Smart Concrete and Autonomous Cars:

Building the Future of Roads

CARS HAVE BECOME "SMARTPHONES ON WHEELS"

INTEGRATED ROADWAYS

CONNECTED 2020'S, AUTONOMOUS 2030'S

INTEGRATED ROADWAYS

BUT ROADBUILDING HASN'T CHANGED THAT MUCH

"Together, the united forces of our communication and transportation systems are dynamic elements in the very name we bear—United States. Without them, we would be a mere alliance of many separate parts."

- President Dwight D. Eisenhower

U.S. INTERSTATE SYSTEM
60th Anniversary
1956 - 2016

Looking north along I-10 and I-110 (then known as I-410) in Baton Rouge ca. 1964
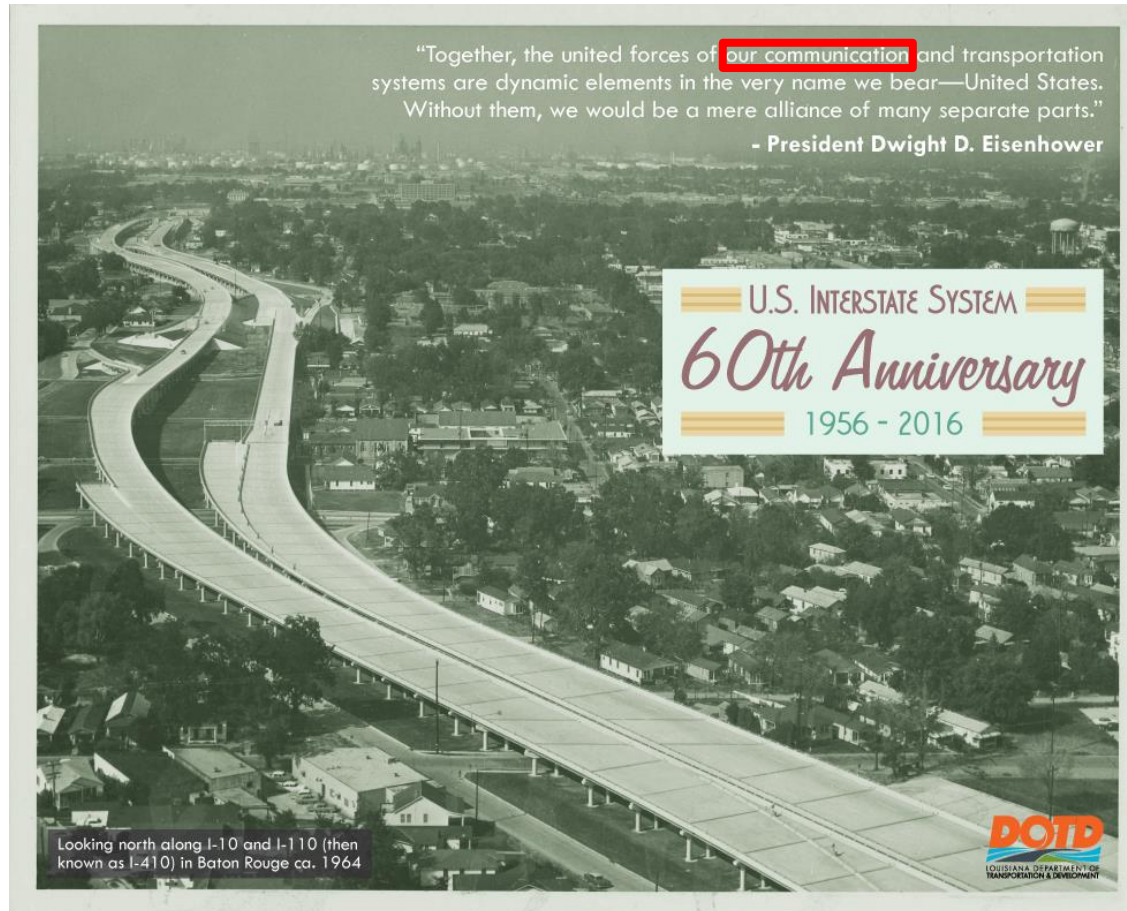
INCREMENTAL IMPROVEMENTS IN ROADBUILDING

Improved continuous paving

Specialized equipment

Better mix design & admix

Type III quickset mixes

Milling & resurfacing

ITS signage, cameras, & sensors

Lane markings

Weather management

Safety & barrier systems

Ramp & interchange design

THERE'S LOTS OF INNOVATION AVAILABLE (NOT ALL GOOD)

Precast concrete

Solar pavement (LOL)

Roller compacted concrete

Plastic materials

Self consolidating concrete

Styrocrete

Pervious concrete

Permanent instrumentation

It's just not being adopted!

INTEGRATED ROADWAYS

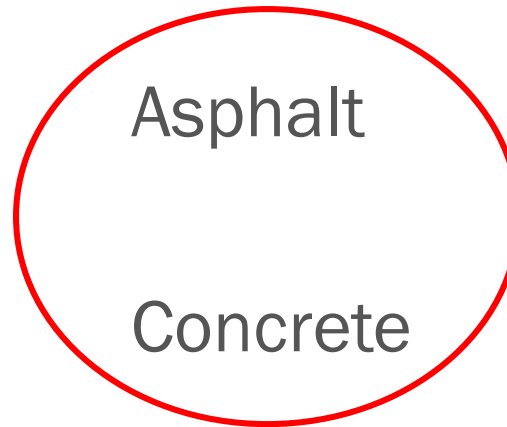# ROADBUILDING HAS CHANGED A LOT, HISTORICALLY

Dirt paths

Log roads

Gravel

Slate

Brick

Cobblestone

Asphalt

Concrete

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INCREMENTAL VS EXPONENTIAL IMPROVEMENT

What is possible

vs

What we are doing

{

1950   1970   1990   2010   2030
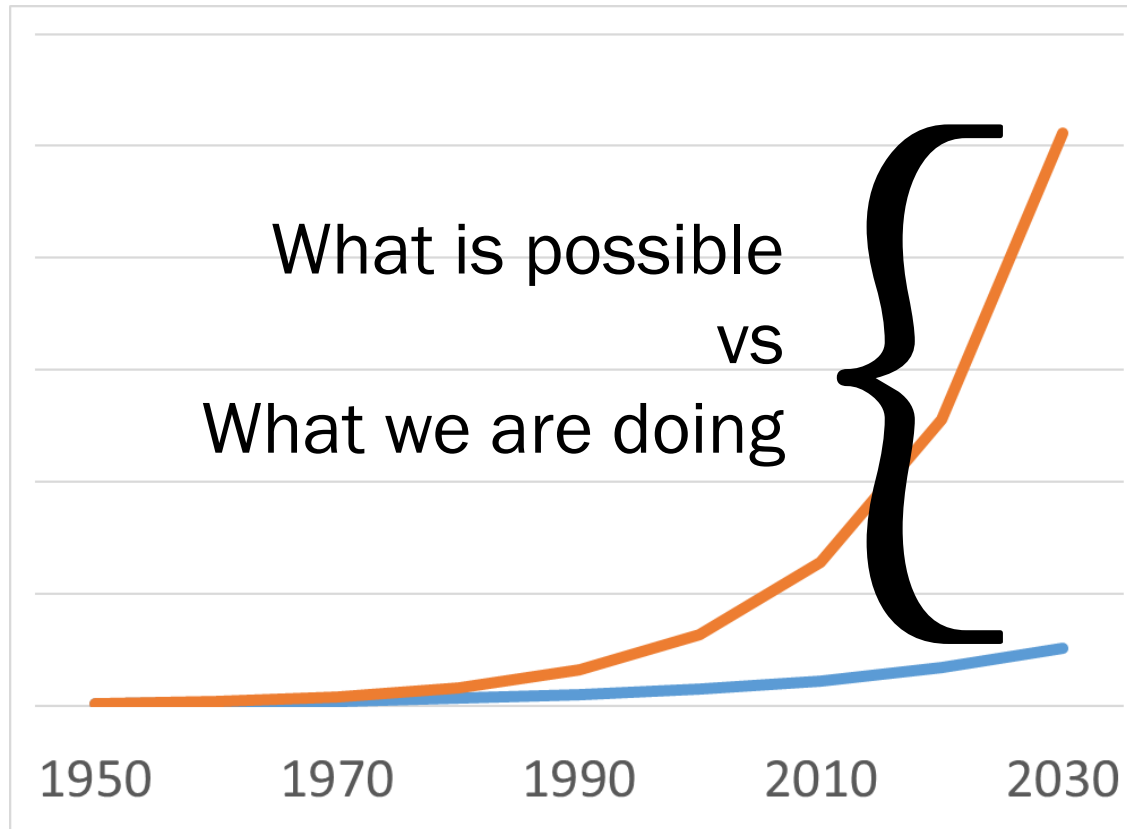
Technology firms focus on **exponential** improvement

- TVs
- Phones
- Computers
- Cars

Regulated industries focus on **incremental** improvement

Capability gap grows over time

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Think About the Future!

In 50 years, will roads still be "just roads"?

Or will they be roads + sensors + data + connectivity + more?

EMERGING DEMANDS FOR INFRASTRUCTURE

Smart Cities

Internet of Things

Dedicated Short Range Comms

5G Distributed Antenna Systems

Charging for Electric Vehicles

Navigation for Autonomous
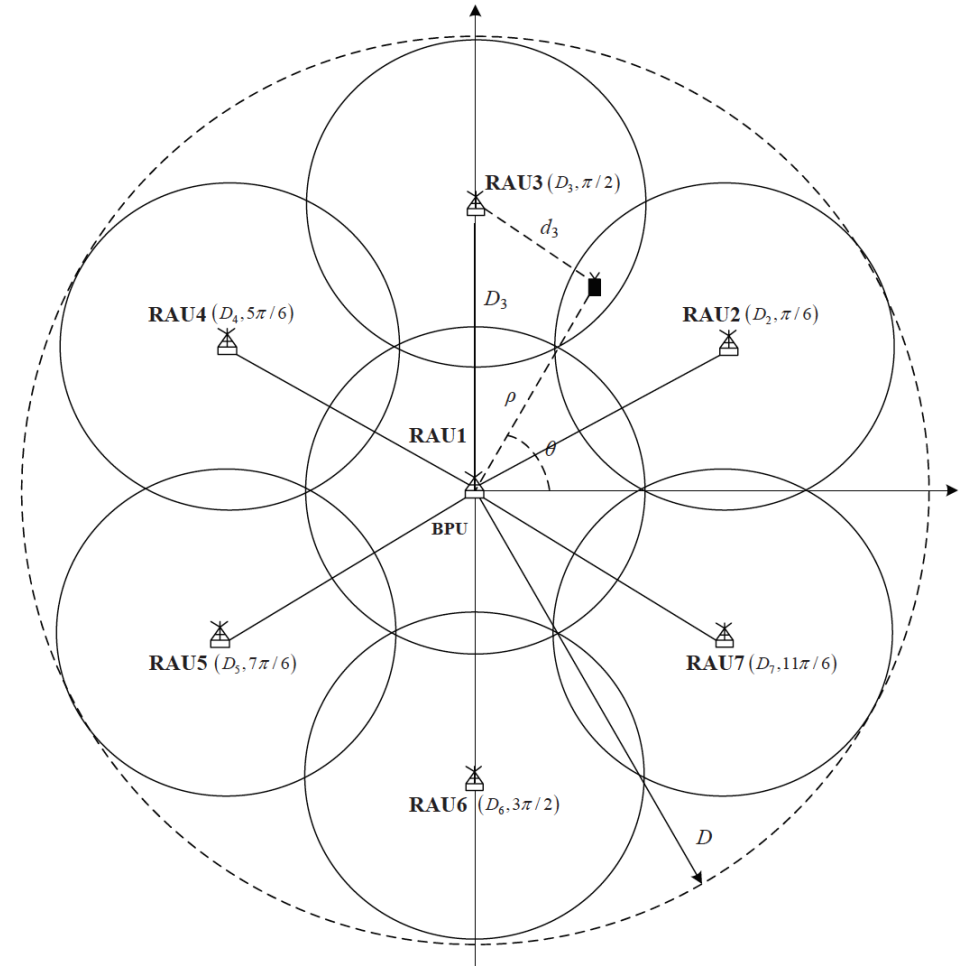
Connectivity for Autonomous

Right-of-Way isn't just for roads!

DISTRIBUTED ANTENNA SYSTEMS

SMART CITY PROJECTS

Kansas City Smart City Corridor
- Cisco
- $15m

Columbus Smart City
- $40m USDOT
- $10m Vulcan (Paul Allen)

LinkNYC
- Sidewalk Labs (Google)

Envision Charlotte
- Verizon

Bos:311
- Boston
- Potholes & other reports

Tons of UK / Euro / Asian work

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CURRENT & EMERGING INTEREST AREAS

Permanent Traffic Counts

Data Driven Safety Systems

Automated Collision Alerts

Blue Signal Indicators

Pavement Condition Indexing

Public Safety Wi-Fi

Full System Signal Integration

License Plate Readers

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STATE SMART HIGHWAY PROJECTS

Ohio Turnpike
- 52 miles
- $1.46m
- Cisco & Local
- Ext

Florid

CDOT RoadX I-70
- Panasonic
- $7.5m to $75m

DIVE AWARDS

D Construction DIVE

PUBLISHED
Dec. 4, 2017

Tech of the Year: Smart highways

MILES OF ROADS:
4.12M

CAGR 2017-2021:
93.54%

MARKET PROJECTION:
$32.81B by 2020

INTEGRATED ROADWAYS
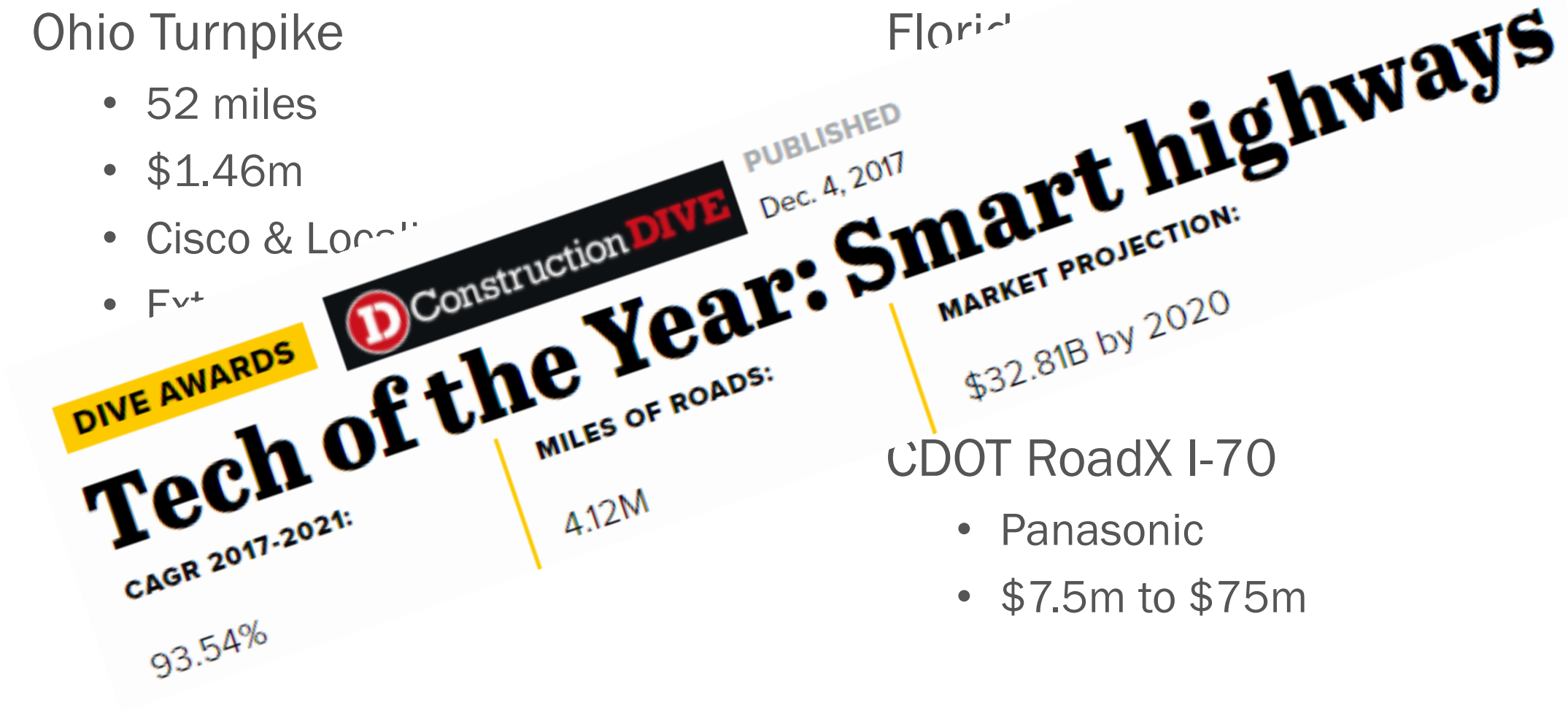
INTELLIGENT TRANSIT SYSTEMS AND SMART CITIES

Limited to a small portion of project funds

Limited to a small portion of projects

Struggle for funding

Struggle for public-facing use-cases

INTEGRATED ROADWAYS

AMERICA NEEDS TO REBUILD ITS ROADS!

C.R.E.A.M. - CASH RULES EVERYTHING AROUND ME

Inventory grows 2% annually

Gas taxes not raised for 30 years

Recent increases ~10% of need

2/3 cost increase over last 10 yrs

More miles than ever

Less money than ever

Backlog growing for 30 years

More expensive than ever!

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PAYING FOR ROADS IS AN INTRACTABLE PROBLEM

8m lane-miles of roads

40% need major service

At least 3,000,000 miles

$2m per lane-mile

>$6 **trillion** dollars

Trump plan is for $1t

Only 20% of it for roads

$200b = 100,000 ln-mi

3% of needed improvements

Brother, can you spare a dime?

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DON'T WORRY, IT GETS WORSE!

Currently, 40% need service

- Increase to 75% by 2035

Cost increase 2/3 in last 10 yrs

- ~100% increase in next 15

By 2035, 75% of roads will need service, at $4m per mile

= $33 trillion dollars…

America's GDP in 2035 is projected at $25 trillion

In 2035 we will need to spend 1.3 years of our GDP to fix our roads

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WHAT IS POSSIBLE VS WHAT WE'RE DOING

Here's our funding source! {

1950   1970   1990   2010   2030

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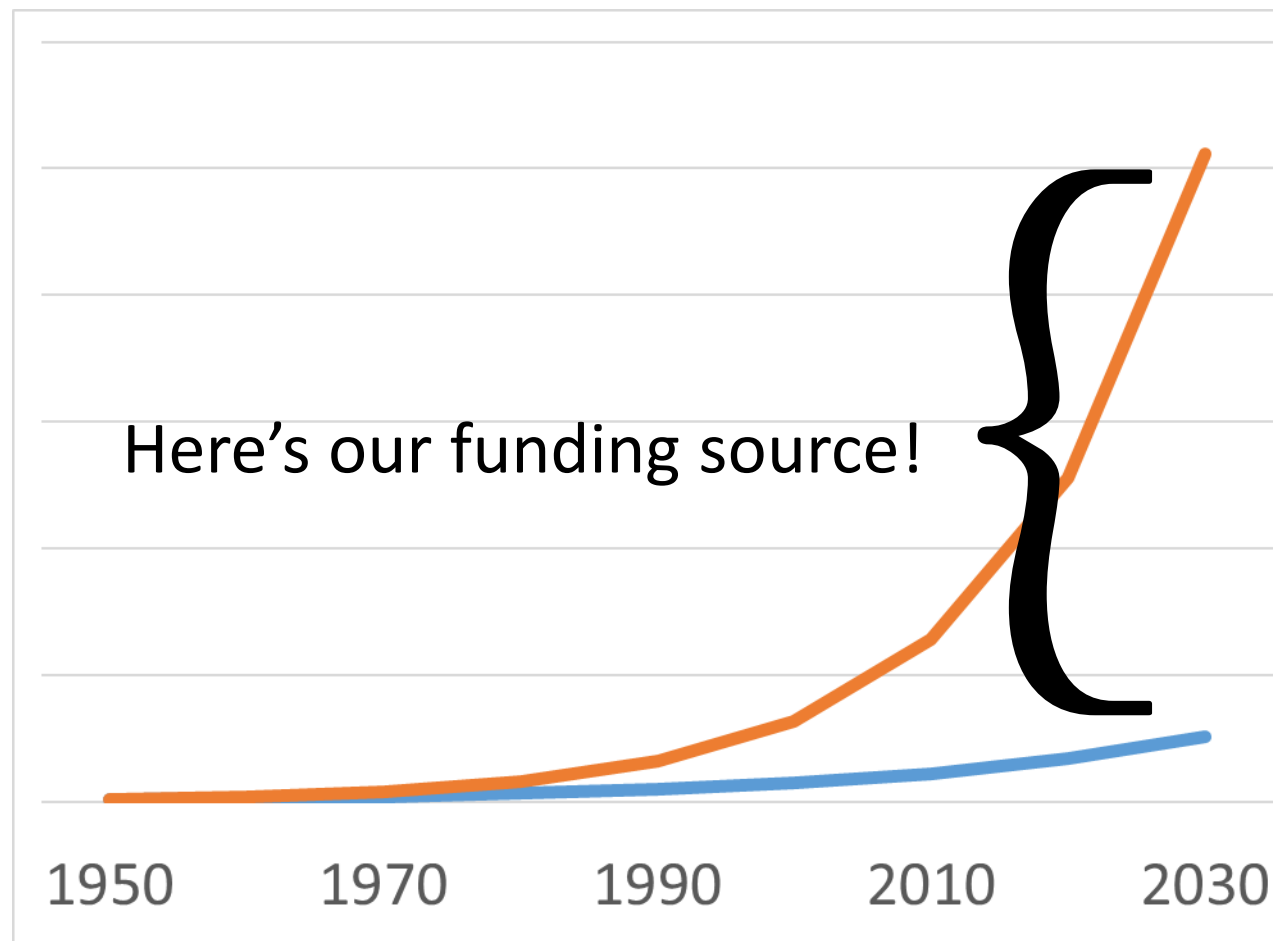
TREAT ROADS LIKE NETWORKS

Do you pay to go on Amazon?

Do you pay to go on Facebook?

Why not?

You being there is more valuable
than charging you a fee!

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NETWORKS CREATE ENORMOUS VALUE

Value of a network:

- X^2 (Claude Shannon)
- X = size of network (miles, users, etc)

Electricity

Telephones

Internet service

Webpages

TV / Radio / Cable

Roads are the ORIGINAL network

Autonomous and connected cars need networks too!

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What if Digital Networks Paid for Road Improvements?

Free to drive, pay to connect

No need for public budgets to fund projects

More users means more funding

THINK ABOUT ROADS LIKE WEBPAGES

Average lane-mile of road costs about $5m over 50 years

Average lane-mile of road carries about 50m users over 50 years

$0.10 per use will pay for the road

Websites can make $0.10 per user without charging to visit

Roads can too, **if we focus on innovations people will pay for**

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PEOPLE SPEND 90 MINUTES DAILY IN CARS

$11 at minimum wage, $20 at most common wage

If you could work, socialize, or be entertained instead of driving, you'd *happily* pay $0.1 per mile

- That's only $4.50 at 30mph, $9 at 60 mph

You'd earn more money by paying the cost & working

You'd pay less than a typical movie if being entertained

You'd pay less than a beer if socializing (and could drink a beer, too!)
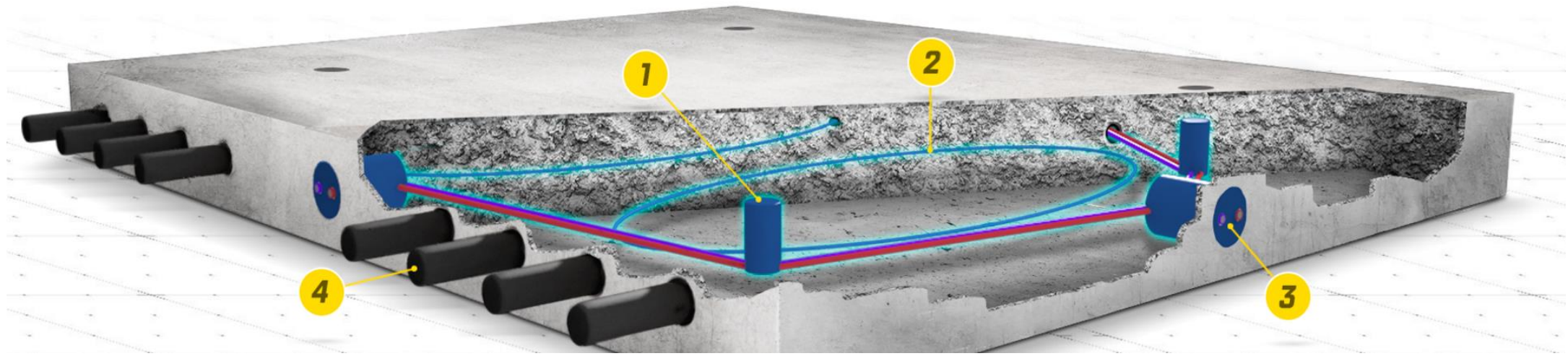
SMART PAVEMENT MAKES ROADS PAY FOR THEMSELVES

Better, faster, cheaper construction

High speed neutral host network

Built in "touch sensitivity" & pavement condition sensing
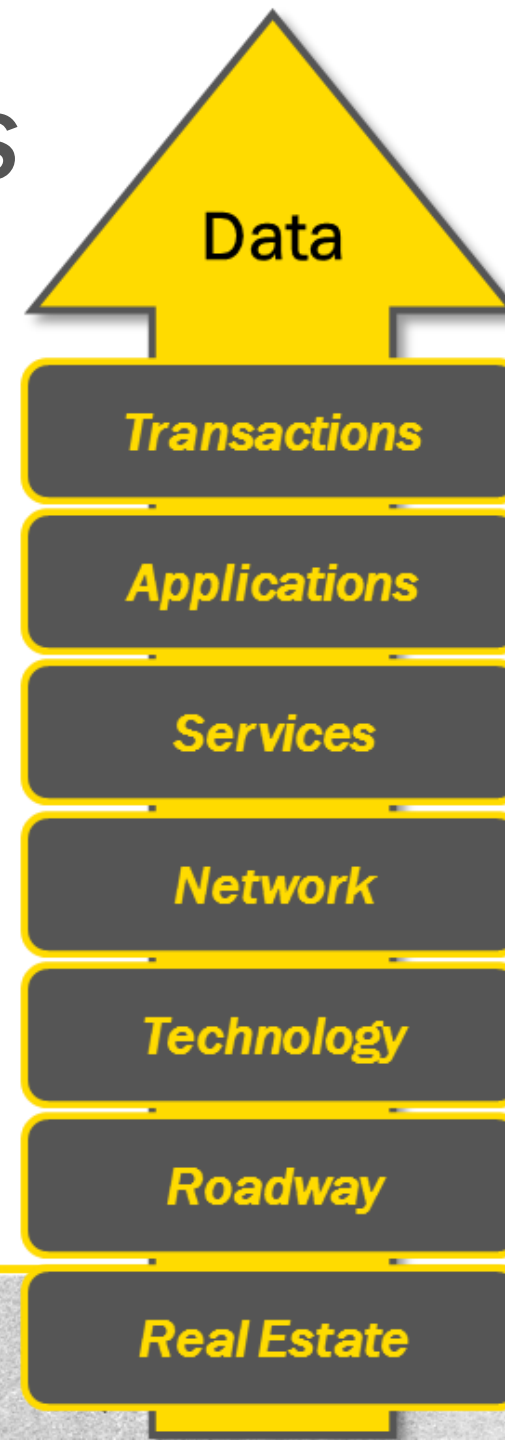
Free to drive, pay to connect

WE TREAT ROADS LIKE NETWORKS

Finance improvements with a P3

Design-build-finance-operate-maintain

Charge for everything above "technology"

Payback in 9 years (early) to 3 years (mature)

Data

Transactions

Applications

Services

Network

Technology

Roadway

Real Estate

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SMART PAVEMENT FEATURES - NOW & NEAR

Traffic counts

Traffic patterns

Driver behaviors

Vehicle speeds

Vehicle weights

Vehicle categorization

Collision reporting

Run off the road reporting

Pavement condition indexing

Dangerous condition notices

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SMART PAVEMENT SERVICES – FUTURE

Real time traffic notices

Vehicle routing improvements

Vehicle to vehicle comms

Vehicle to infrastructure comms

Neutral hosting for carriers

"AdWords for physical spaces"

Navigation & routing for autonomy

Telemetry for autonomy

Apps platform for next-gen mobility
- "Internet for cars"
- Productivity, social, entertainment

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Smart Cars and Smart Cities Need Smart Roads and We Need You to Build Them

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