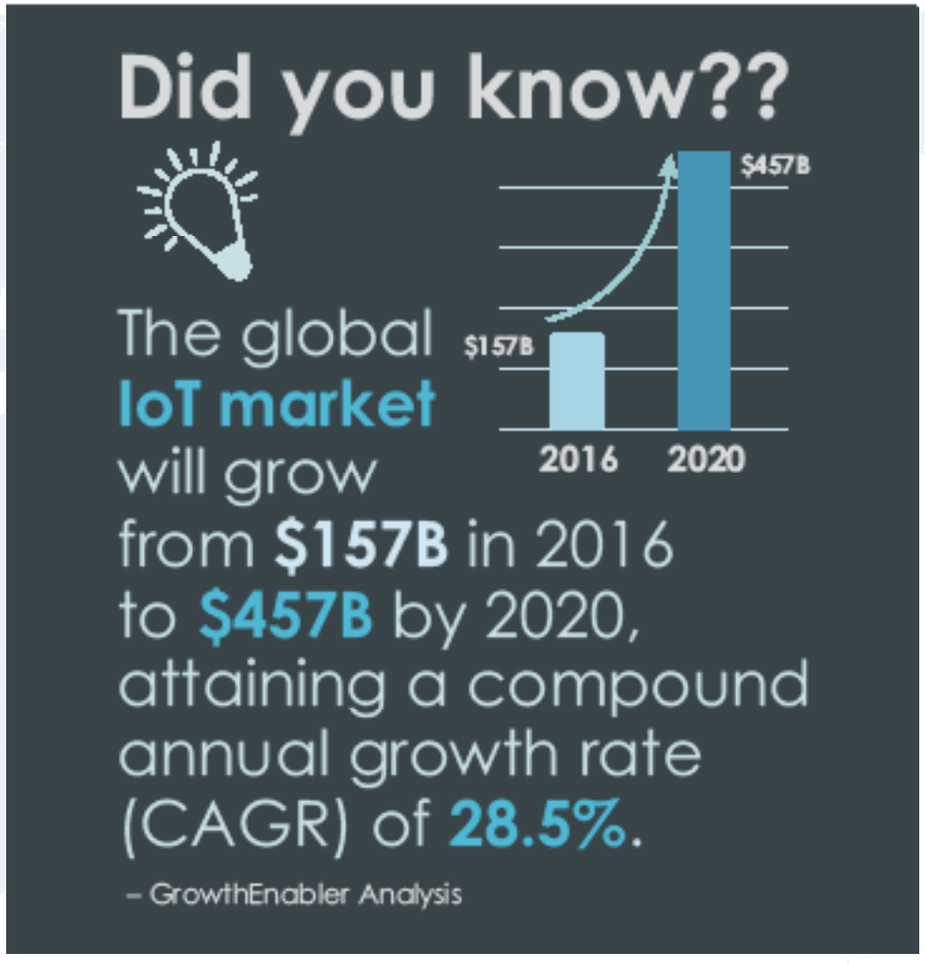
IoT is Everywhere

For the past decade we've been heavily focused on turning our world into a smart, connected world. This will be even more true in the decade to come.

*Smart cities and homes, connected health, industrial **IoT** and smart products are in our present and our future. This, is a major driver in the electronics industry, opening brand new markets and opportunities.*



IoT is Everywhere, but...

Surviving the Revolution of Electronic Product Development is Not Easy

Though to consumers, IoT devices look sleek and simple, the reality is, they are very far from it. A distinct set of components, physical interfaces, PCBs and rigid-flex circuits add design challenges we didn't have before.

So – if you're looking to enter the IoT marketspace and design your own IoT device, you need to start by designing an AWESOME PCB.

Here are the 7 design areas you need to consider!

Did you know that

only 26%
of all surveyed companies
are successful
with their IoT initiatives

And the **reasons** for that are

- Quality of data
- Internal expertise
- Time to completion
- IoT integration
- Budget overruns

Source: The Journey to IoT Value, by Cisco, May 2017

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#1 The IoT Design Domain

With the cost of components for IoT devices being relatively high, component selection is key to making sure you meet both your cost and functional demands.

ADC Analog–to-digital converters	**are used in IoT designs to process, store or transport any analog signal in digital form to a microprocessor.**	Converting from the analog world to the digital world enables electronics to interface to the analog world around us!
MEMS Micro-electro-mechanical systems	**sensors gather information from their surroundings while actuators execute given commands.**	Fitness trackers that detect your steps, smartphones that rotate the screen according to your holding angle, and more, are all enabled by MEMS sensors!
RF Radio frequency	**is a radio module that connects IoT devices to the cloud through WiFi, Bluetooth, or a custom protocol.**	RF design has a set of rules and protocols that must be adhered to when used on a PCB to ensure proper power consumption, range and connectivity!

60% believe

that IoT initiatives look good on paper, but prove more complex than expected

Source: The Journey to IoT Value, by Cisco, May 2017

Human interface devices must to be low-power and highly-efficient, to last for a reasonable amount of time without charging!

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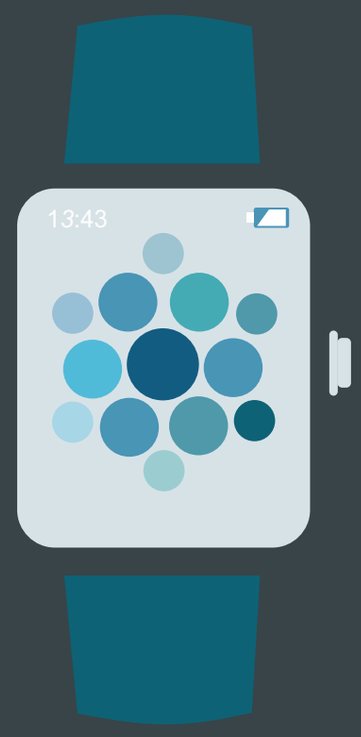
#2 The Form and Fit of IoT Devices



If a fitness tracker is not light, comfortable, and fashionable, or if a smart watch is too bulky, or if an IoT door lockset doesn't fit in aesthetically, the product is unlikely to ever get off the ground.

Size, weight and look and feel are all critical aspects when designing your IoT device!

64% agree

that learning from stalled or failed initiatives helps accelerate their IoT investments

Source: The Journey to IoT Value, by Cisco, May 2017

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#3 IoT Design Components

Human interface devices must be low-power and highly efficient, to last for an extended amount of time without charging!

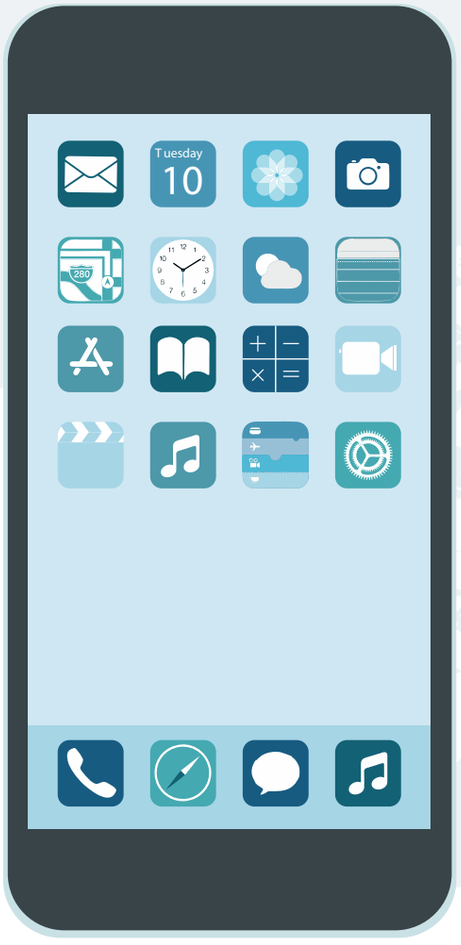
Your PCB will typically include

- Analog/ Mixed-signal ICS
- ADC Converters
- Radio Modules
- Microphones
- Sensors
- Actuators
- Displays
- Speakers
- MEMS
- LEDs
- Cameras

IoT devices can even contain

- Reed sensors
- Fingerprint detectors
- Force sensing resistors
- Flexibility sensors

Cost of selected parts	
Display	$52.50
Memory	$31.20
Apps Processor	$27.50
RF/ PA Section	$24.60
Power Management	$16.05
Cameras	$32.50
Mechanical	$50.95
Other	$45.42
Total parts	**$280.72**
Manufacturing costs	**$7.36**
TOTAL	**$288.08**
U.S. RETAIL PRICE	**$800**



#4 Capturing the IoT Design Intent in the Schematic

When defining connections between components in a schematic, make sure you:

- Use component management to source components and manage costs
- Use pre- and post-layout simulation on your analog/ mixed signal circuits

It's critical to meet your design integrity, physical characteristic requirements, and cost requirements!

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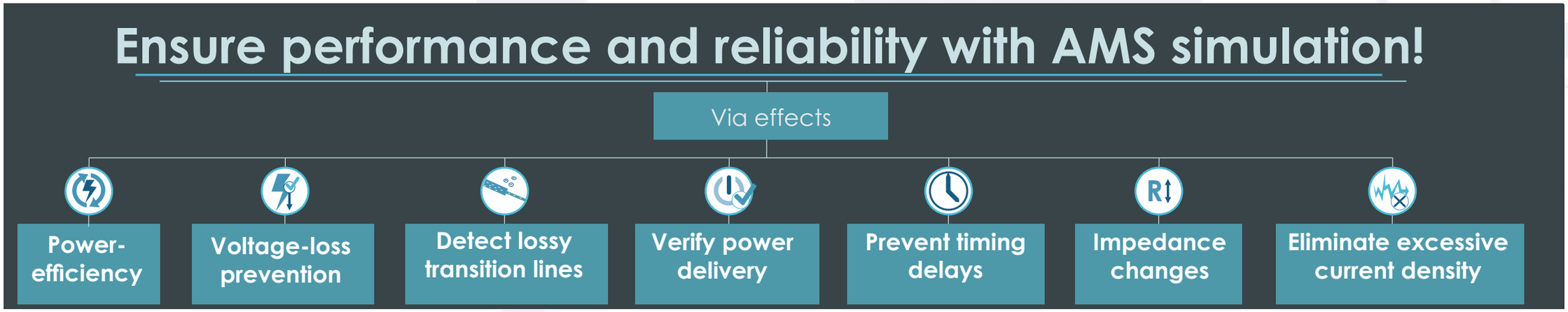
#5 Ensure Design Performance
Validation, Power, & Memory in IoT Design

IoT designs contain analog/mixed-signals circuits, that require model-based AMS, simulation and analysis during the design phase to ensure high performance and reliability.

IoT designs typically operate in multiple modes, such as standby, transmit/receive, active sensing, recharging, etc. Functional verification MUST be performed on each of these modes!

Simulation is also necessary to get a comprehensive view of your memory interface, whether it's DRAM or flash!



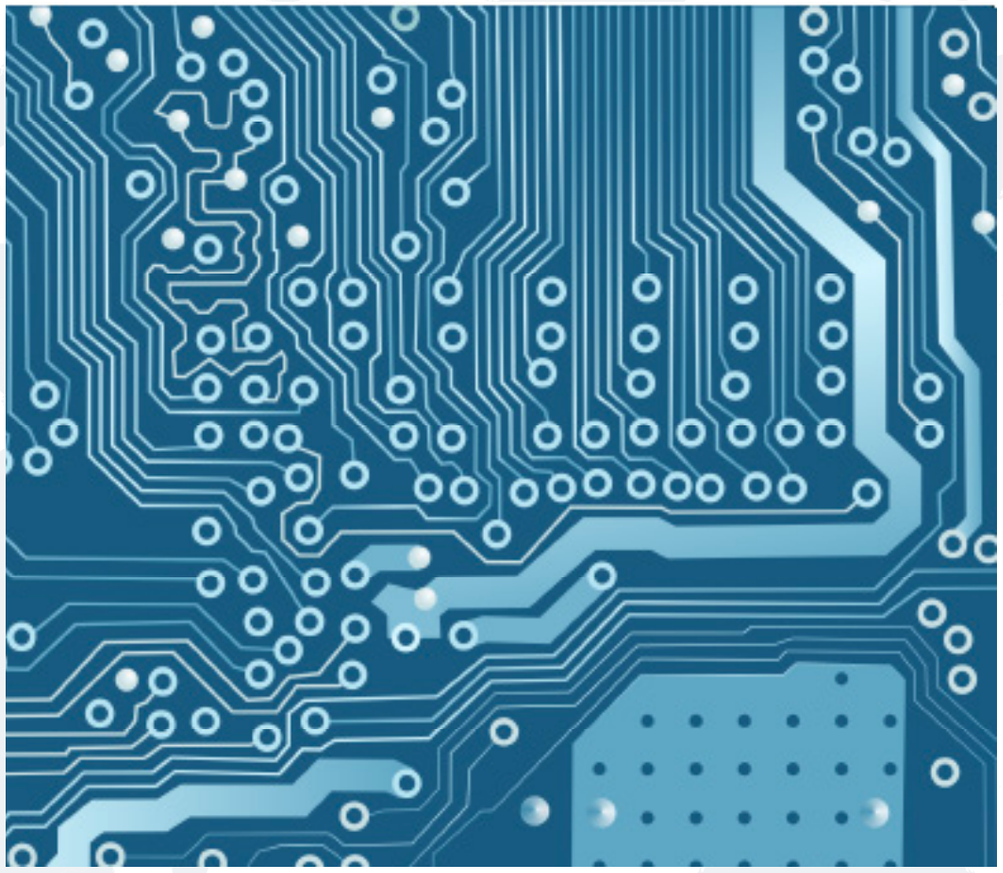
#5 Ensure Design Performance

Validation, Power, & Memory in IoT Design

Being key to every IoT product, you want to make sure you invest in memory connections as well!

To reduce design and debug cycle time of your DDR-based design, you'll want to rely on a well-defined constraint management system with the best DDR routing technology you can find.

With upfront planning, simulation, and validation, you'll be able to quickly and accurately route high-speed, high-bandwidth traces.



#6 PCB Layout

Things that can help:

1. Designs are driven by pre-defined, marketable form factors so it's critical to see each board in its 3D enclosure prior to routing

2. Bi-directional cross-probing between schematic and layout speeds up component placement

3. A constraint management system helps you set and enforce electrical constraints

4. Placing components in 2D and 3D helps avoid violations

5. Using capabilities specific to flex and rigid flex to make sure parts of the design do not interfere with folding, including: part placement on flex layers, flex routing plane shape fills, and exporting the design as a 3D solid model to MCAD for better collaboration

#7 Manufacturing & Assembly for IoT Design

Final key to success:
Consider the manufacturing and assembly demands of your IoT device during the design flow

DFT (Design for Test)

Ensure the testability of your design from a bare-board perspective to identify shorts and other manufacturing defects

DFMA (Design for Manufacturing Analysis)

Identify issues such as resist slivers and unintended copper exposed by soldermask, so that they can be corrected prior to fabrication

Making Awesome IoT PCB Designs
Things to Remember

To be successful in IoT design...

- Remember that, although it can look simple enough, IoT has a set of challenges and complications that has to be addressed seriously.
- Use all available design technologies to ensure your IoT device meets cost and time-to-market requirements.
- Verify and analyze your work constantly to avoid issues that can cost you time and money.
- Learn from your mistakes! Always document what you learned so that you can do things better in your next project.
- **And remember!**
  Designing for IoT can be hard, but the opportunities are endless.

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