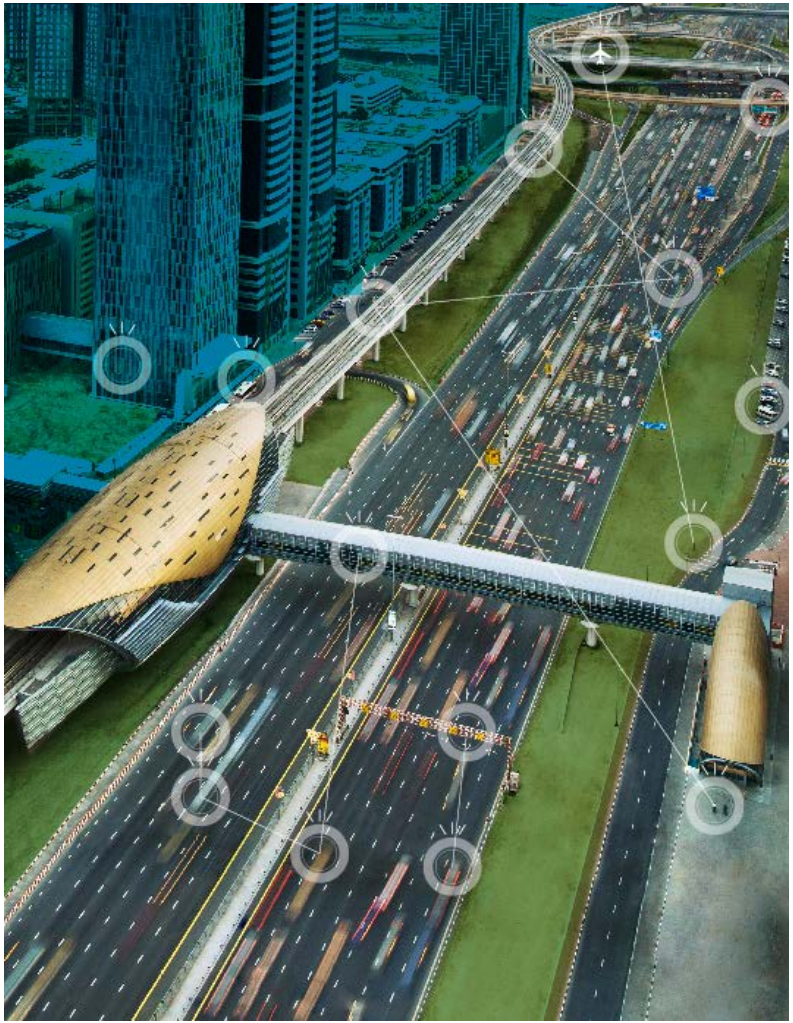


Autonomous & Connected Vehicles

Presentation to

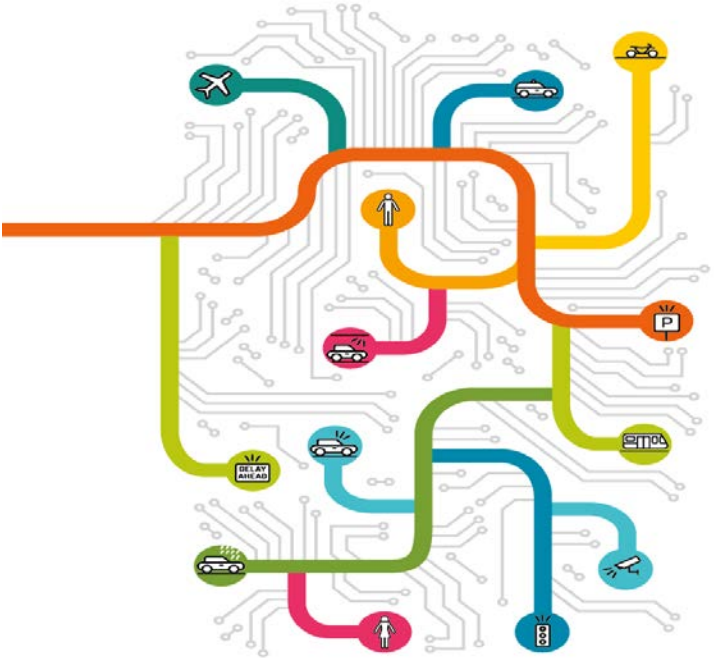
KCITE & WTS

Presentation by

HNTB

July 9, 2015

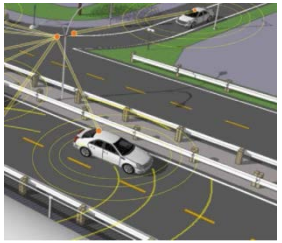
“Now” technologies constantly emerging



- Coordination through connectivity
  - Intermodal integration
  - Integrated corridor management
  - Active traffic & demand management
- Mobility applications on smartphones
- Parking applications
- Managed lanes
- Electronic tolling solutions
- Smart truck parking

Connected and automated vehicles

- **Connected Vehicle** – Uses wireless technology to communicate with other vehicles and infrastructure
- **Automated Vehicle** – Aspects of safety-critical control functions occur without driver input





Levels of Automation



NHTSA, 2013

Levels of Automation

Level 0 No Automation

Level 1 Function Specific

Level 2 Combined Function

Level 3 Limited Self-Driving

Level 4 Full Self-Driving

NHTSA, 2013



Honda

Levels of Automation

Level 0	No Automation
Level 1	Function Specific
Level 2	Combined Function
Level 3	Limited Self-Driving
Level 4	Full Self-Driving

NHTSA, 2013



Tesla

Levels of Automation

Level 0	No Automation
Level 1	Function Specific
Level 2	Combined Function
Level 3	Limited Self-Driving
Level 4	Full Self-Driving

NHTSA, 2013



Freightliner

Automated vehicles

ABC News (May 8, 2015)

http://abcnews.go.com/WNT/video/nevada-experiments-legalization-driving-freightliners-30932237

Levels of Automation

Level 0	No Automation
Level 1	Function Specific
Level 2	Combined Function
Level 3	Limited Self-Driving
Level 4	Full Self-Driving

NHTSA, 2013



Connected vehicles: current state



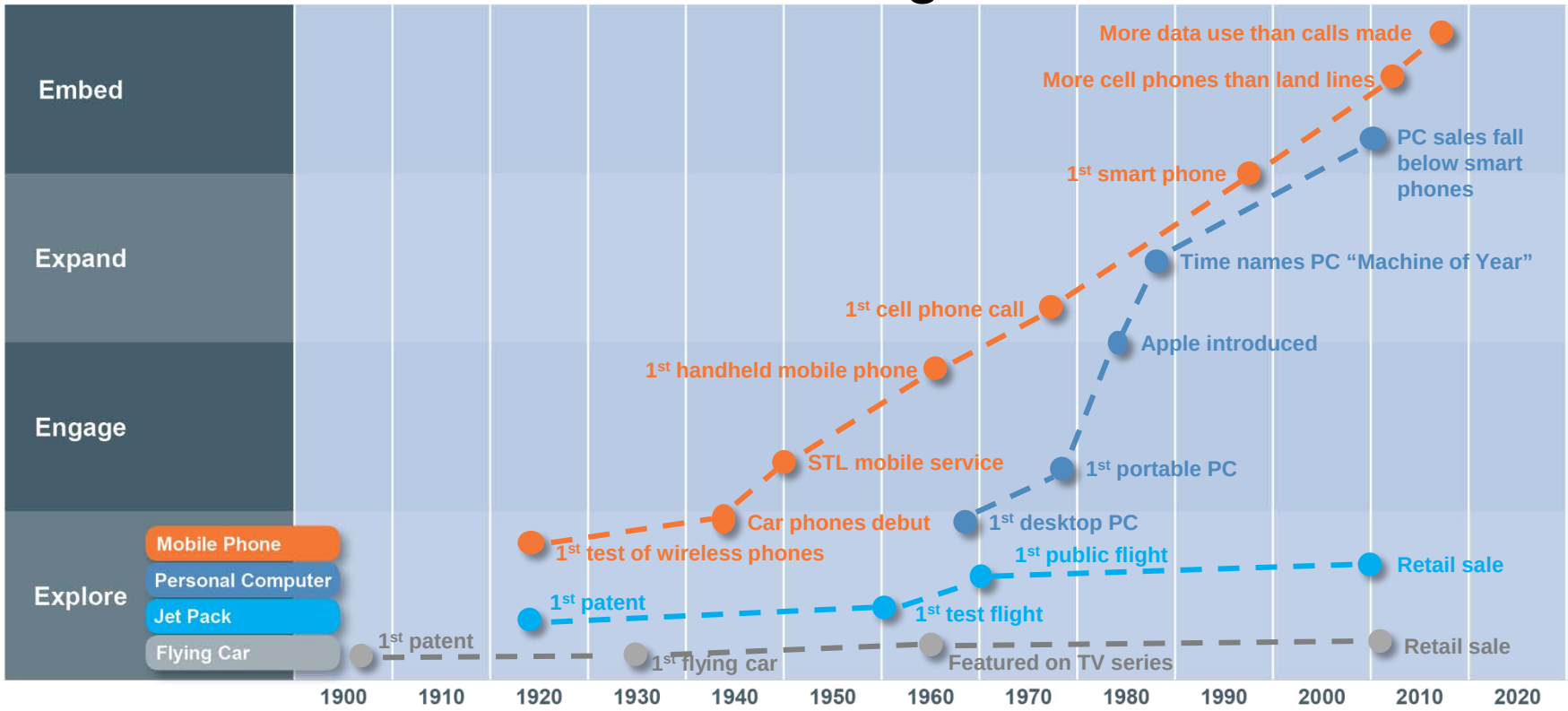
- National Highway Traffic Safety Administration advance notice of proposed rulemaking on August 18, 2014
- Final rule on V2V expected in 2016
- AASHTO “Footprint Analysis” for infrastructure applications
- USDOT Connected Vehicle Pilot Deployment Program
- GM announced they would offer connected vehicles in the 2017 model year

TRANSPORTATION IMPLICATIONS

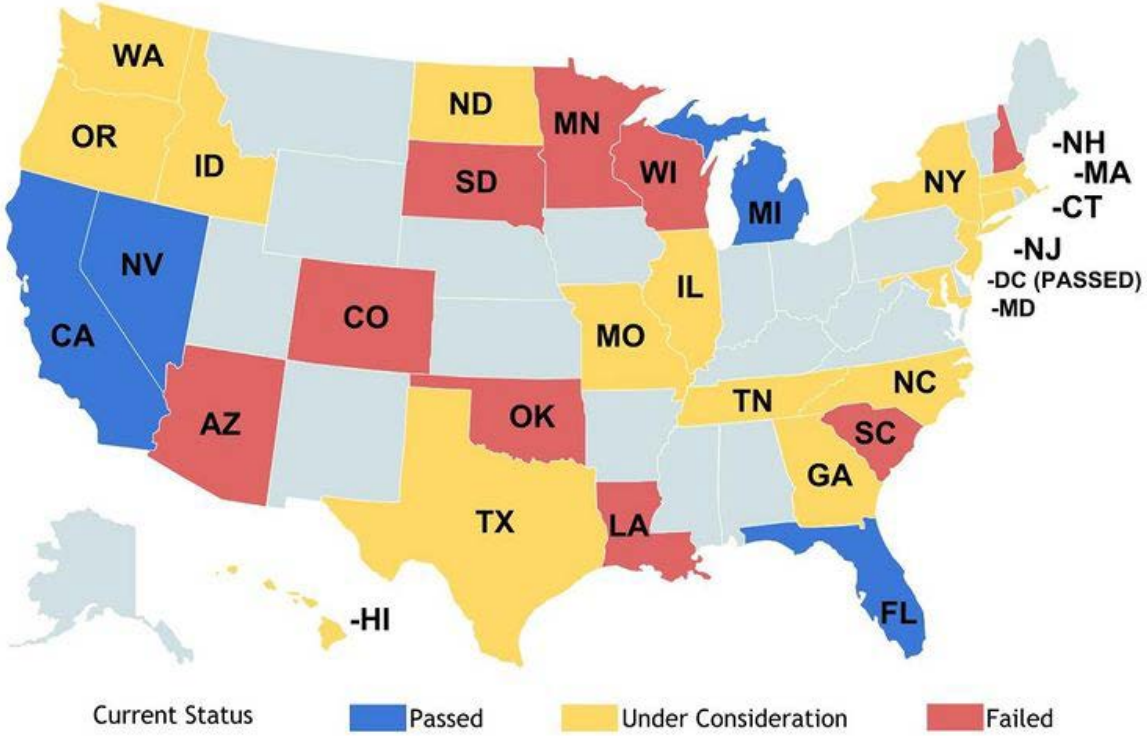
- Policy
- Education
- Planning
- Design
- Technology

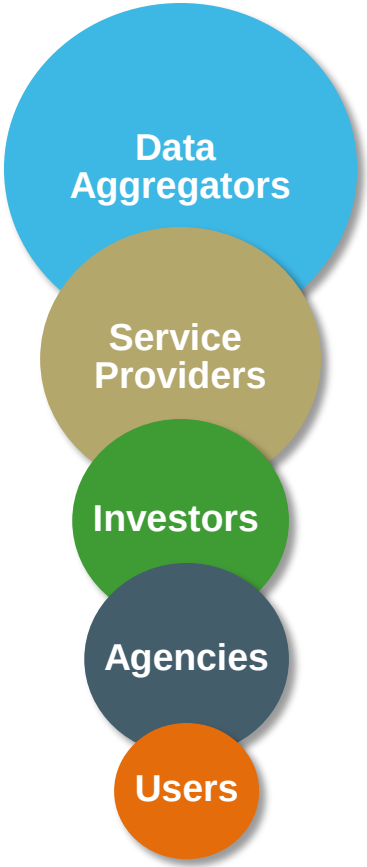
POLICY & COMMUNICATION

How soon will our business change?



Many bet the change comes soon…





What is the policy/communication focus so far?

1. What is an autonomous vehicle?
2. Are they legal to operate and under what conditions?
3. Who's the boss after the ignition is on – human or machine?
4. What driver/passenger behavior is it still wrong … and what's the punishment?
   (speeding, distracted driving, drinking, service hours)
5. Who's to blame … and how guilty are they?
   (roadway design flaws, software/hardware issues, shared failures, 4w1h evidence)
6. Who owns my data and what can they do with it?
   (big data, privacy, project prioritization)

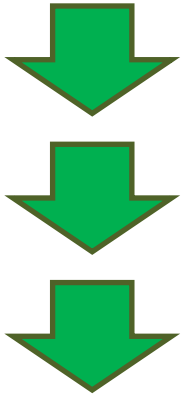
Big issues remain unresolved

Legal (What is it?)	Governance (Who owns it?)	Operations (How do we run it?)	Finance (What are the costs?)
Short term	**Short term**	**Short term**	**Short term**
• Risk management	• Risks (+/-) I.D.	• Security	• Initial costs
• Liability assignment	• Process changes	• Privacy	• Funding transition
• Enforcement	• Technical skills	• Transition planning	**Long term**
Long term	**Long term**	**Long term**	• Project prioritization
• Litigation management	• Needs assessment	• Impacts assessment	• Funding sources
• Change management	• Goals development	• Long-range planning	• Impacts mitigation
• Existential definition	• Organization & Policy	• System/driver obligations	
• Impact governance	• Performance	• Penalties/inducements	
	• Social equity	• Access cut-off(s)	

PLANNING

Increased Safety

- Traffic accidents
- Lives lost
- Insurance costs



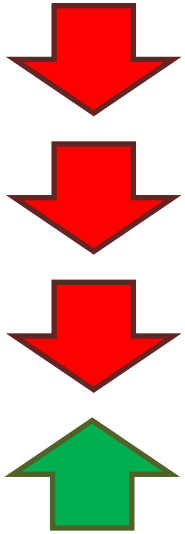
Benefit
to Society?

Yes

No

Fewer Jobs

- Human drivers
- Repair shops
- Automobile manufacturing
- Fleet managers



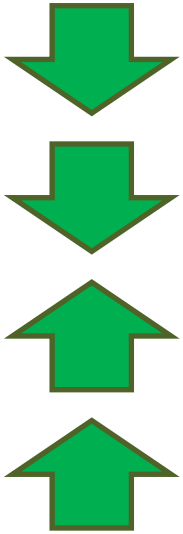
Benefit to Society?

Yes

No

Less Parking

- On-street parking
- Surface parking
- Developable land
- Activity center density



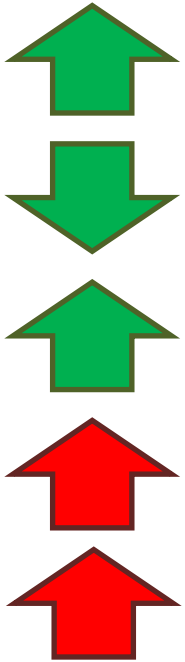
Benefit
to Society?

Yes

No

Longer Commutes

- Productive time
- Housing cost
- Travel speed
- Energy use
- Carbon footprint



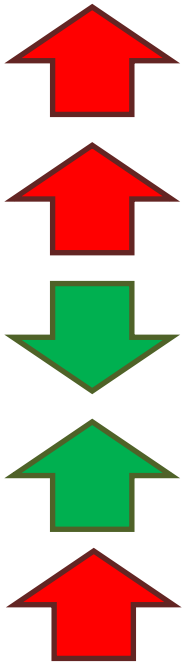
Benefit to Society?

Yes

No

More Congestion

- Longer trips
- Empty trips
- Lane width
- Road capacity
- Vehicle interactions



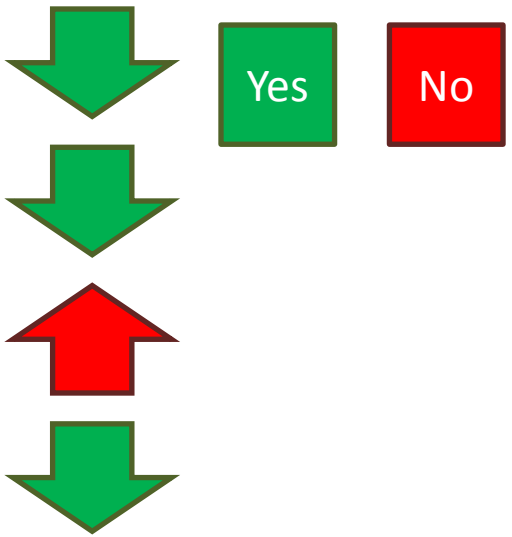
Benefit
to Society?

Yes

No

Transit Mode Share

- Walk time — Door-to-door service
- Wait time — On-demand
- Travel time — Slower
- Fare cost — Less



DESIGN

Design

A Different Vehicle + A Different "Driver" = A Different Roadway

- Facility Type Selection
  - Capacity assumptions
  - Effects of driver behavior
- The Physical Roadway
  - Roadway geometry
  - Roadside design
  - Dedicated AV/CV facilities
  - Provisions for technology infrastructure
    - Connected vehicle roadside infrastructure
    - Electric vehicle charging – wireless induction
    - Toll infrastructure
    - VMT data capture
- Navigational Aids – How do we communicate with the "driver"
  - Traditional signing and signalization
  - In-Vehicle messaging
  - Non-traditional communications
- Phased Implementation
  - Evolving blend of traditional and non-traditional vehicles
  - Planned facilities capable of evolution

TECHNOLOGY

Technology

- Roadside infrastructure
  - Type, location & density
  - Leverage existing
  - Interoperability/standards
- Communications infrastructure
  - Capacity
  - Technical capability
  - Network security
- Back-office systems
  - Data management
  - Application development
- Staff capabilities
- Reliability/maintenance
- Cost
- When to implement

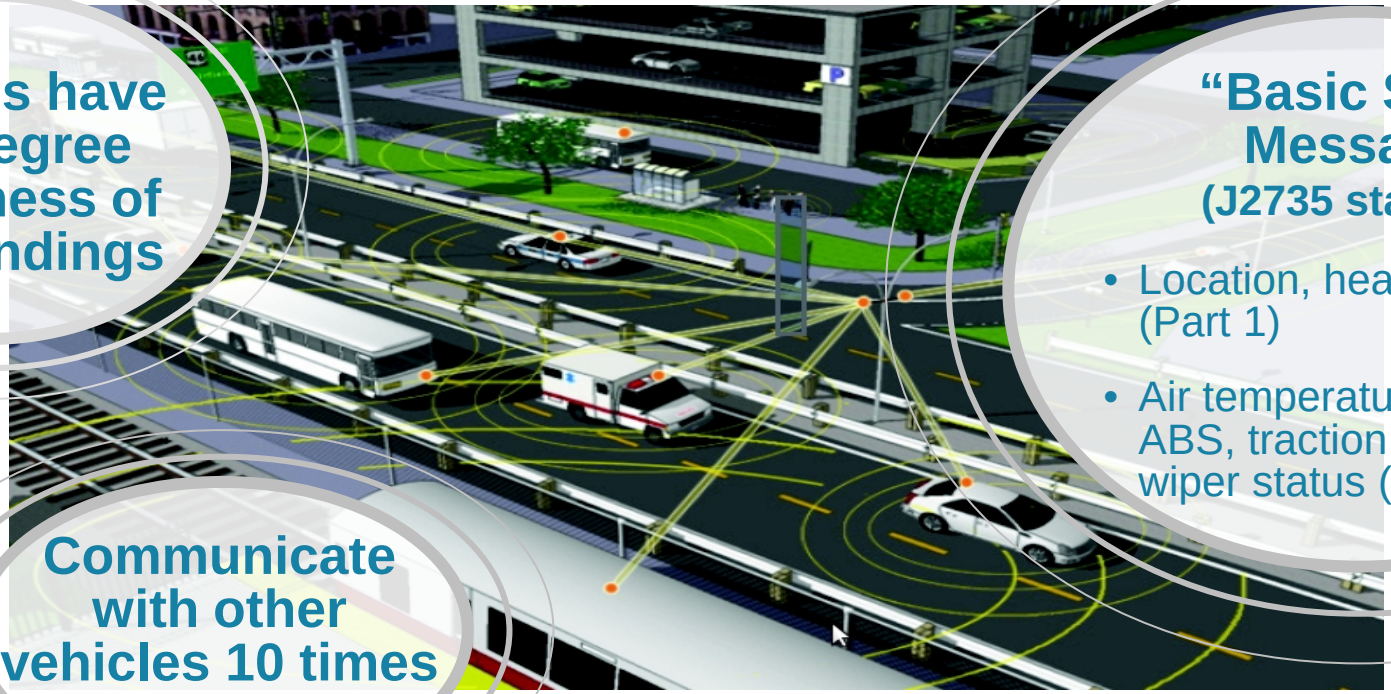
Connected vehicles

- Cellular
- DSRC



Dedicated short range communications (DSRC)

Vehicles have 360 degree awareness of surroundings



Communicate with other vehicles 10 times per second

“Basic Safety Message”
(J2735 standard)

- Location, heading, speed (Part 1)
- Air temperature, lighting, ABS, traction control, wiper status (Part 2)

System performance data and vehicle-to-infrastructure

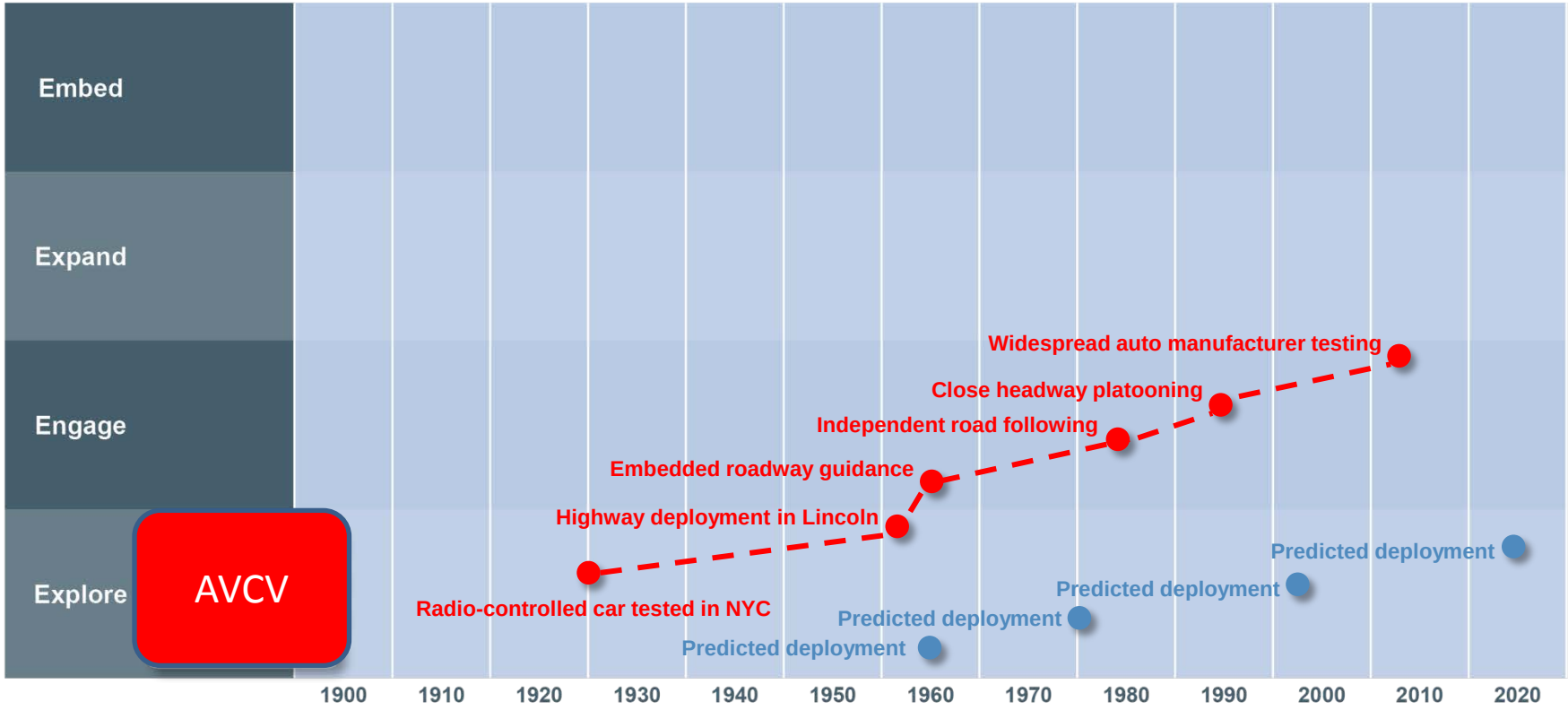


Most public agencies want basic vehicle probe information for improved system performance

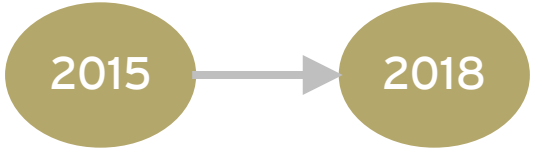
- Real-time data for:
  - Traffic signal control strategies
  - Corridor management
  - Active traffic management
  - Weather and event management

FUTURE DEVELOPMENTS

Be careful about predicting the future



TIMEFRAME: 2015-2018



Connectivity Solutions

- Connected vehicle solutions piloted
- First DSRC connected vehicles introduced
- Intermodal connectivity solutions expanded through mobile devices
- Vast new data resources from vehicle probes for performance management and traveler information

Automated Vehicle Solutions

- Semi-automated vehicles (high and low speeds)
- Platooning pilots

TIMEFRAME: 2018-2035



Connectivity Solutions

- Widespread V2I connected vehicle solutions
- Dynamic mobility & environmental applications

Automated Vehicle Solutions

- Truck and transit platooning in dedicated lanes
- Fully automated vehicles introduced

TIMEFRAME: 2035 AND BEYOND

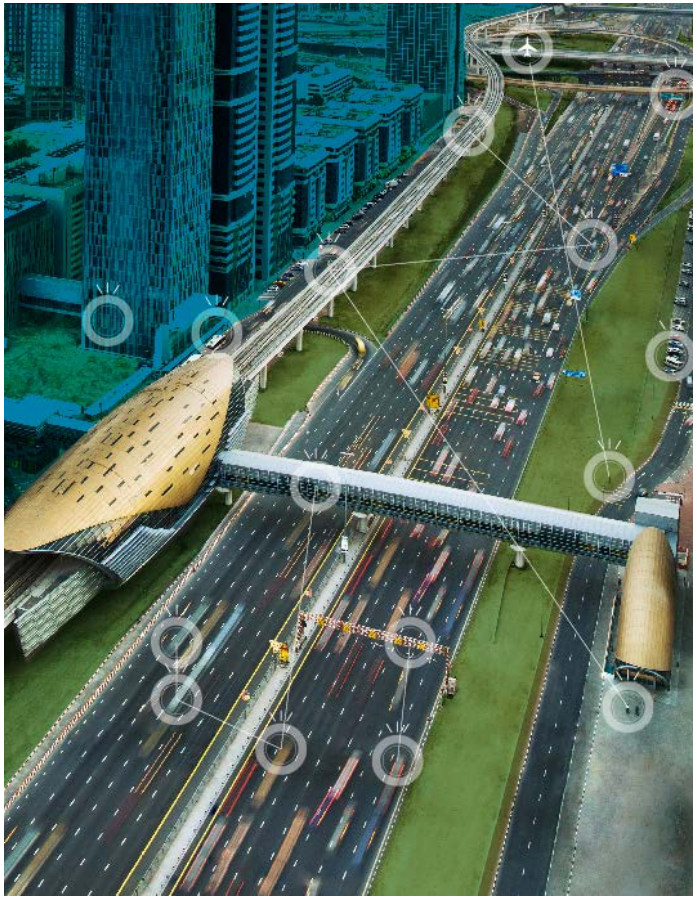


Connectivity Solutions

- All vehicles are connected
- New safety and mobility apps introduced

Automated Vehicle Solutions

- Fully automated vehicles are common
- Dedicated automated vehicle lanes offer premium service



Questions?

Kip Strauss
kstrauss@hntb.com

Chuck Miller
cmiller@hntb.com

Michael DeMent
mdement@hntb.com

816-472-1201