

The future is here,
it's just not evenly distributed
- William Gibson

Mark Johnson, MCNC
Broadband Communities Summit, 2015



IoT

- What are these “things” we’re talking about?
- Some other trends in play
- The future is here: an IoT existence proof
- What could/should be here: personal medical devices
- opportunities, challenges, trends
 - security, standards, business models

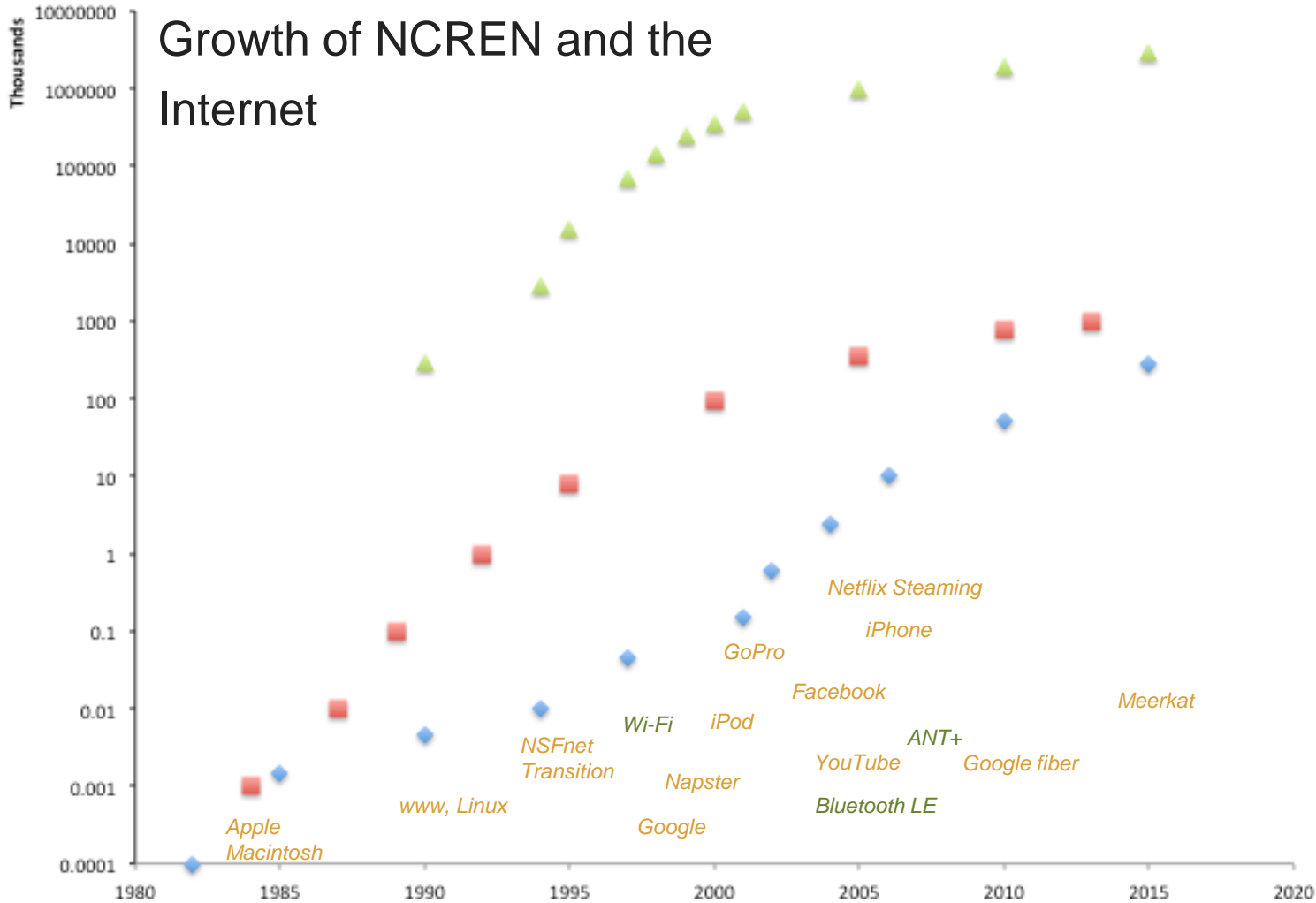
Internet of “Things”



- A “**thing**” is a device that senses, analyzes, or acts on the physical world.
- **Sensors** are just measuring some quantity and reporting that measurement
- **Analyzing** involves doing some kind of computation on measurements and other data
- **Acting** is causing something to happen in the physical world

When we talk about the IoT we also often mean these things are communicating among themselves. Humans may or may not be in the analytical process.

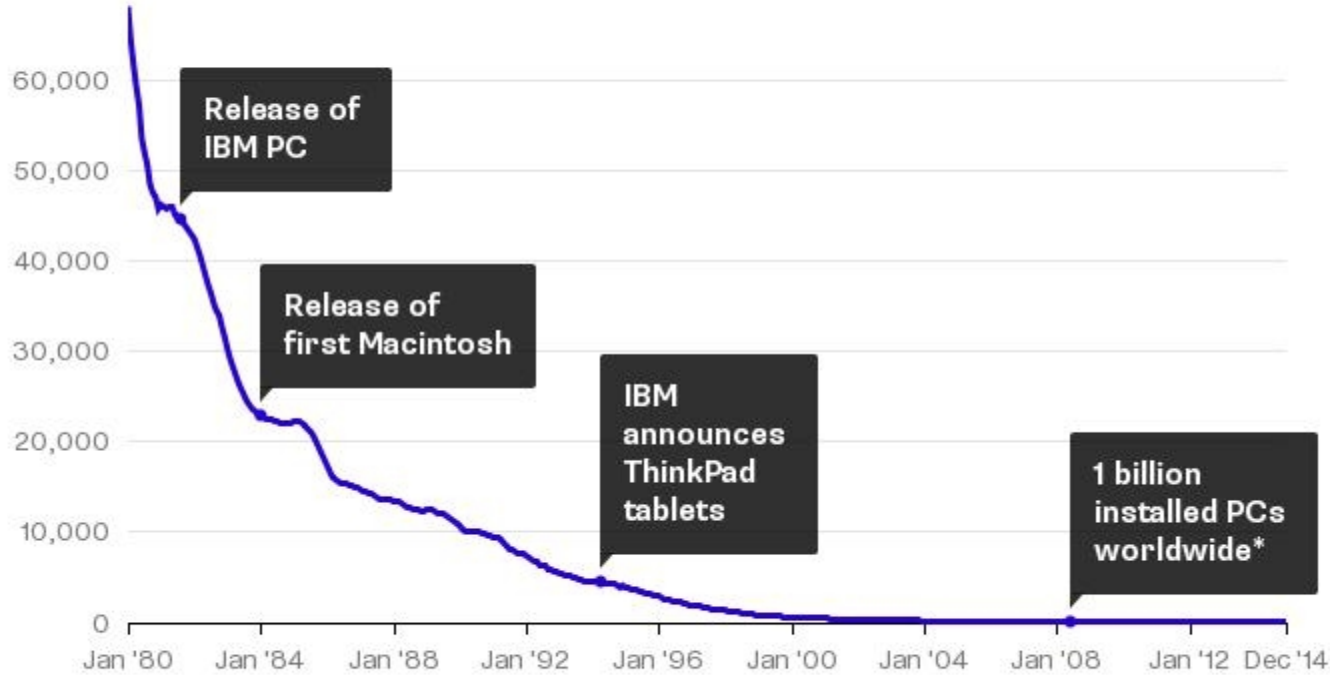
Growth of NCREN and the Internet



The Price of PCs

Personal computers are now 99.9% cheaper today than in 1980

■ Personal computers & peripheral equipment price index

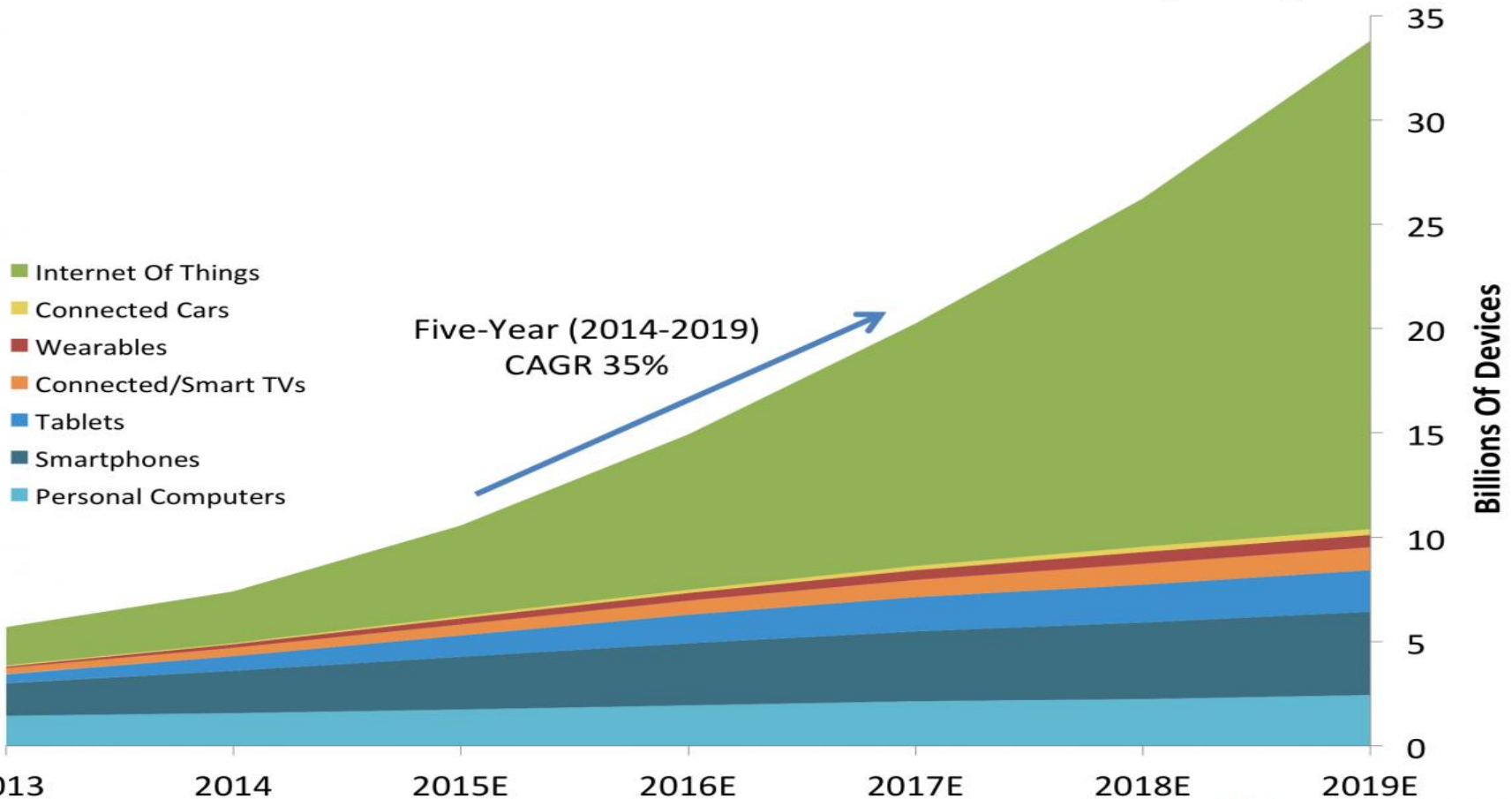


bloomberg business

Source: U.S. Bureau of Economic Analysis; *Gartner

Bloomberg 

Number Of Devices In The Internet Of Everything



Source: BI Intelligence Estimates

BI INTELLIGENCE

Metcalfe's Law:

The value of a telecommunications network is proportional to the square of the number of connected users of the system (n^2).

Boston Marathon 2014: 35,671 instrumented runners



passive - no power required

RFID: now can store some info as well as report a serial number
data rate 40-640kbps

Cycling: mobile, connected, social, etc

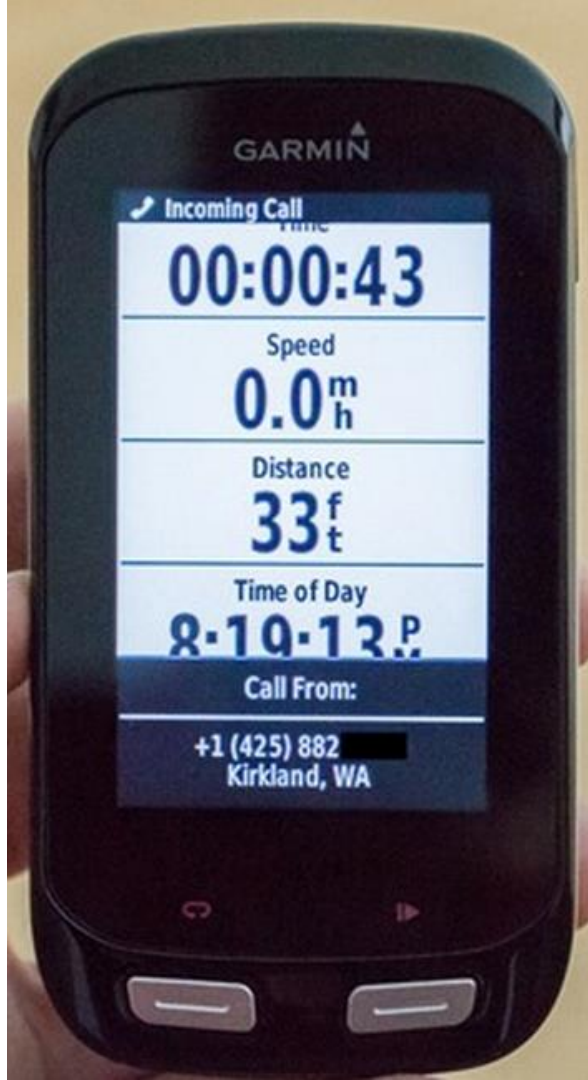
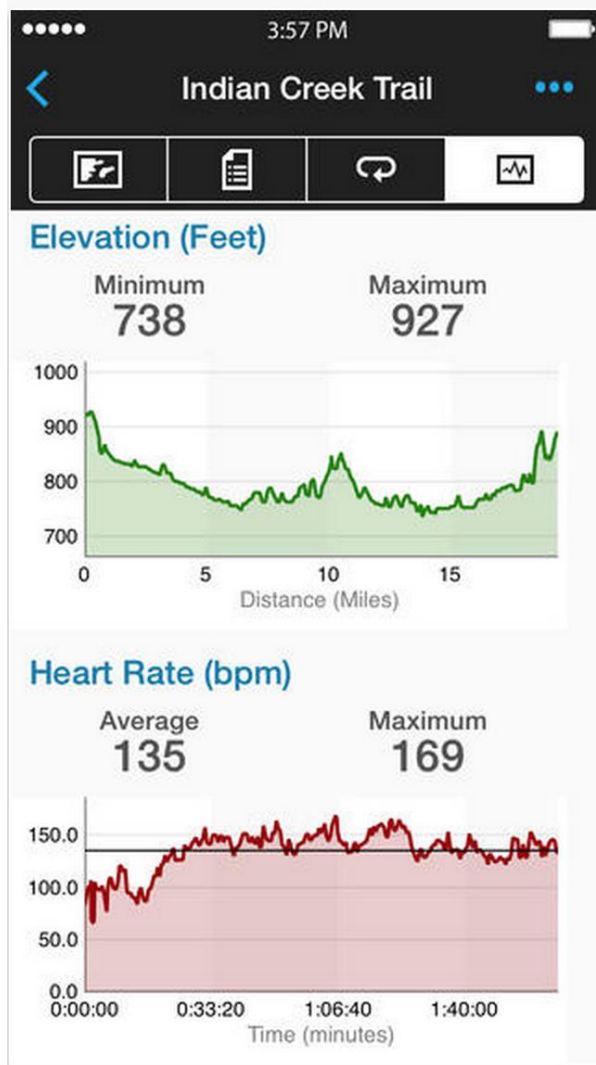
- constellation of sensors delivering realtime data to a mobile display unit.
- heart rate, power, cadence, speed, temperature, location, elevation
- sensors and display units may be mixed and matched thanks to a common wireless protocol **standard** (Ant+) designed for collecting nearby sensor data
- event data is stored in the cloud where **standard** data formats allow analysis by a variety of software
- A social community is created facilitating sharing and competition among community members
- analysis can occur on a personal (what's my performance and how might I improve it?), community (how do I compare to others?), and global (what are the trends, effects of these activities)?

also:

live tracking of location to remote apps
notifications of incoming phone calls
integration of GoPro video and sensor data

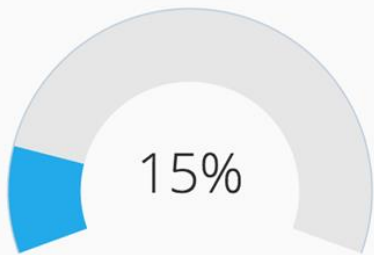
Device ecosystem enabled by standards







Moots (Moots Psycho X) ...
10 Activities since Feb 13, 2015

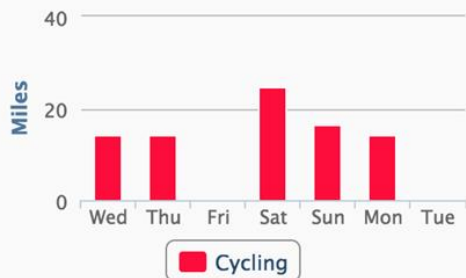


156.5 of 1,000 mi
Max Distance

REPORTS

Total Distance

Mar 18 - Mar 24, 2015

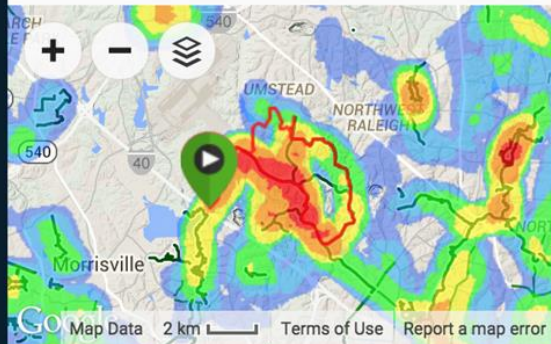


Morrisville Cycling

Mar 23, 2015 Cycling Uncatego...

14.17 mi 57:46

Distance Time
Speed (mph) 892 Calories 873 ft Elev Gain



Mar 23, 2015 0 Like 0

Mar 23 - Mar 29, 2015

Mon

Today

Wed

Thu

Fri

Sat

Sun

DEVICES

Forerunner 220

Device Settings
Getting Started Video

CONNECTIONS



johnsmj



Morrisville Cycling

TC climb

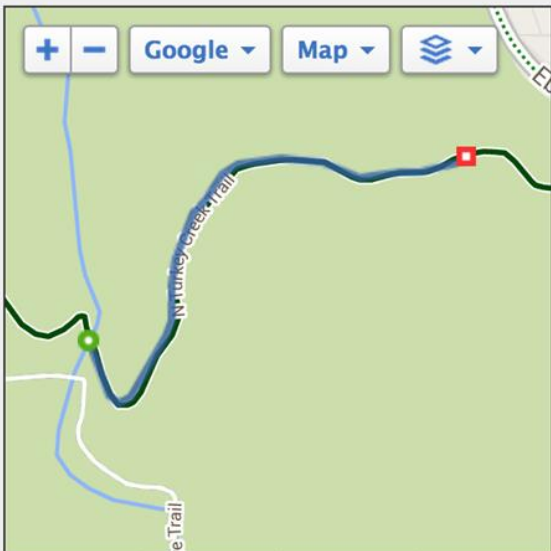
Your Best Time: 2:15 on [Sep 6, 2014](#) 

Crossed By: 360 People | Activities: 1790 | Edited: Jan 10, 2015

[Like](#) · [Comments \(0\)](#)



Summary



Distance	Avg Grade	Elev Gain	Elev Loss
0.36 mi	5.8 %	0 ft	0 ft

Segment Type:
Hill Climb

Surface:
Gravel

Leaderboard:

Everyone

Last 12 Months













Men & Women

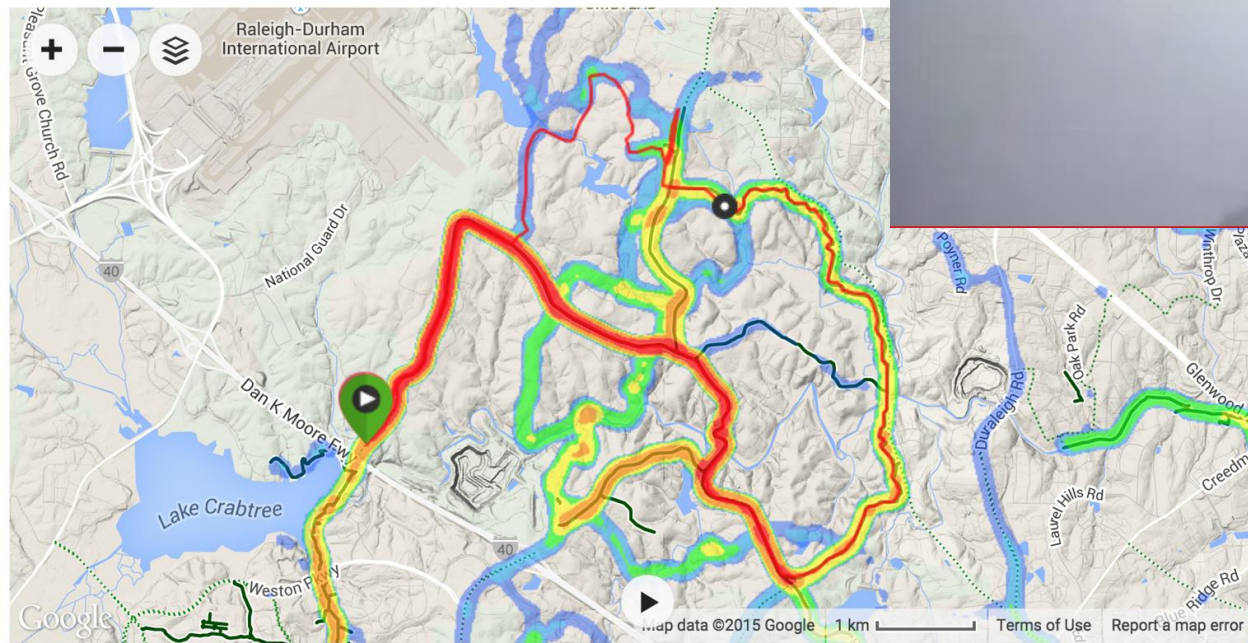
All Weight Groups

All Age Groups

All Cycling Classes

YOUR RANK: 31

		TIME	SPEED (MPH)	HR (BPM)	POWER (W)	CADENCE (RPM)	WIND	DATE
1		jeremymorgan	1:24.5	15.29	172	--	92 12 mph 	November 6, 2014
2		KenMetzger	1:45.4	12.25	--	--	0 mph 	August 21, 2014
3		revnine	1:45.9	12.20	184	329	0 mph 	June 10, 2014
4		ChristopherS	1:46.3	12.14	170	--	97 5 mph 	October 30, 2014
5		Ehoff	1:48.2	11.94	177	--	84 4 mph 	May 10, 2014
6		slong427	1:54.0	11.32	--	336	85 0 mph 	June 9, 2014



personal medical devices

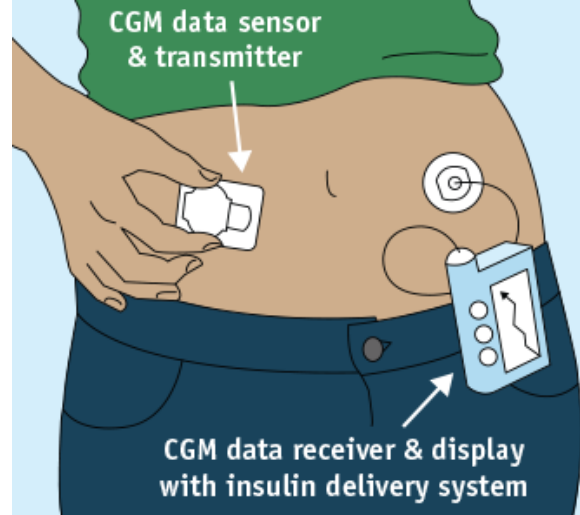
Virtually no integration across devices

- Barriers
 - FDA approval processes
 - business models of device vendors, insurance companies, and medical providers
 - concern over quality of data, security, possible side effects
- Result
 - rate of innovation is slow
 - little to no attention to security since the systems are proprietary and closed

Personal medical devices

Continuous glucose monitor (CGM)

sensor + specialized display



Bone conduction hearing aids

sensor +
special device for integrating other inputs

Glucose pumps

actuator +
specialized control device



Opportunities

Personal instrumentation (fitness, medicine)

Home instrumentation and control

HVAC, appliances, security

Community instrumentation and control

Smart grid, utility management (water, waste collection, lighting, etc)

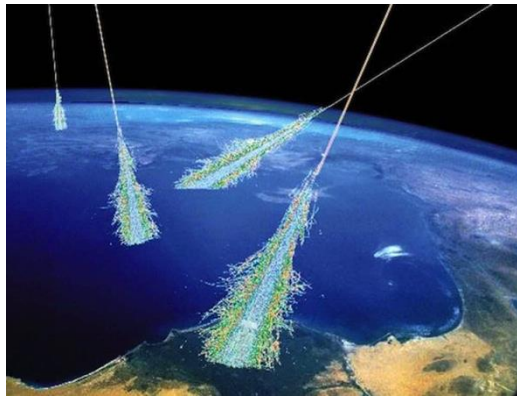
Business instrumentation and control

Sensors for field moisture, GPS controlled planting, maintenance,
harvesting,

Market tracking and analysis

trends

More elaborate and capable sensors
e.g. crayfis cosmic ray



Less expensive and more capable embedded



Challenges

Lack of relevant standards and APIs

Business models work against IoT
implementation

Potential security risks

Lack of quality connectivity, especially in
rural areas

Questions?

Mark Johnson - CTO, MCNC

mi@mcnc.org



iPhone sensors and radios

Sensors:

- Proximity
- Ambient light
- Accelerometer (2)
- Magnetometer (compass)
- Gyroscopic sensor
- CMOS image sensor (the camera)

Radios

- Wi-Fi
- Bluetooth (not LE ...yet)
- GPS
- NFC (Apple Pay)
- LTE & 3G cell