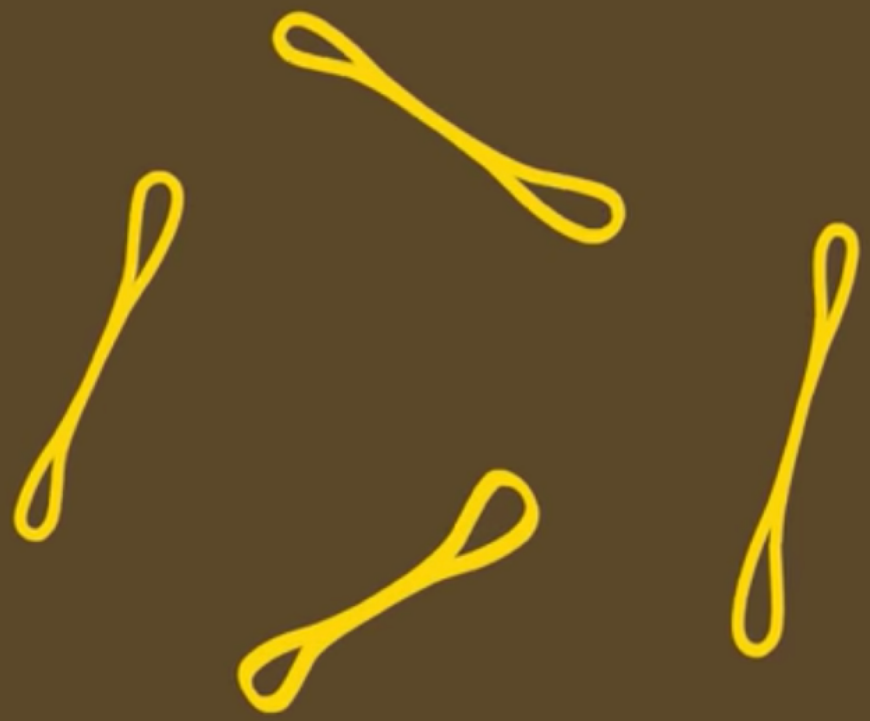
THE EVOLUTION OF LOW-POWER WIRELESS IN CYCLING

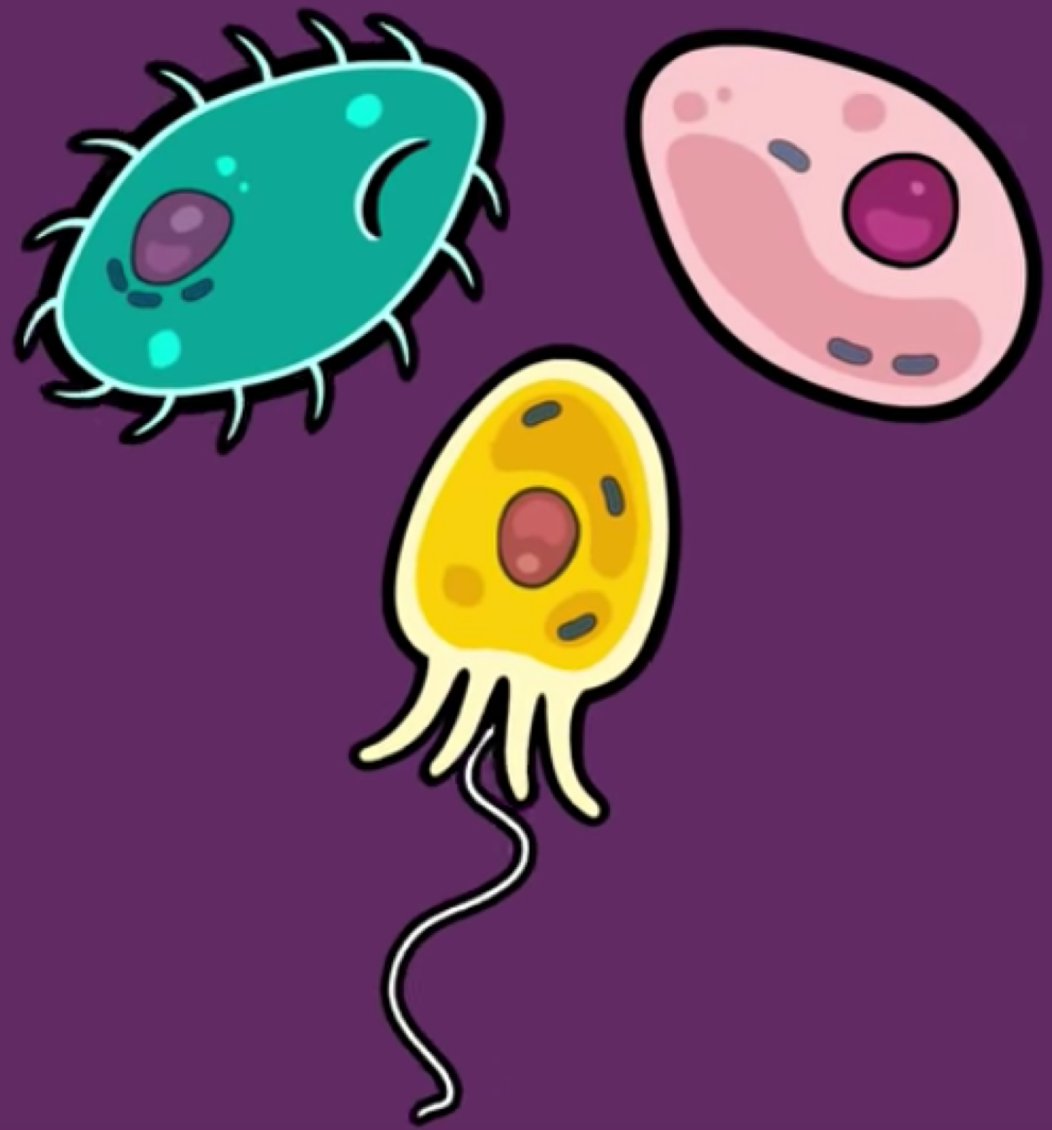
VIROIDS

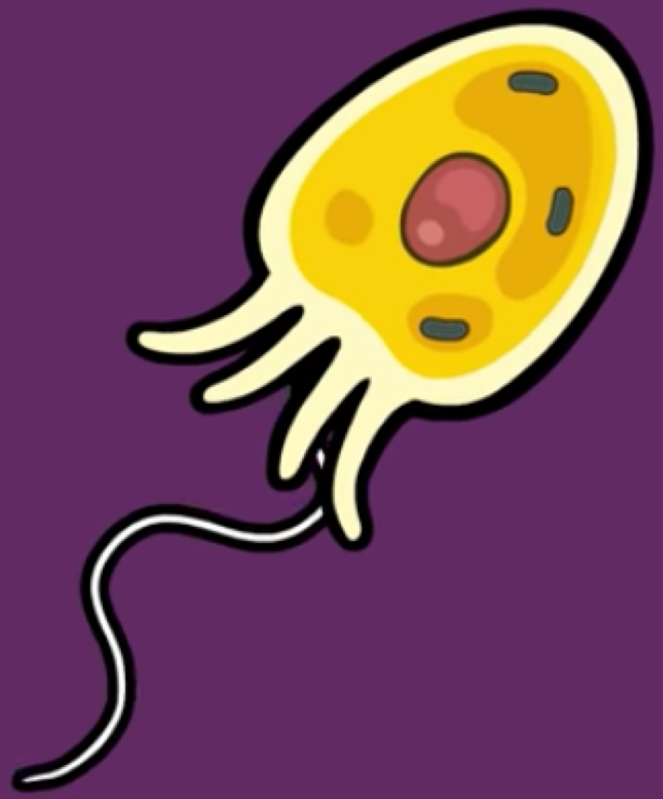


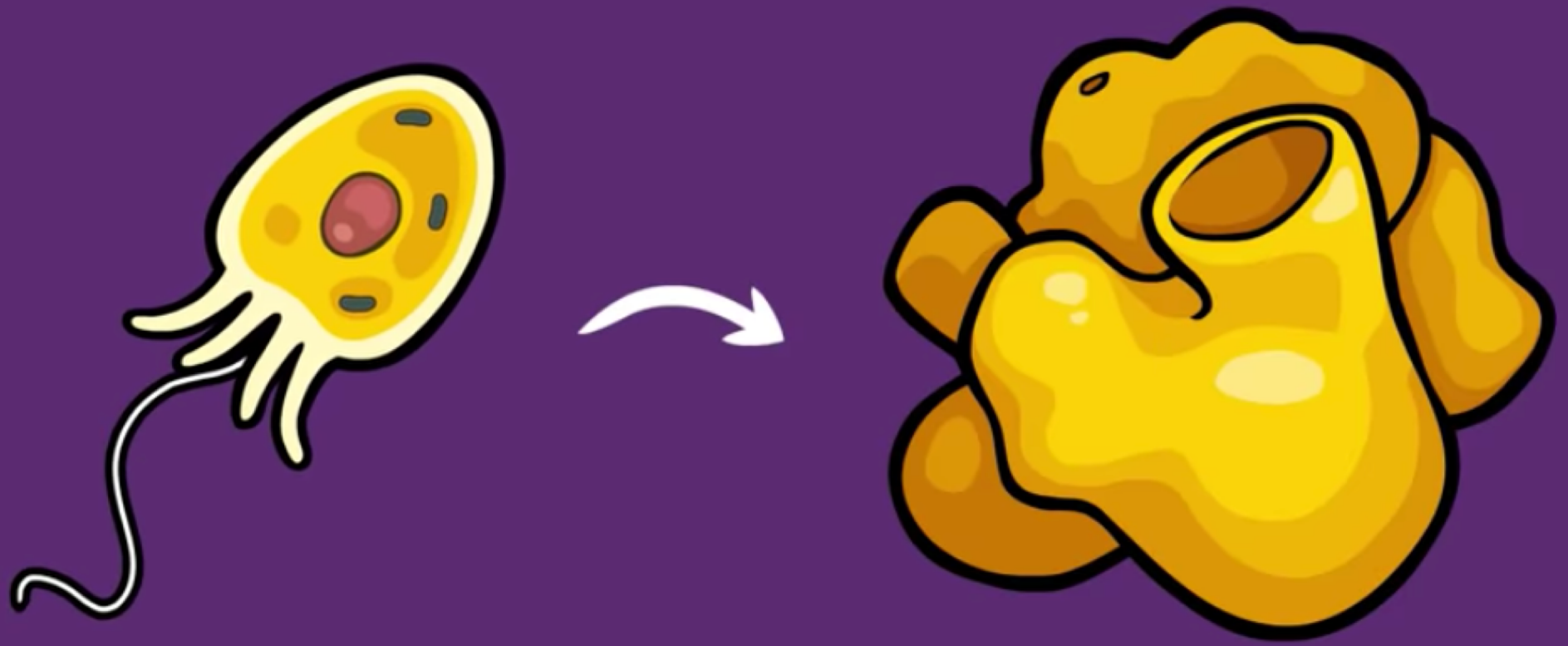
BACTERIA

ARCHAEA

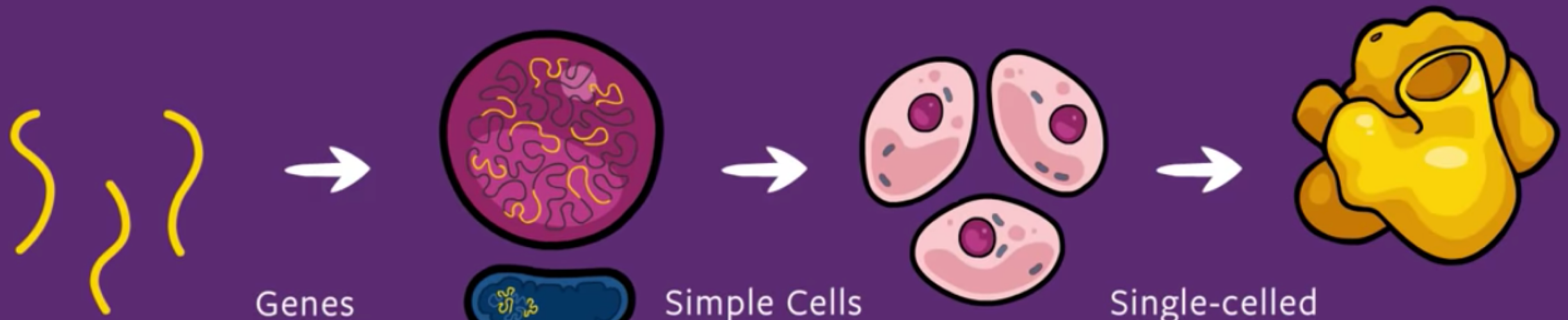
EUKARYOTES







MAJOR EVOLUTIONARY TRANSITIONS

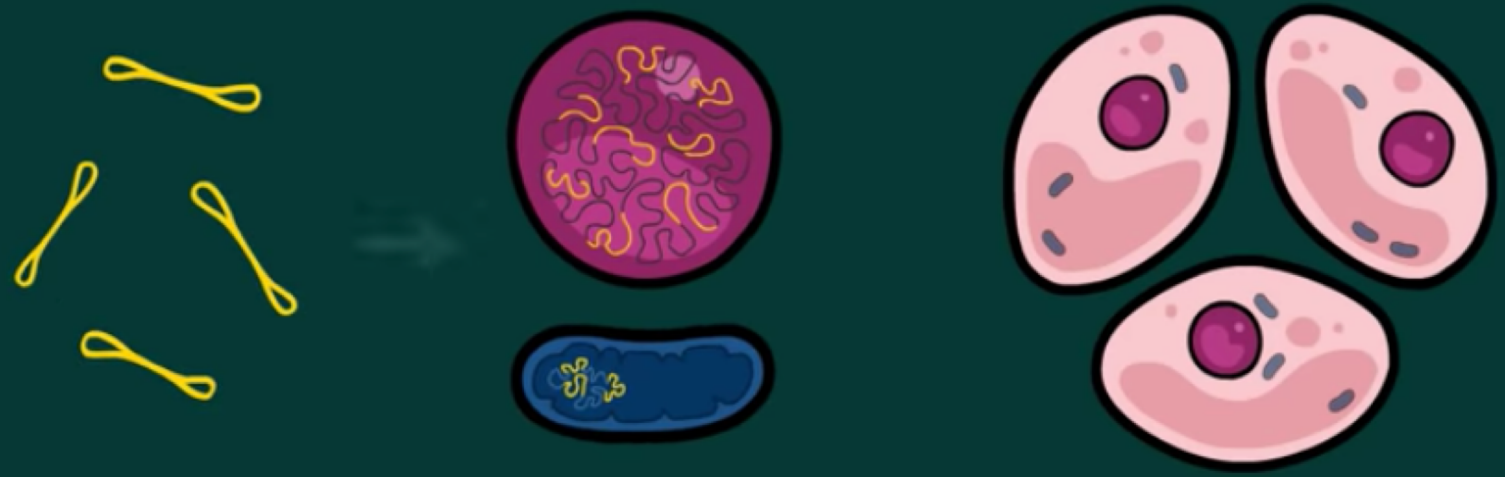


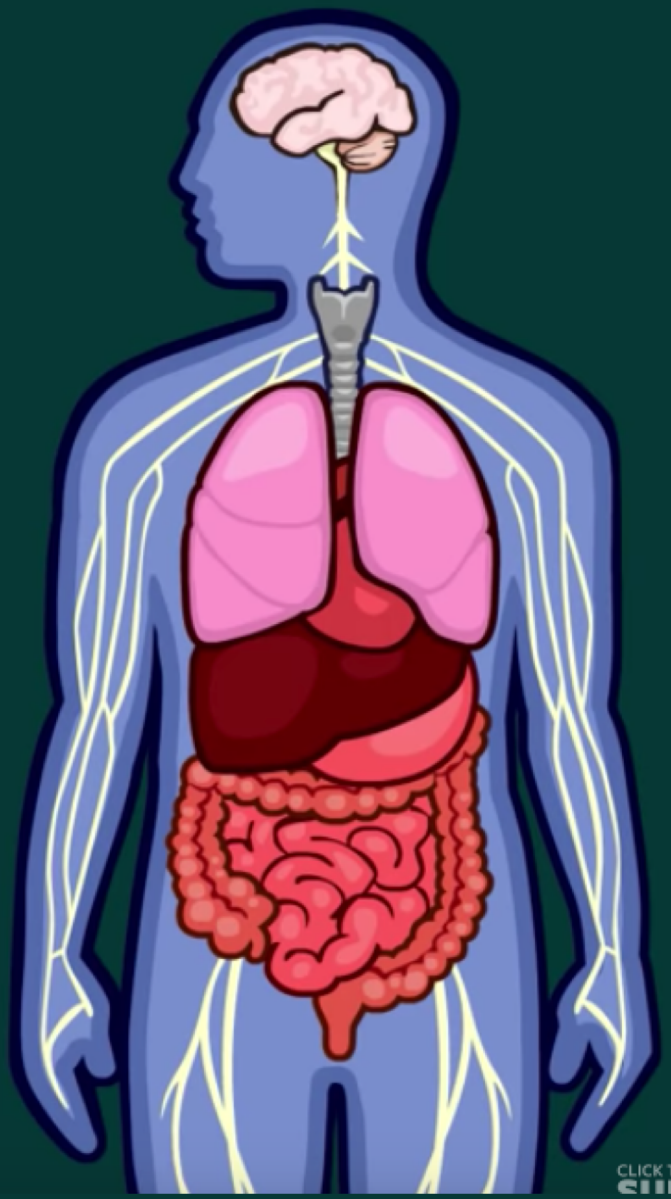
Genes to Genomes

Simple Cells to Complex Cells

Single-celled to Multi-celled

4 LEVELS OF LIFE





A complex system that works
is invariably found to have evolved from
a simple system that works.

- Gall's Law

WIRELESS PRODCUT ERA
2000 to 2010

12:10
TUE
2001

GARMIN

Owner's Manual

Edge™ 205/305

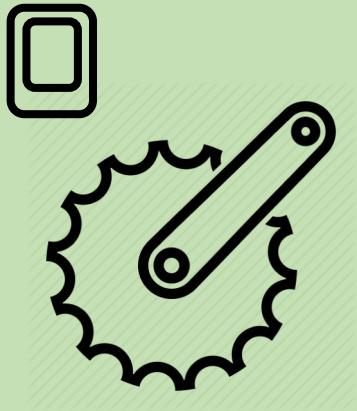
GPS-enabled computer for cyclists

2005

QUARQ
THINK FAST

2007

Low-Power Wireless in Cycling



Wireless
Products

INDUSTRY ECOSYSTEM ERA
2007 to Today

ANT+
TM

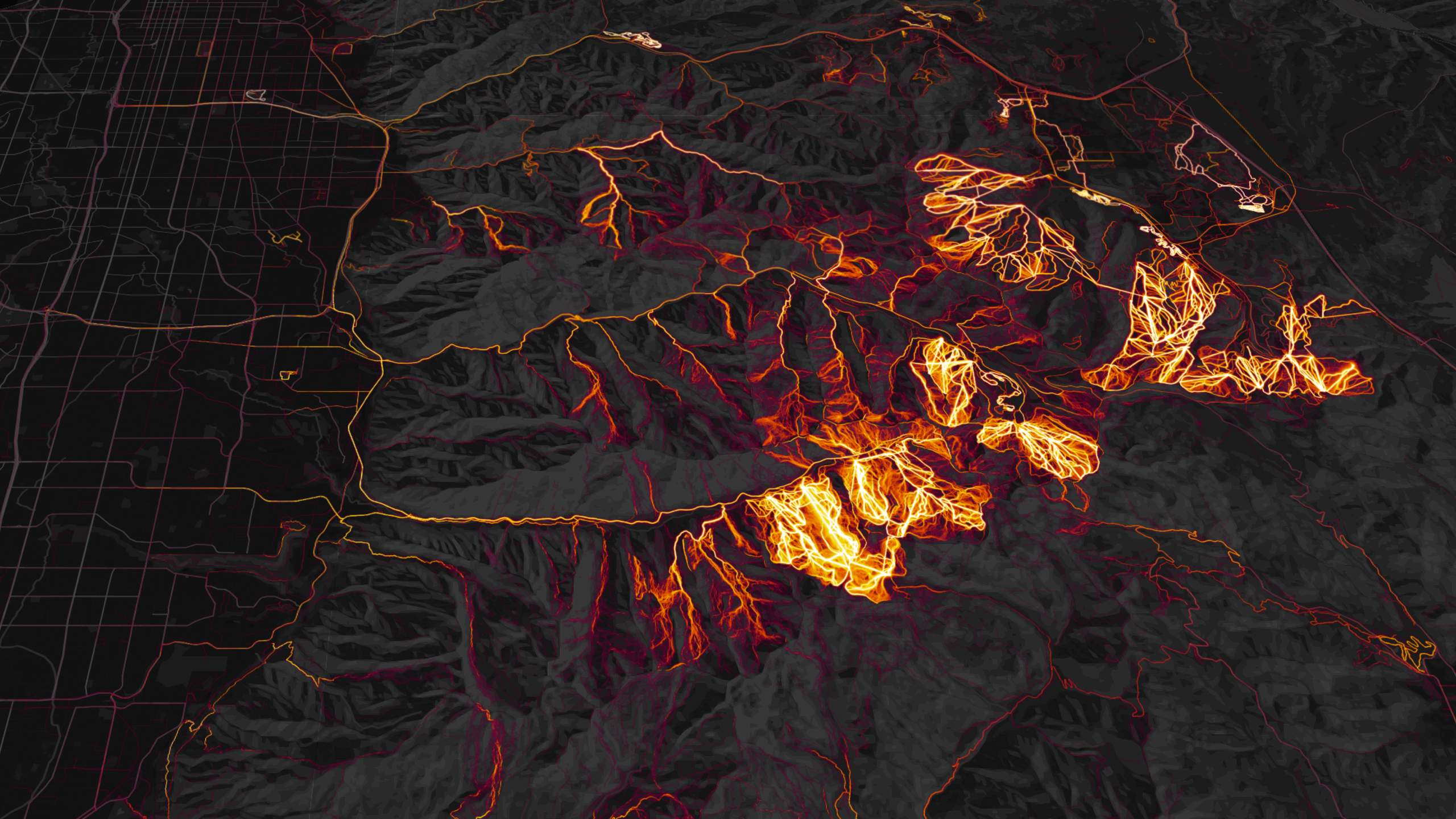
GARMIN
out
zoom
in
menu
mode
Untersee
Eibsee
Frillensee
SEILBAHN
1000
1000
940
1100
1140
1080
1120
1200
300m
mapsource
Edge 705
reset
lap
start/stop
GARMIN

GARMIN
Time
01:55:25
Lap Speed
21.0 mph
Distance
38.32 mi
Totl. Ascent
1913 ft
Grade
11%
Call From:
Tom
810-120-1821

ROCK
Shockwiz

SRAM 50/37T 12-SPD
SRAM

Tyrewiz



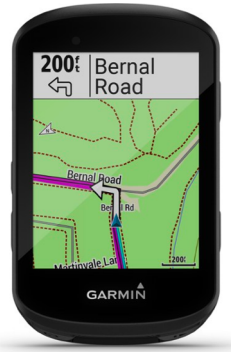
tern
BOSCH
ActiveLine Plus
tern

SPECIALIZED

ANT+ Device Profiles

SRAM
SRAM

ANT+



BLE

SRAMLink

ANT+

BLE

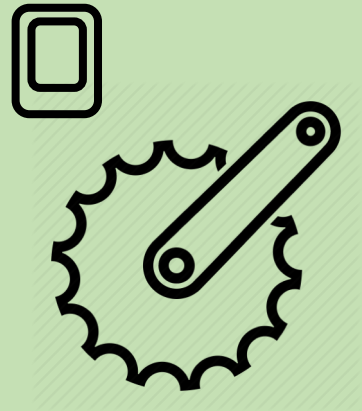
SRAMLink

Do users want BLE or ANT or SRAMLink?

They don't care!

Users just want things to work together!

Low-Power Wireless in Cycling



Wireless Products

Industry Ecosystem

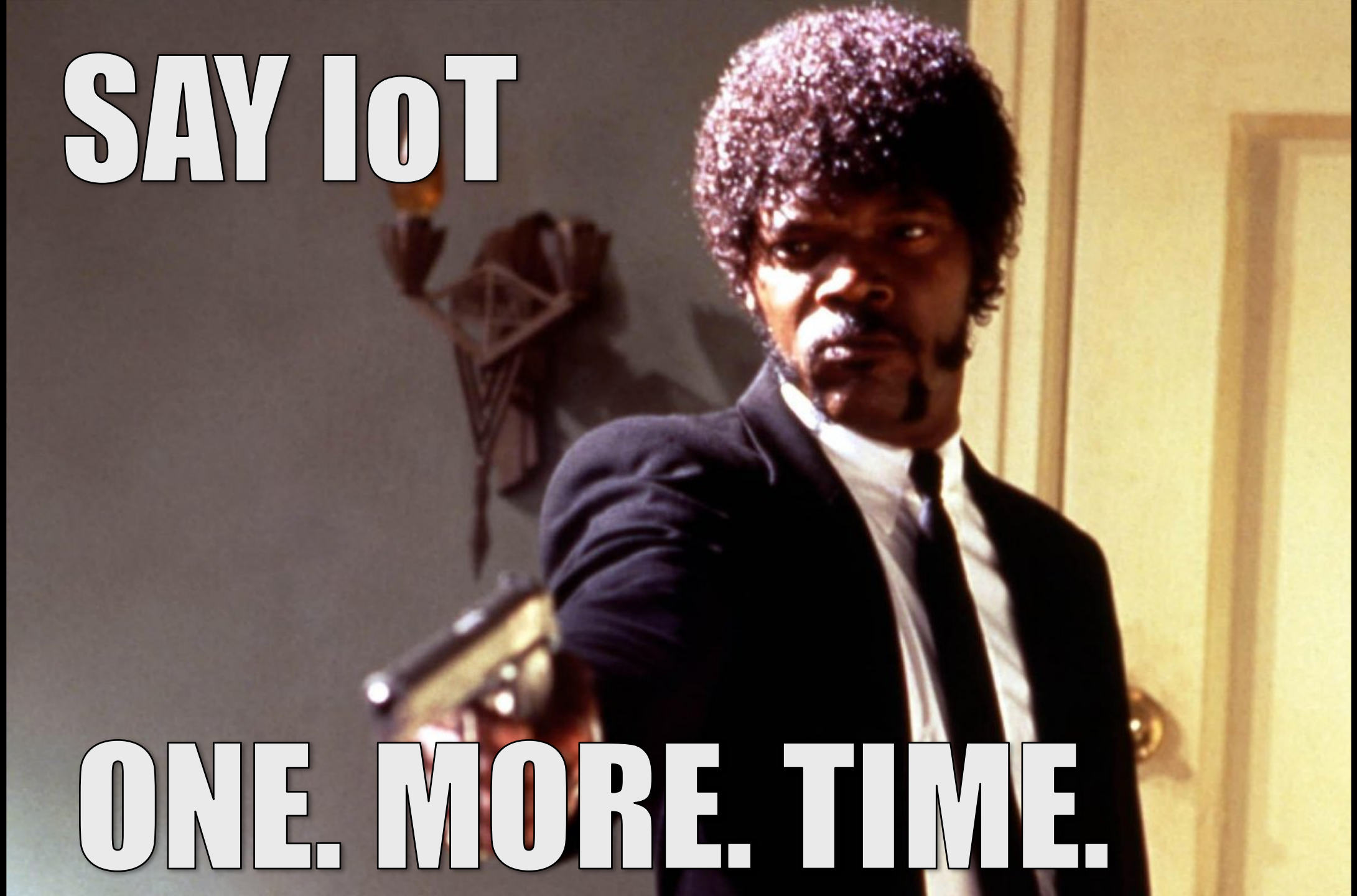
GLOBAL ECOSYSTEM ERA 2020 and BEYOND

Industrial Internet - Internet of Everything

Web of Things - Industrial Internet of Things

Smarter Planet - life.augmented - Digital Life

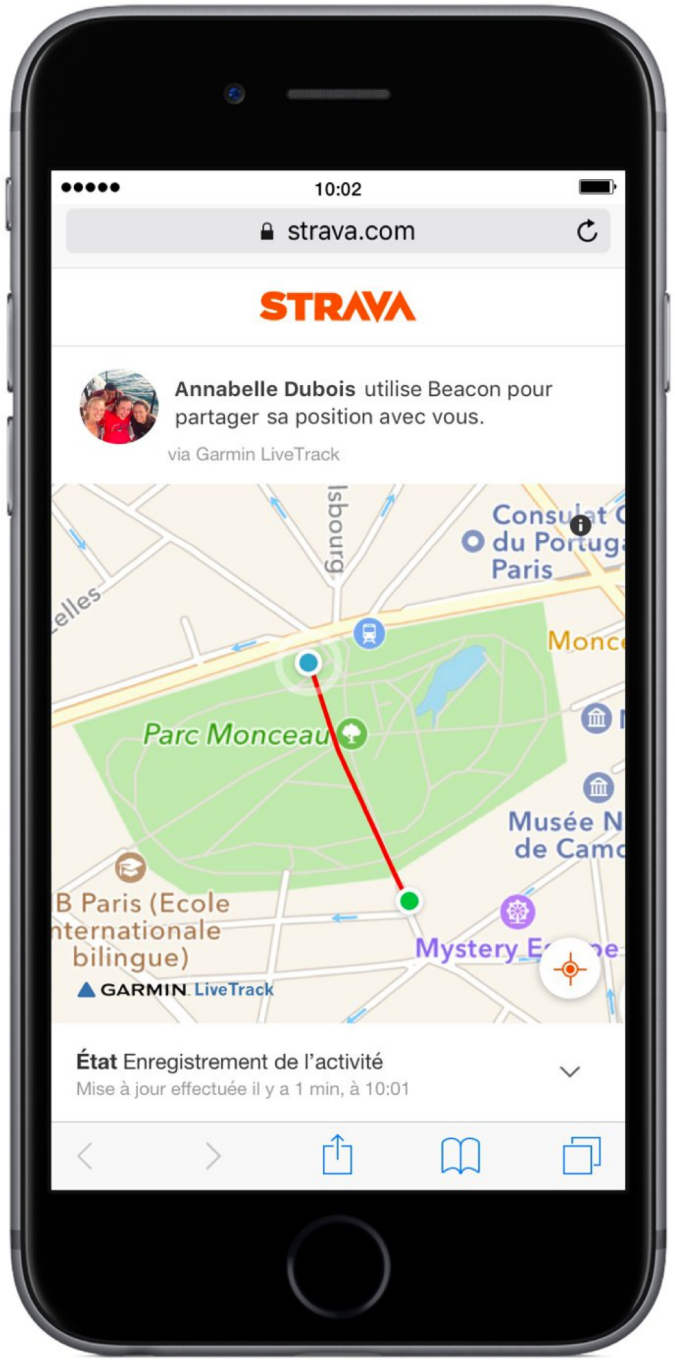
IoT - M2M - ambient intelligence - smart dust


SAY IoT
ONE. MORE. TIME.

WHAT WILL “KILLER APP” WILL DRIVE THE NEXT STAGE OF TRANSFORMATION?

BIKE SAFETY

GARMIN

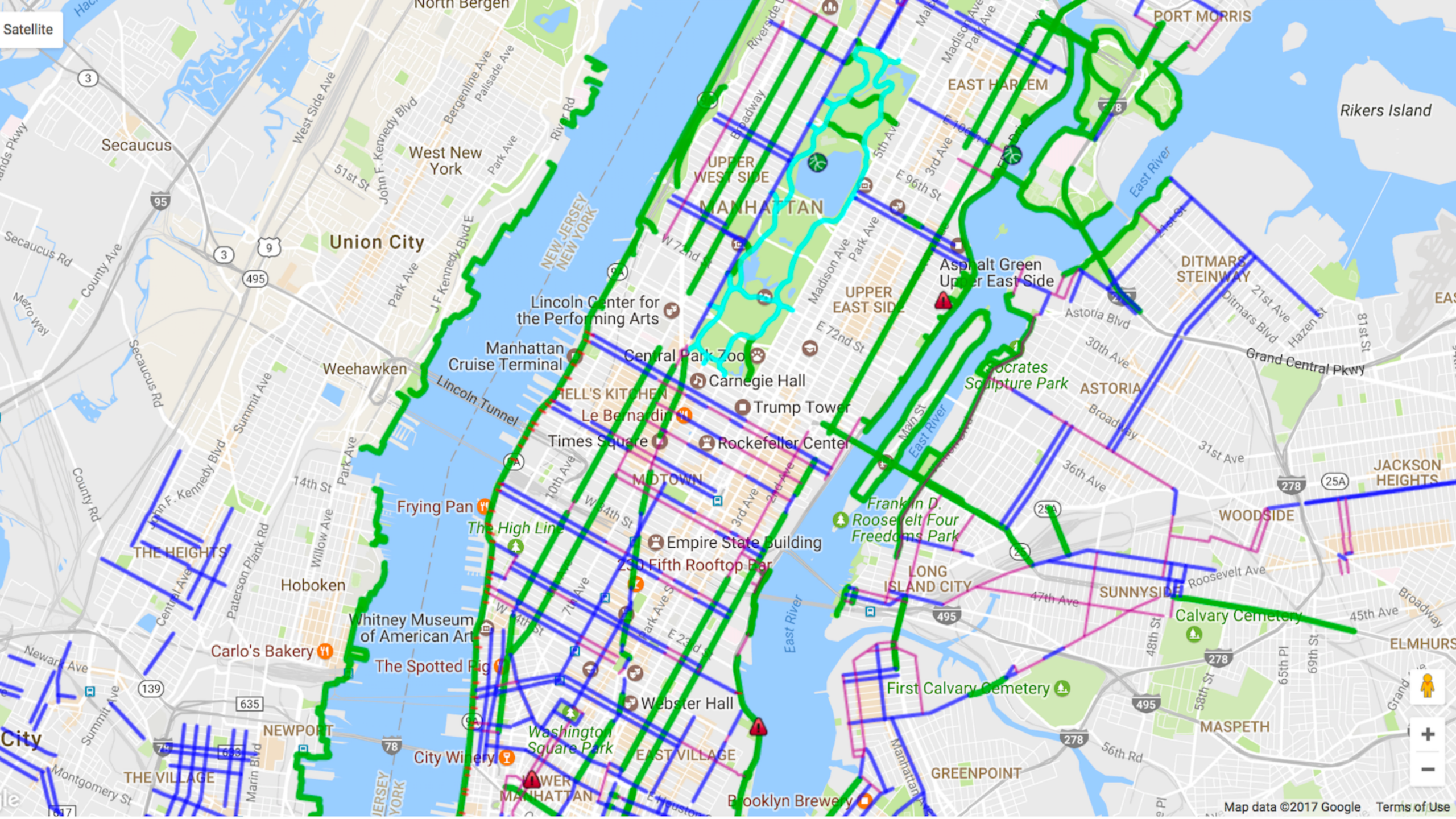

10:02
strava.com
STRAVA
Annabelle Dubois utilise Beacon pour partager sa position avec vous.
via Garmin LiveTrack
Parc Monceau
Mystery
GARMIN LiveTrack
État Enregistrement de l'activité
Mise à jour effectuée il y a 1 min, à 10:01

GARMIN
LiveTrack en cours
00:00:09
Vitesse
5.6 km/h
Distance
52 m
Heure
10:02:48
Calories
0 cal

QUARQ

GPS
spot
GEN3
S.O.S.
OK

JEFFERSON
TURNING VEHICLES
STOP FOR
THE BLOMMER CHOCO
JOHNSON PIPE


Satellite
North Bergen
Secaucus
West New York
Union City
Weehawken
Hoboken
Carlo's Bakery
Whitney Museum of American Art
The Spotted Pig
Frying Pan
The High Line
Lincoln Center for the Performing Arts
Manhattan Cruise Terminal
Central Park Zoo
Carnegie Hall
Trump Tower
Rockefeller Center
Times Square
Le Bernardin
HELL'S KITCHEN
MIDTOWN
Empire State Building
230 Fifth Rooftop Bar
Webster Hall
Washington Square Park
City Winery
EAST VILLAGE
LOWER MANHATTAN
Brooklyn Brewery
UPPER WEST SIDE
MANHATTAN
UPPER EAST SIDE
EAST HARLEM
PORT MORRIS
Rikers Island
Asphalt Green Upper East Side
Socrates Sculpture Park
Franklin D. Roosevelt Four Freedoms Park
LONG ISLAND CITY
SUNNYSIDE
Calvary Cemetery
First Calvary Cemetery
GREENPOINT
MASPETH
ELMHURST
WOODSIDE
JACKSON HEIGHTS
ASTORIA
DITMARS STEINWAY
NEWPORT
THE VILLAGE
THE HEIGHTS
NEW JERSEY
NEW YORK
East River
Lincoln Tunnel
Grand Central Pkwy
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WHAT TECHNOLOGY WILL ALLOW BIKES AND CARS TO WORK TOGETHER?

B2V TECHNOLOGY

B2V Safety Workshop

14th August 2019 - Detroit, Michigan

B2V Attending Companies

1. 3M
2. Allegion
3. Aptiv
4. Audi
5. Bosch
6. CAMP
7. CAR
8. Charles River Analytics
9. City of Detroit
10. Consumer Technology Association
11. USDOT - FHWA
12. Ford Motor Company
13. Ford Smart Mobility
14. Garmin
15. General Motors
16. Giant Bicycle, Inc.
17. GM
18. HAAS Alert
19. Honda
20. Hyundai America Technical Center, Inc.
21. Lyft LBS
22. MAGNA International
23. MEDC - PlanetM
24. Nordic Semiconductor, Inc.
25. Ohio State University
26. Panasonic
27. PeopleForBikes
28. PreAct Technologies
29. Qualcomm
30. Quality Bicycle Products
31. SAE International
32. See.Sense
33. Shimano
34. Specialized Bicycles
35. SRAM
36. Stages Cycling LLC
37. Subaru Research and Development, Inc.
38. Toyota Motor North America
39. Tome Software
40. Trek
41. UMTRI
42. University of Michigan
43. Veoneer
44. Volkswagen Group of America

V2V	Vehicle to Vehicle	*Cars, Trucks, etc*
V2I	Vehicle to Infrastructure	*Traffic lights, Road signs, etc*
V2X	Vehicle to [whatever]	
B2V	Bicycle to Vehicle	
VRU	Vulnerable Road User	*Cyclists, Pedestrians, Scooters*
RSU	Road Side Unit	*Traffic light, road marker*

DSRC

- DSRC - Dedicated Short Range Communications
- Spectrum allocated in 1999
- Defines communication message content
- Defines security layer
- DSRC hardware will likely loose to C-V2X

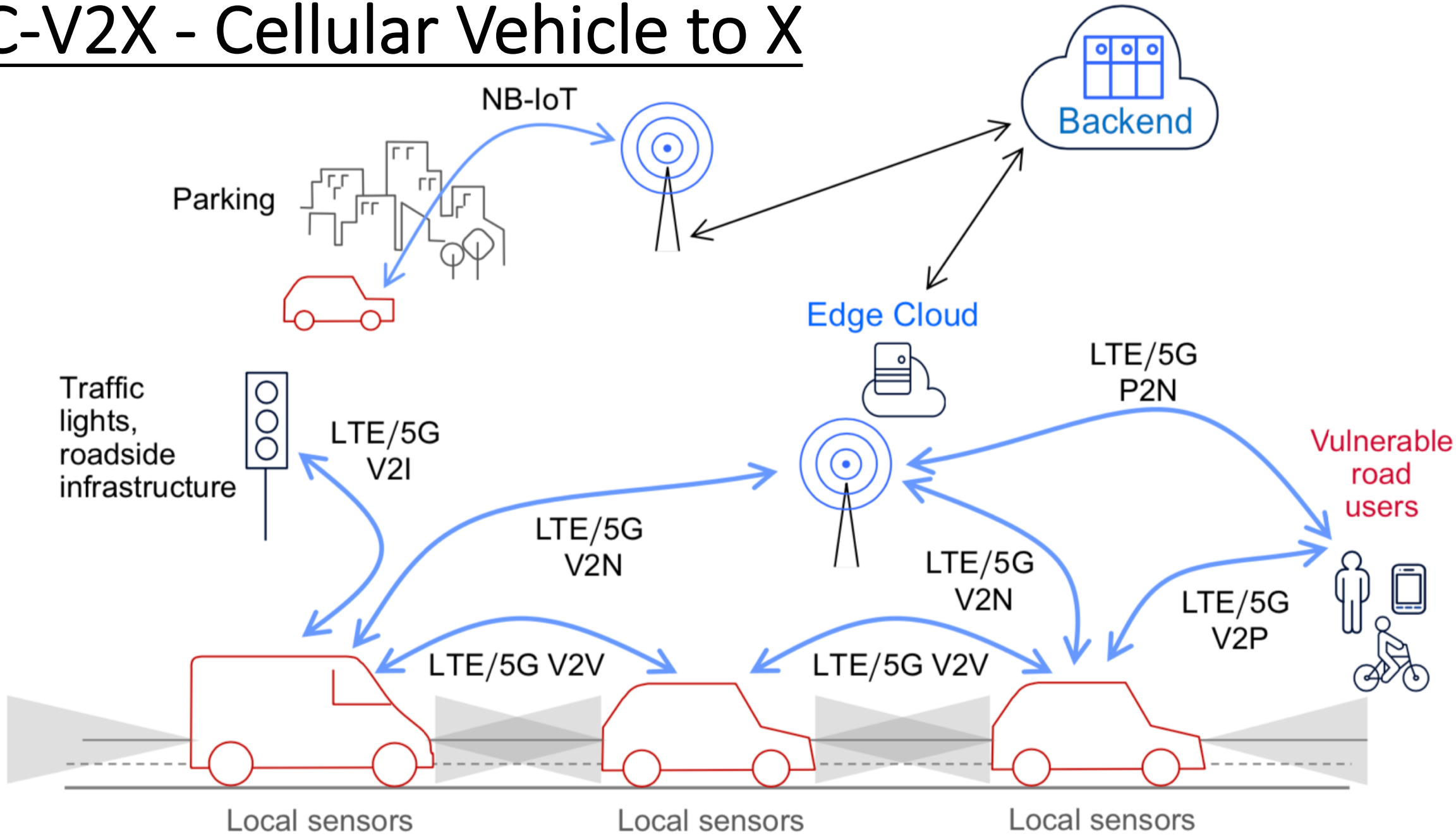
C-V2X

- C-V2X: Cellular Vehicle to X
- Uses messages and security defined in DSRC
- Hardware is likely 5G NR cellular technology

5G NR

- 5G NR: 5th Generation New Radio
- Designed to be the global standard for the air interface of 5G networks
- Large scale commercial launch expected in 2019
- Includes “Sidelink” technology – allows direct connection between 5G devices without tower

C-V2X - Cellular Vehicle to X



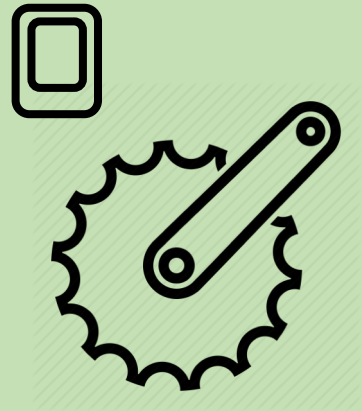
POSSIBLE B2V SAFETY COMPONETS

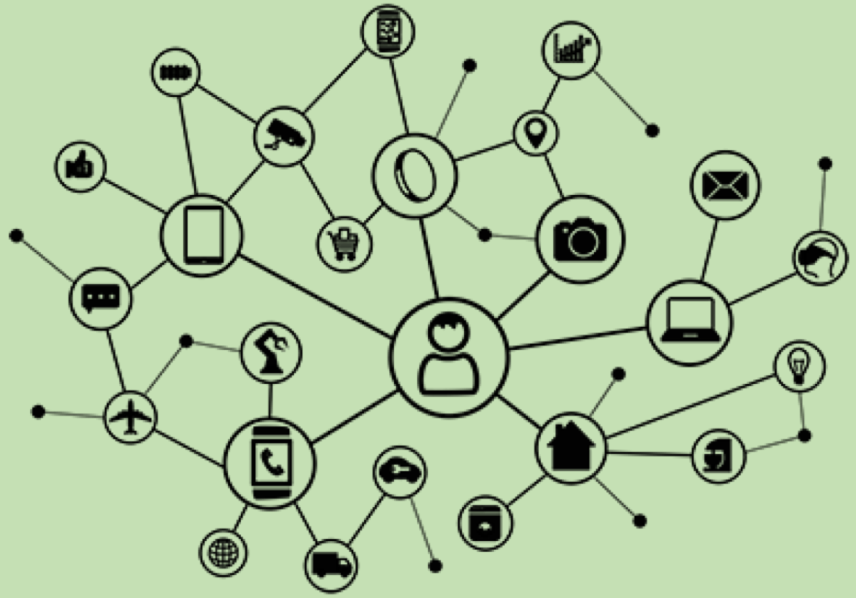
The critical Technical Constraint

in B2V bicycle safety technology

will be the Electrical Energy Source.

Low-Power Wireless in Cycling

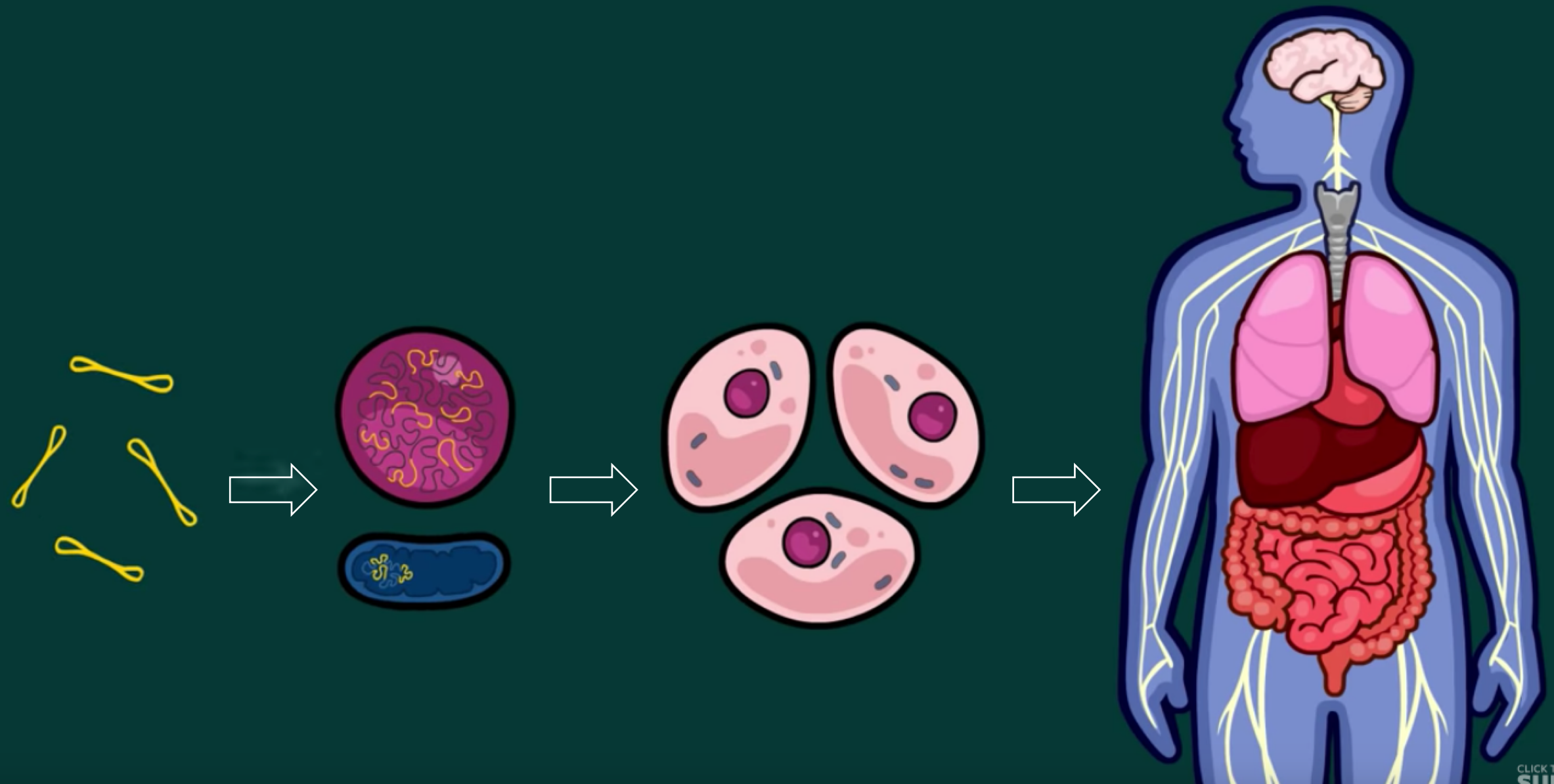




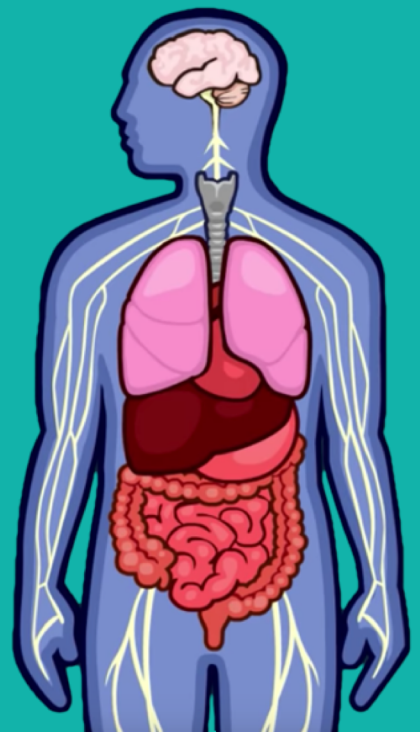
Wireless Products → Industry Ecosystem → Global Ecosystem

THE FUTURE

Evolutionary Transitions in Life



Evolution Intersects with Technology

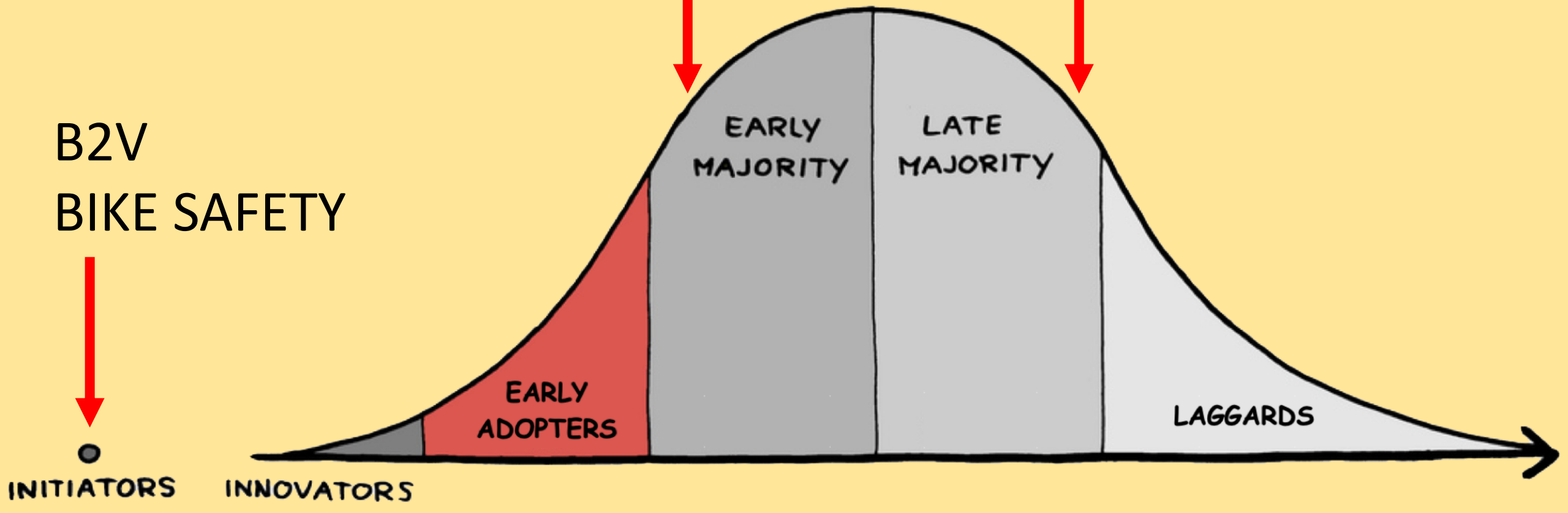


ECOSYSTEM EVOLUTION & ADOPTION

INDUSTRY ECOSYSTEM

WIRELESS PRODUCTS

B2V BIKE SAFETY



#1 FINISH THE INDUSTRY ECOSYSTEM

- 50% done now

- Need to button up the pain points
  - Pairing
  - Compatibility
  - Security

#2 CONNECT TO OTHER INDUSTRY ECOSYSTEMS

- Key use cases or killer apps will drive integration
- Bike Safety likely to be an early application

What other 'killer apps' could drive the transformation to a Global Ecosystem?

THANK YOU