V2X = Connected Vehicle Technology

V2V = Vehicle-to-Vehicle communication
V2I = Vehicle-to-Infrastructure communication
I2V = Infrastructure-to-Vehicle communication

V2X = Vehicle-to-Everything communication
Vehicles have a lot to say...

Untapped vehicle data enabled by V2X

All built on national and federal standards.
Intelligent Transportation Systems

- CCTV
- ITS with C/V
- Weather Station
- Side-Fired Radar
- Variable Message Sign
- Ramp-Metering
- Atmospherics Detection 10+ Miles
- Toll Tags
- Variable Message Sign

 ITS with C/V
Cities have limited situational awareness and a one-way communication path to vehicles and often deal with the ramifications of non-roadway operators re-routing traffic.
Unlocking a Direct, Bi-Directional Path to the Vehicle for Holistic Situational Awareness and Traffic Operations; Putting Cities Back in the Driver Seat on Managing Roadways.
Why V2X Technology?

The three biggest problems facing our nation’s roadways...

- **5.6 million crashes**
- **32,719** deaths
- **6.9 billion hours in traffic**
- **3.1 billion gallons wasted**

“**The safety benefit of V2V is undeniable. It will save lives, and everybody knows that. A delay in rolling out V2V will cost lives, and that’s a tragedy.**”

- Harry Lightsey, General Motors
1. **On-Board Equipment (OBE)** – V2X equipment inside vehicles that transmits and receives data between vehicles and to the infrastructure.

2. **Roadside Equipment (RSE)** – V2X equipment installed on the infrastructure that transmits and receives data to and from vehicles.

3. **V2X Data Ecosystem (VDE)** – The “Brain”
The V2X Ecosystem Unlocks Even More

Imagine...

V2X ecosystem gives roadway operators the ultimate situational awareness of all roadways providing:

• Highly accurate, geo-located traveler information
• Highly accurate, localized weather data
• Faster emergency response times
• Improved incident management
• More intelligent, coordinated traffic signal systems
• Improved truck parking information/availability
• Enhanced maintenance decision support systems (e.g., snow plow operations)
• Improved infrastructure diagnostics (e.g., pothole identification, roadway friction)

Benefit to Cities:
1. Empowers DOTs with data ownership and delivers open data for the world.
2. Prepares DOTs for autonomous vehicles

Prevent 419,000 additional crashes
Save 5,000 more lives
Avoid 5,000 more fatal crashes

Improve freeway travel times by 42 percent
Improve arterial travel times by 27 percent
Reduce poor weather incidents by 25 percent

Improve fuel savings by 22 percent
Reduce VMT by 20 percent
Improve freeway travel times by 42 percent

A Different Approach to V2X
CDOT-Panasonic V2X Deployment Program

Phased Deployment Approach

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<th>Project Plan &amp; System Design</th>
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<td>• Develop Phase 0 Baseline Schedule</td>
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<td>• Complete Systems Engineering Planning</td>
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<td>• Select Project Vendors &amp; Partners</td>
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<td>• Build CDOT-Panasonic V2X Test Environment</td>
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<td>• Develop Phase 1-5 Preliminary Schedule</td>
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<td>• Develop Phase 0 Final Report defining Phases 1-5</td>
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Agile, Iterative Delivery

CDOT Live Environment

CDOT Pilot Sites

Panasonic V2X Test Environment (Lab, Garage, Roadways)
V2X Deployment Program

Signage
Traffic Lights
Emergency Alert
Community Alert
CDOT-Panasonic V2X Data Ecosystem

PHASE 1
PHASE 2
PHASE 3
PHASE 4
PHASE 5

V2I Data
RSU

Camera Sensors Weather

Existing Traffic Management Platform

Input Sources

Output Sources

Signage Traffic Lights Emergency Alert Community Alert

Panasonic V2X Deployment Program
### Agile, Iterative Process for Technical Advancement

#### CDOT Live Environment

- **Live Environment**
  - Live1: Planning
  - Live2: Platform Development
  - Live3: App/Service Development

#### Fully live environment (Production)

#### Pilot Site (beta)

- **P1: Planning**
- **P2: Platform Development**
- **P3: App/Service Development**

- One site, live environment, limited public engagement

#### CDOT Pilot Sites

- **Lab**
  - L1: Planning
  - L2: Platform Development
  - L3: App/Service Development
  - Software Simulation in development environment

- **Garage**
  - G1: Planning
  - G2: Platform Development
  - G3: App/Service Development
  - Software on target platform with simulated motion

- **Roadways (alpha)**
  - R1: Planning
  - R2: Platform Development
  - R3: App/Service Development
  - Software on target platform with full motion, controlled environment

#### Panasonic V2X Test Environment (Lab, Garage, Roadways)