

# Microcontrollers for IoT Prototyping



# IoT Definitions

- Several Definitions from Gartner, IEEE, EU, IERC, Guillemin & Friess...

**“An IoT system is a network of networks where, typically, a massive number of objects, things, sensors or devices are connected through communications and information infrastructure to provide value-added services via intelligent data processing and management for different applications (e.g. smart cities, smart health, smart grid, smart home, smart transportation, and smart shopping).”**

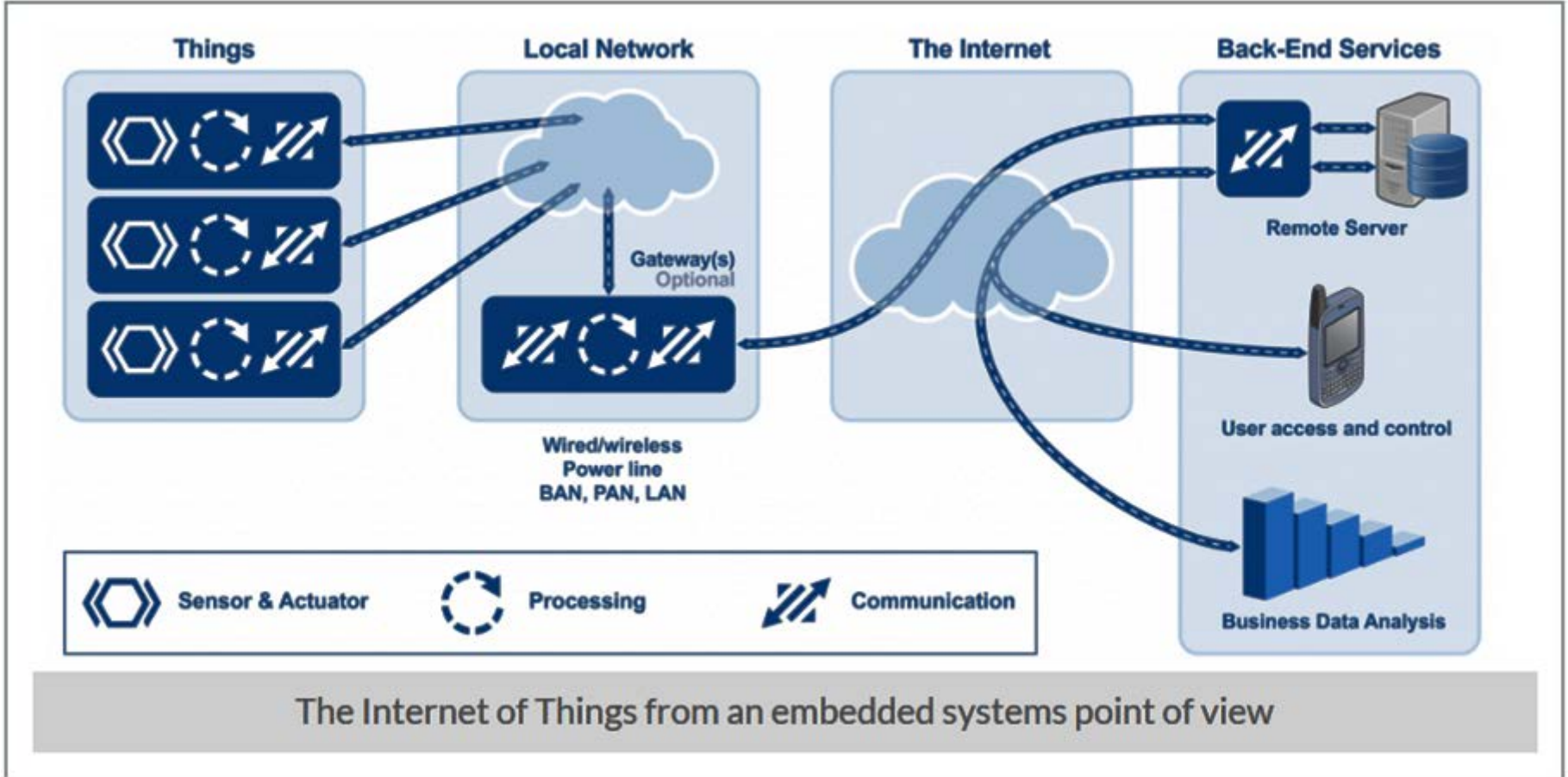
***-- IEEE Internet of Things Journal***

# How to think about the Internet of Things

Four main components of an IoT system:

1. The Thing itself (the device)
2. The Local Network; this can include a gateway, which translates proprietary communication protocols to Internet Protocol
3. The Internet
4. Back-End Services; enterprise data systems, or PCs and mobile devices

# IoT – Embedded systems point of view



# Idea of the Internet of Things

The idea of the Internet of Things suggests that rather than having a small number of very powerful computing devices in your life (laptop, tablet, phone, music player), you might have a **large number of things** which are **less powerful** (umbrella, bracelet, mirror, fridge, shoes) – **all connected to Internet**, and providing **value added** services.

# The Internet of Things: Why Now?

- Internet of Things is the **most hyped** “emerging technology” today, and that the term—and the associated technologies—is far from being new.
- Bob Metcalfe, inventor of the Ethernet : “It's a media phenomenon. Technologies and standards and products and markets emerge slowly, but then suddenly, chaotically, the media latches on and BOOM!—It's the year of IoT.”
- Hal Varian, Chief Economist at Google: “The price of sensors, processors, and networking has come way down. Since WiFi is now widely deployed, it is relatively easy to add new networked devices to the home and office.”

# The Internet of Things: Why now?

- Janus Bryzek, known as “the father of sensors” (and a VP at Fairchild Semiconductor), thinks there are multiple factors “accelerating the surge” in interest.
- First, there is the new version of the Internet Protocol, IPv6, “enabling almost unlimited number of devices connected to networks.”
- Another factor is that four major network providers—Cisco, IBM, GE and Amazon—have decided “to support IoT with network modification, adding Fog layer and planning to add Swarm layer, facilitating dramatic simplification and cost reduction for network connectivity.”

# The Internet of Things: Why now?

## Mind-blowing estimates

- Gartner estimates that IoT product and service suppliers will generate incremental revenue exceeding \$300 billion in 2020.
- IDC forecasts that the worldwide market for IoT solutions will grow from \$1.9 trillion in 2013 to \$7.1 trillion in 2020.
- Acquity Group (Accenture Interactive): More than two thirds of consumers plan to buy connected technology for their homes by 2019, and nearly half say the same for wearable technology. Smart thermostats are expected to have 43% adoption in the next five years.



# 2014 GARTNER HYPE CYCLE

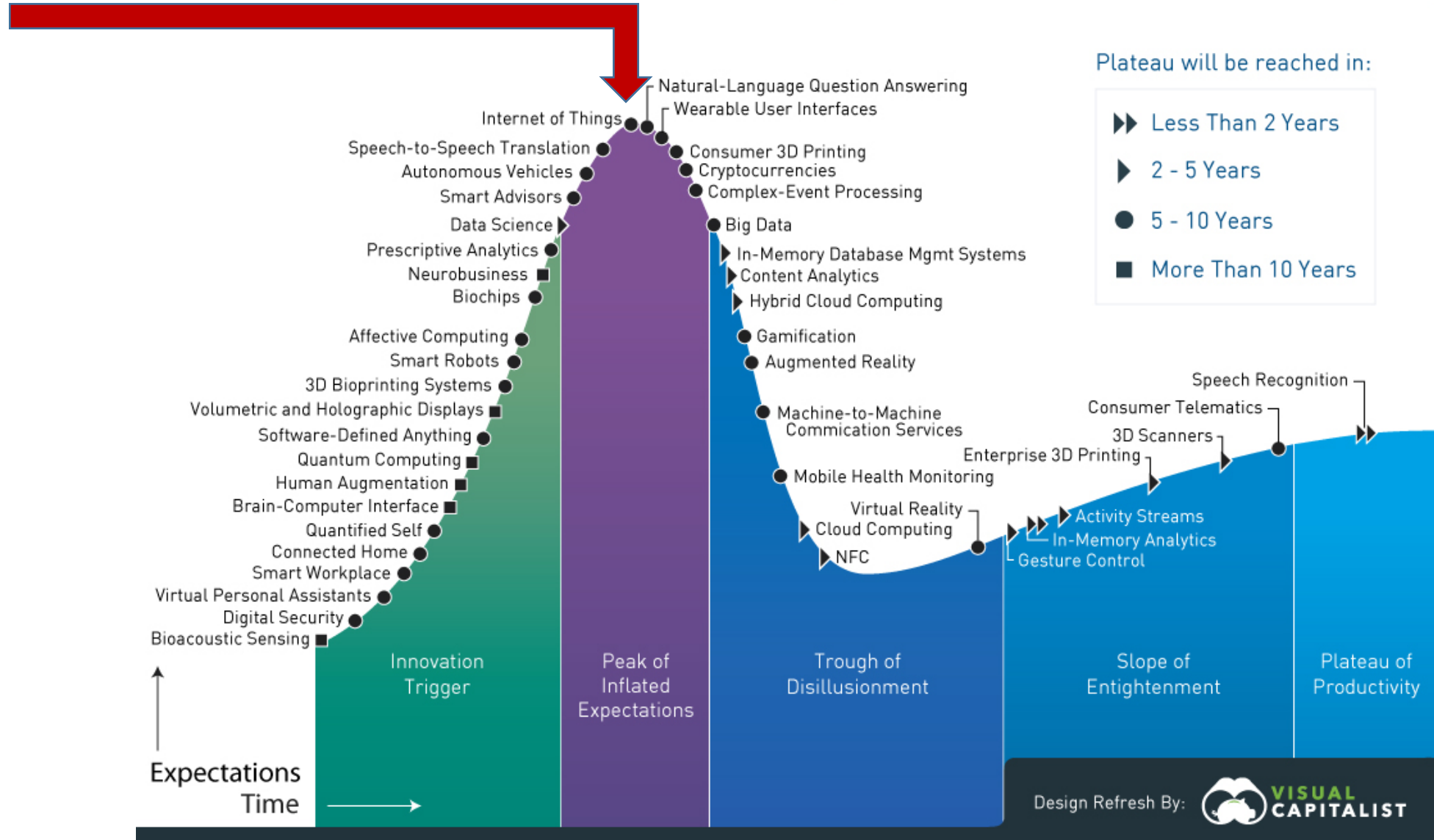
Current as of July 2014



What is this?

Hype Cycles offer a snapshot of the relative maturity of technologies, IT methodologies and management disciplines. They highlight overhyped areas, estimate how long technologies and trends will take to reach maturity, and help organizations decide when to adopt.

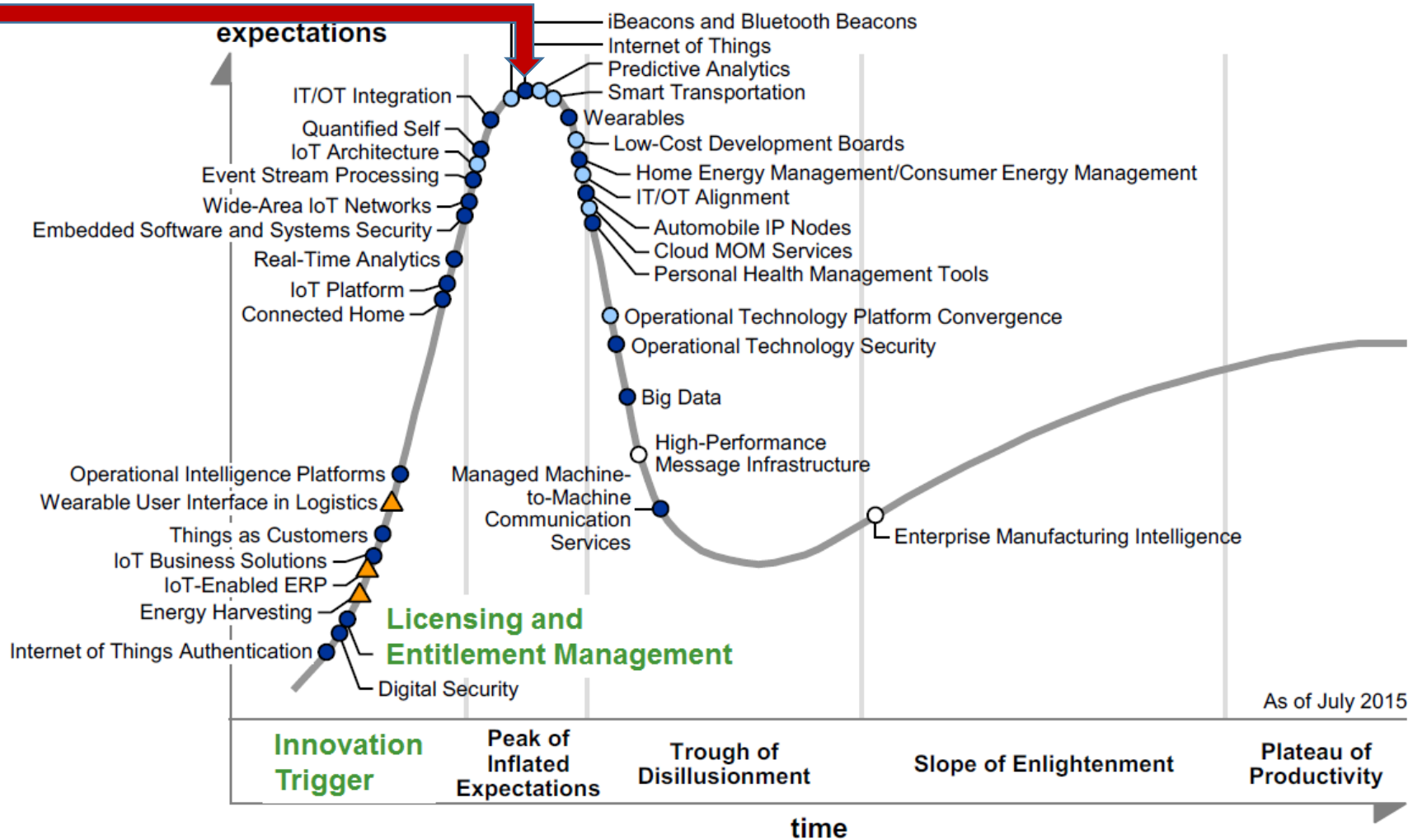
IoT



# Hype Cycle for the Internet of Things, 2015

Figure 1. Hype Cycle for the Internet of Things, 2015

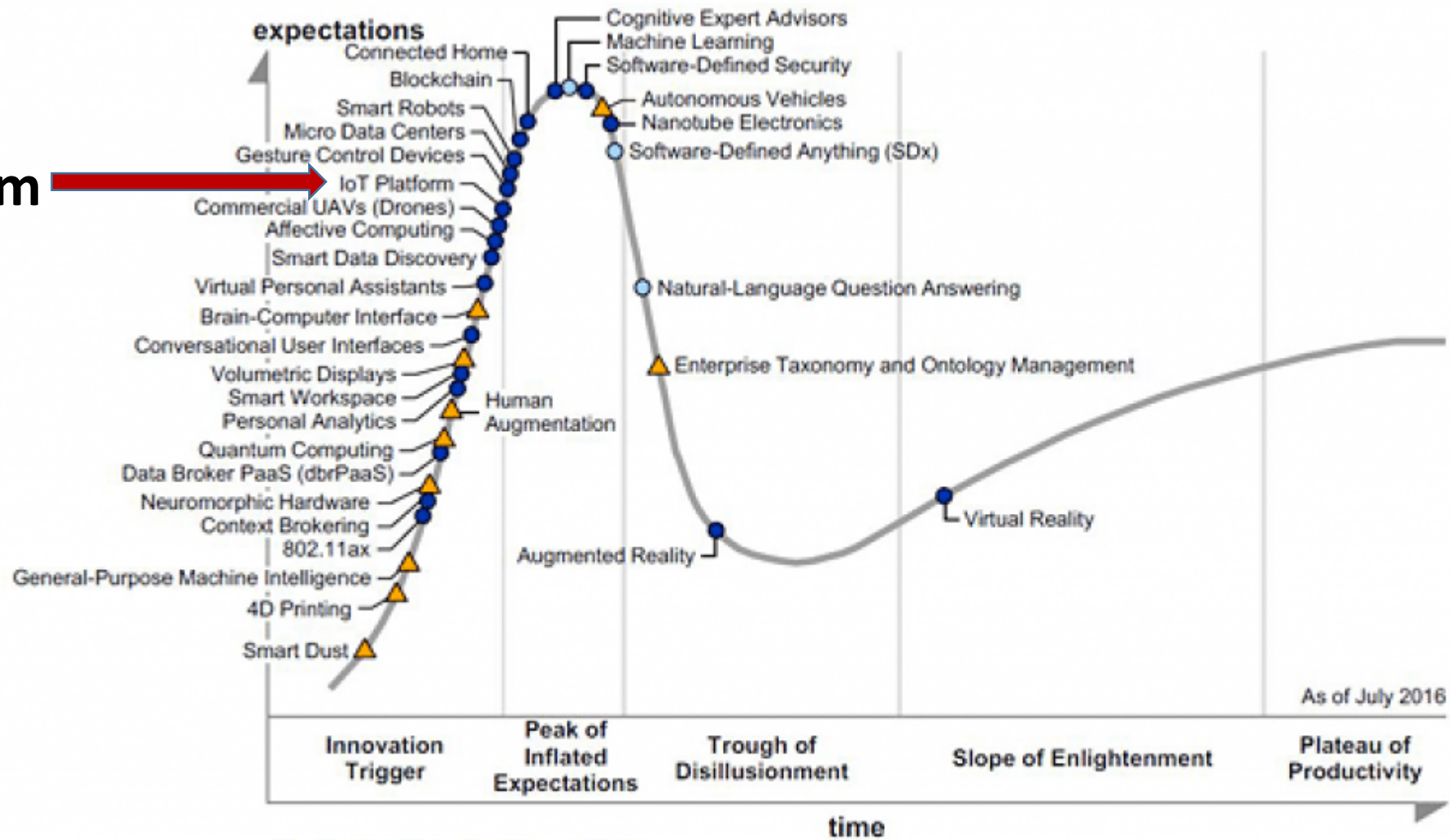
IoT



Source: Gartner (July 2015)

# Hype Cycle for the Internet of Things, 2016

IoT platform



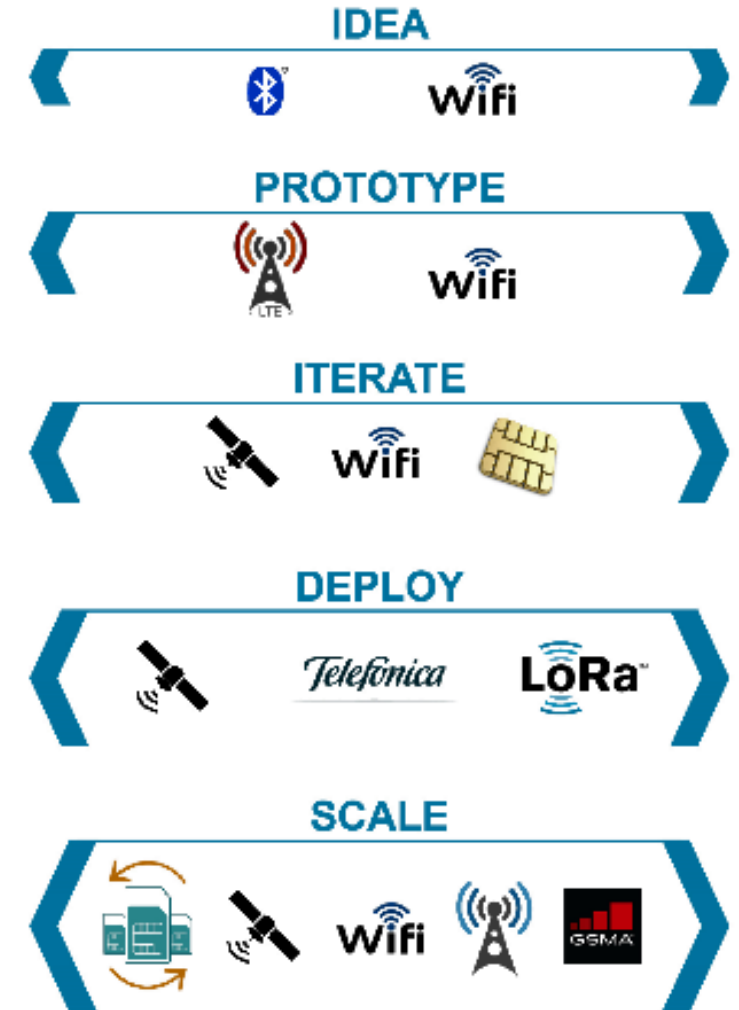
# Mind-blowing estimates

- Cisco predicts we'll see as many as 50 billion “things” connected to the Internet by the end of this decade. That's a four-fold increase in just six years.
- GE estimates that the Industrial Internet has the potential to add \$10 to \$15 trillion to global GDP over the next 20 years.
- McKinsey Global Institute predicts the IoT will generate as much as \$6.2 trillion in global economic value over the next ten years. That's about ten times as much economic value as will be created by 3D printing, another transformative trend.

# IoT Product development

## Step-by-step process

- Develop your product roadmap
- Create the product design
- **Prototype**
- Test
- Documentation
- Engage suppliers and manufacturers
- Go to market.



# Prototyping phase

- When it comes to showcasing finished products, there is a tendency to stress on product design, features, services that can be provided, etc...
- Often, the iterative, behind-the-scenes process that leads to the creation of something new and innovative gets less attention.
- But it's in this prototyping phase where insights are gained and challenges can sometimes turn into unexpected opportunities.
- Physical prototypes allows us to quickly move from concept to reality.

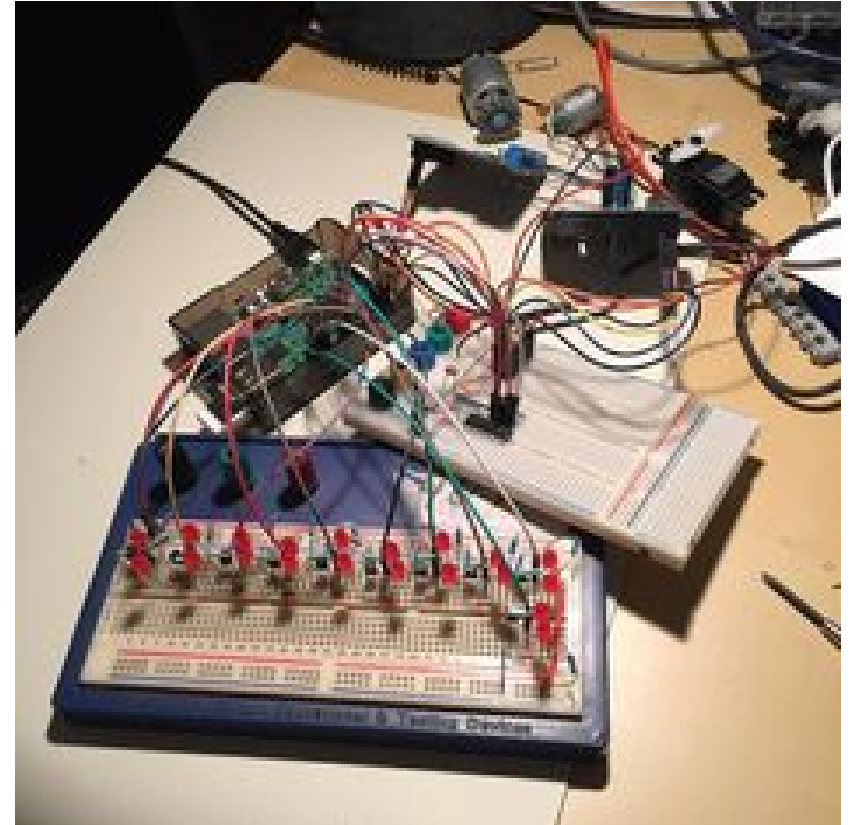
# Best connected (IoT) device

Sleek hardware or flashy features?

Low prices?

Creating the best experience for end users.

Need to find out what users truly want  
Can be achieved through prototyping.



# What exactly is rapid prototyping?

It's a problem solving framework that enables you to quickly solicit and leverage user feedback.

Using this scientific approach to product design, you can determine what will and won't resonate with customers — before full production begins.

Rapid prototyping helps companies make smart decisions in the IoT space.



Few tips for prototyping...

# Challenge your assumptions.

The riskiest assumption you can make is that your new product will solve a market need. If it doesn't, it won't sell.

**What problem am I solving?**

**Who am I solving it for?**

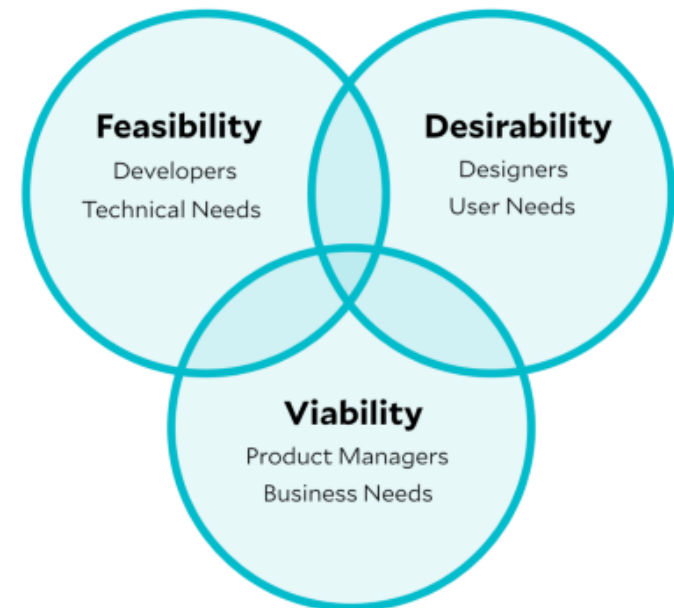
**Do they actually need this solution?"**

Smart switch startup Lumos

# Listen to users

Prototype should be guided by user needs, not your own assumptions or opinions.

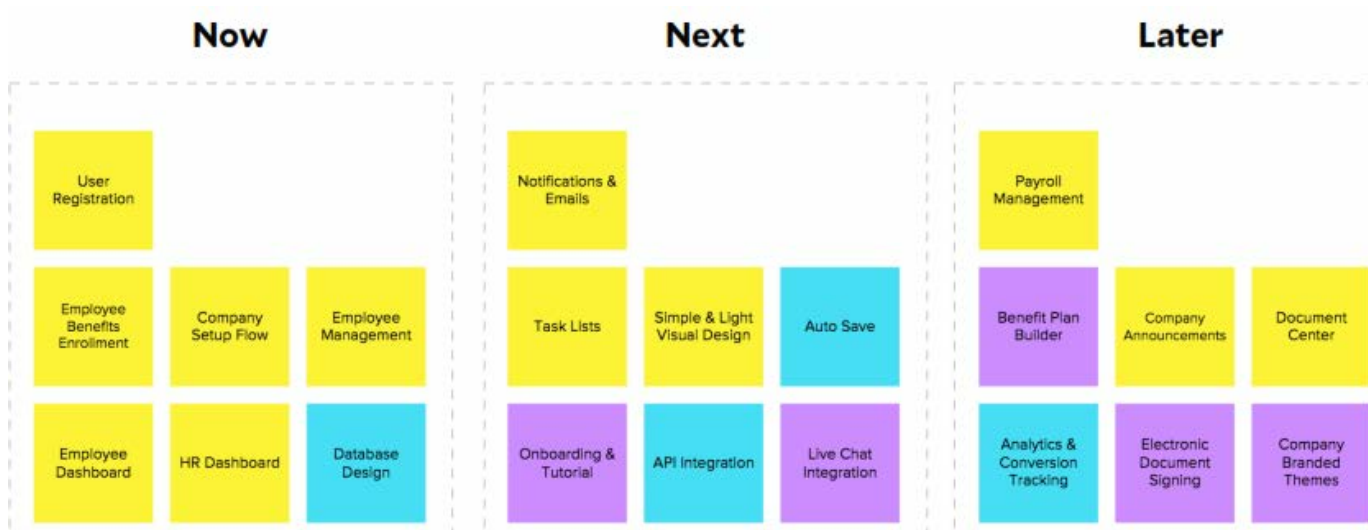
Feedback is the fuel that will propel your prototype onto store shelves and into users' homes.



# Put the foundation first.

Concentrate on your product's core functionality first.  
Bells and whistles can wait for later iterations.

Prioritization is critical to successful prototyping.



# Take stock of your tools

Does your kitchen gadget need a temperature sensor?

Prebuilt components are your friend.

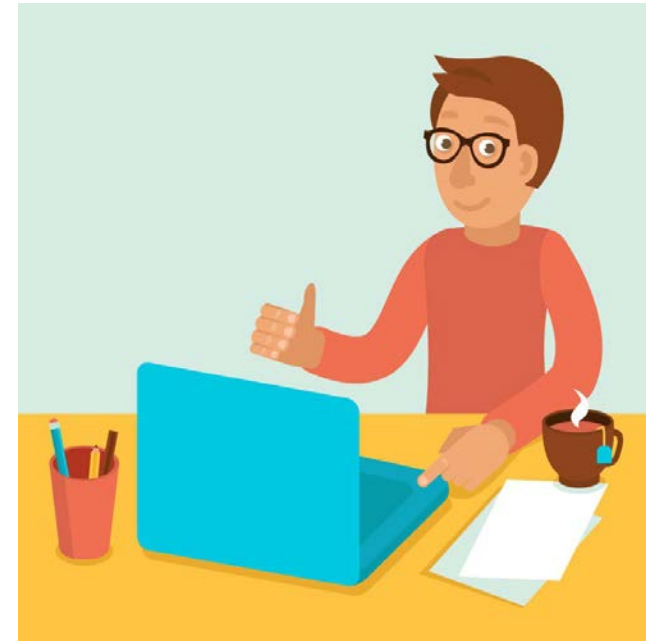
Do whatever you can to make production simpler, cheaper, and faster.

Just don't sacrifice core functionality in the process.



# Be ready to scrap it

Don't get too attached to a prototype.



Henry Ford's first car ran on ethanol, but it never made it to production.

Why? Gas prices dropped, forcing Ford to ditch his design.

# Iterate and reiterate

Prototypes almost always require multiple iterations before they're finished.

Small, incremental steps are how the race is won.

listen to users → rapidly prototype a smart solution → roll it out → listen to users again → leverage those learnings to create a powerful second edition.

“Iterate” can't be reiterated enough.

# Give voice to the voiceless.

Product failure hurts even more when an employee's idea could've saved it.

Seek feedback early and often from the product owner, designers, developers, strategists, salespeople, marketers, and more.





# Go for good, not perfect

Your prototype won't be bug-free.

Don't expect it to be. You should, however, expect it to be reliable, testable, and, hopefully, well received by users.

# Feast on feedback.

Actionable user feedback is the secret sauce of rapid prototyping.

Assess the feasibility of a specific functionality and determine whether users derive value from it.

That requires you to solicit and incorporate user feedback.

## **Snapchat Spectacles v/s Google Glass**

Snap listened to how people wanted to wear Spectacles and baked their answers into its vision for the final product.

# Hardware Prototype

- As with any startup, iterating and improving the prototype is crucial. However, it's not as easy or as cheap as for a software startup.
- In fact, for a long time hardware prototyping has been prohibitively expensive
- The good news is that all of this is changing very rapidly. Today we have new technologies and tools you can use to build your own first hardware prototype.

# New Technologies and Tools

- **3D printing = cheap & rapid prototyping**

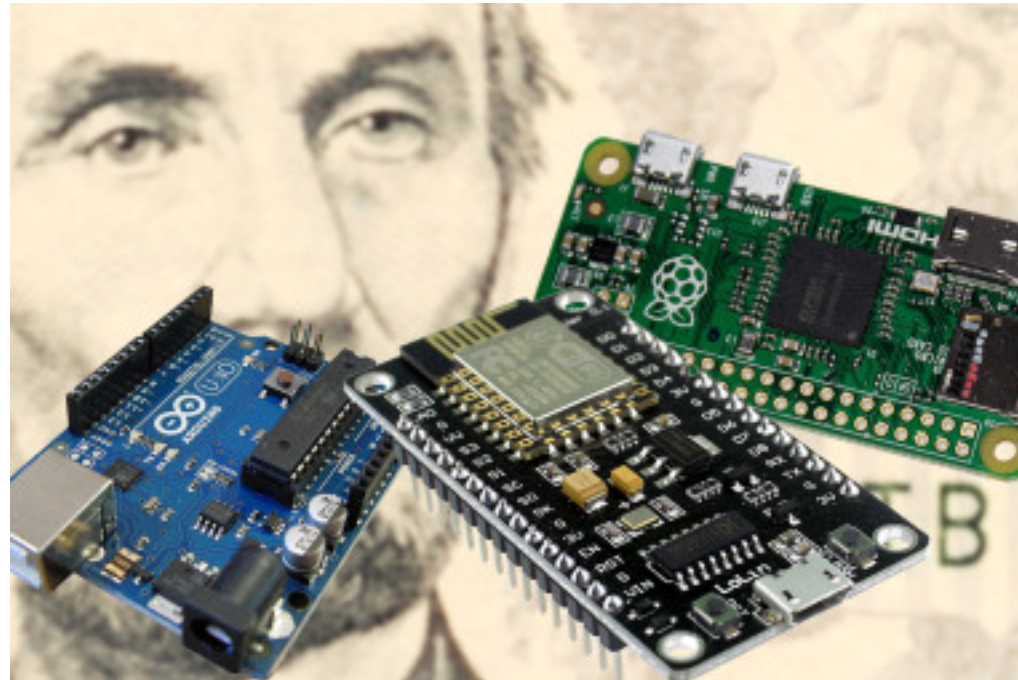


Unlike injection moulding, 3D printing allows you to quickly manufacture a single prototype at a very low cost. You will need CAD (computer-aided design) software to create a digital model, which will then be printed layer by layer.

# New Technologies and Tools

- **Use cheap easy-to-program microcontrollers**

Arduino, Raspberry pi, TinyDuino....



# New Technologies and Tools

- **Use Open source**

One of the biggest, if not the biggest, advantage for a startup is the ability to use open source.

looking for code and resources? → <https://github.com/>

