Transportation Management Systems (TMS)

California Cross Agency Asset Management Forum (CAAMF)

September 18, 2023

September CAAMF Agenda

- Welcome – CAAMF Organizing Committee
- Recording the session
- CAAMF Topic Suggestions for voting at next meeting
- Presentation – Caltrans Assets Management
  - Karan Dhungana
  - Stan Slavin
- Audience Question and Answer Session
  - Jas Bhullar – Caltrans Maintenance
  - Grant Zammiit – Federal Highway Administration
  - Dean Campbell – Caltrans ITS
  - Michael Robinson – Caltrans Electrical Engineering

Agenda

- **Assets Classes and Types**
- **TMS Operation and Maintenance**
  - Lifecycle
  - Cost
  - Performance metrics
- **Data**
  - Validation and Visualization
- **Guidelines**
- **Innovative Ideas**

Assets

Classes and Types Breakdown

Asset: Classes

Caltrans assets are divided into four primary and eight supplementary classes

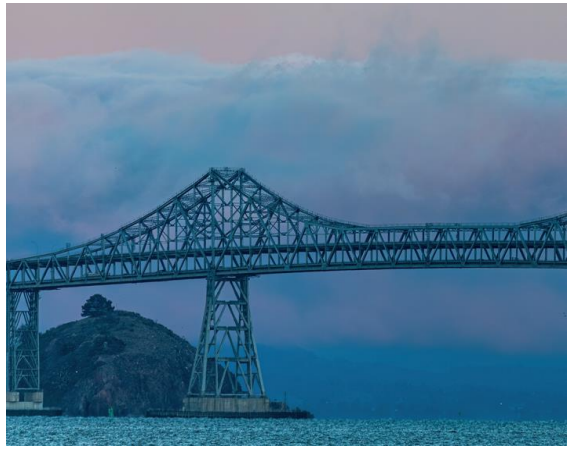
Reason for four primary assets classes:

1. They represent significant portion of California's annual transportation investments
2. Also, in part because of federal legislation which prioritizes safety, pavements, bridges, and those assets related to system performance.

Asset: Primary Classes

- Pavements

- Bridges and Tunnels



- Drainage

- Transportation Management System (TMS)

Asset: Supplementary Classes

- Weigh-In Motion Scales
- Drainage Pump Plants
- Safety Roadside Rest Areas
- Complete Streets
- Transportation Related Facilities
- Office Buildings
- Highway Lighting
- Overhead Sign Structures

Asset: TMS

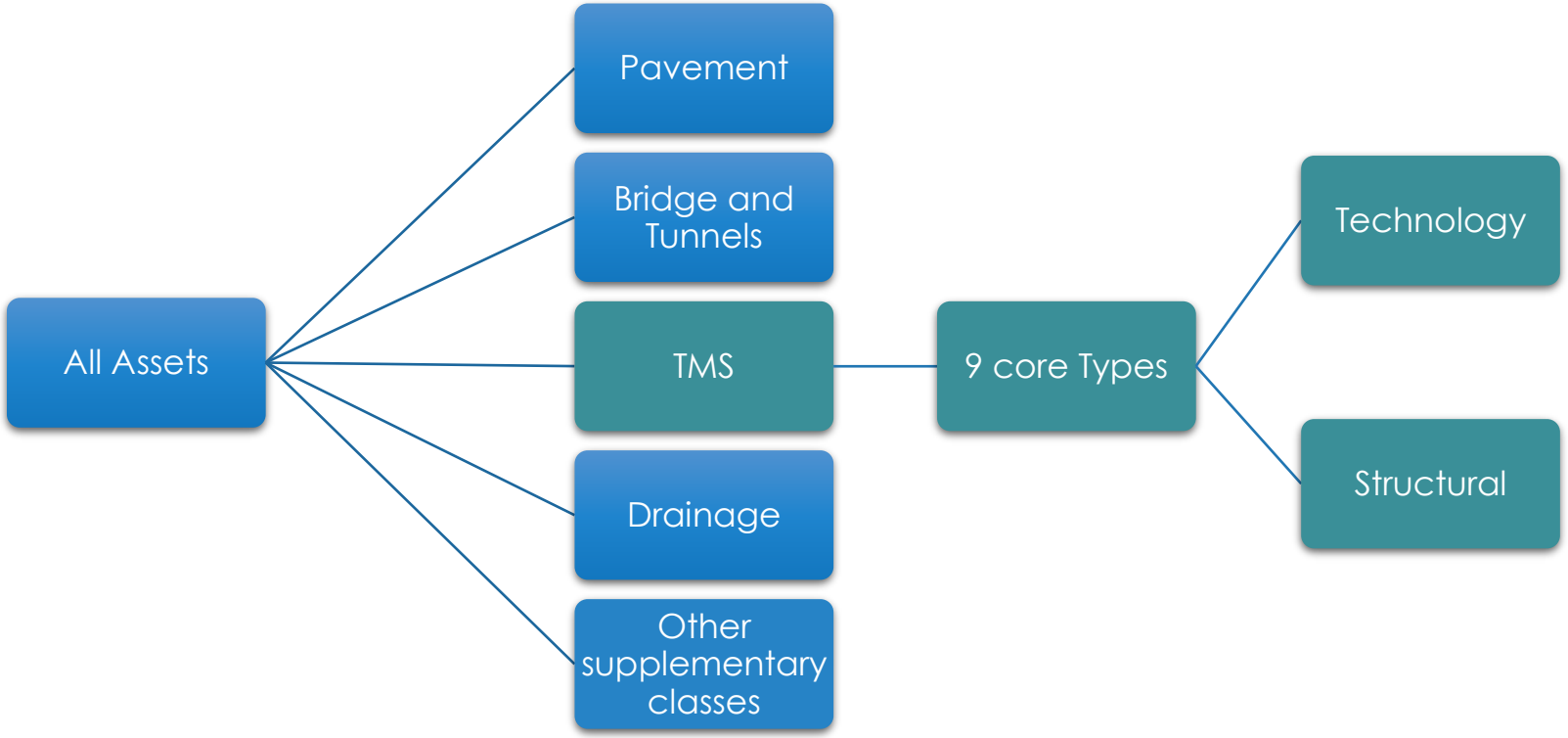
- There are over 20,000 TMS units on the SHS
- These are categorized into nine core TMS types
    1. Traffic signals
    2. Freeway ramp meters
    3. Changeable message signs
    4. Extinguishable message signs
    5. Closed circuit televisions
    6. Traffic monitoring detection stations
    7. Traffic census stations
    8. Roadway weather information systems
    9. Highway advisory radios

Assets: TMS elements in the field

Asset: TMS Components

- TMS assets are further separated into Technology and Structural components.
- This is due to their difference in cost and lifespan

Break down So far:



TMS: Operation and Maintenance

Life Cycle, Cost, and performance metric

TMS: Life Cycle

Core Types	Life cycle (in Years)	
	Technology	Structural
Traffic Signals	25	50
Freeway ramp meters	25	50
Changeable message signs	20	50
Extinguishable message signs	20	50
Closed circuit televisions	10	50
Traffic monitoring detection stations	20	50
Traffic census stations	20	50
Roadway weather information systems	10	50
Highway advisory radios	15	50

TMS: Unit Cost

Core Types	Unit Cost	
	Technology	Structure
Traffic Signals	$148,996	$367,966
Freeway ramp meters	$73,560	$234,823
Changeable message signs	$161,454	$416,901
Extinguishable message signs	$64,864	$52,542
Closed circuit televisions	$57,300	$57,825
Traffic monitoring detection stations	$61,730	$90,921
Traffic census stations	$62,250	$90,921
Roadway weather information systems	$102,427	$66,624
Highway advisory radios	$97,451	$92,364

TMS: Investment Strategies

Our investment strategy:

- Fix-it-first approach
- Prioritize improvements over expansion

Table 4-1. SHOPP and Maintenance Investment Strategies

Investment Strategies	
Strategy	**Description**
Fix-It-First	• Prioritize maintenance, rehabilitation, and safety improvements over capacity expansion. • Focus on the right treatment at the right time to preserve or improve condition at optimum time and cost.
Leverage Investments	• Support the full range of Caltrans strategic goals. • Make progress towards multiple goal areas with each SHOPP investment. • Employ innovative and emerging technologies to realize efficiencies in design, construction, and maintenance activities.
Focus on Selected Asset Classes	• Focus on the most important assets on the SHS, as measured by vehicle-miles traveled and by asset value. • Pavement, bridge, drainage, and TMS assets represent a significant portion of SHS maintenance and rehabilitation investments.
Address Environmental Stewardship Priorities	• Reduce environmental impacts through sustainable treatment strategies. • Reduce impacts to air and water quality through best management practices.
Integrate All Transportation Modes for All Users	• Design accessible transportation infrastructure to support all modes for all users and address ADA requirements. • Ensure investments make progress towards broad transportation goals. • Include enhancements to pedestrian, bicycle, and transit infrastructure in multi-objective projects to leverage more efficiency.

TMS: Performance Metrics

TMS Life Cycle Health	TMS Up-Time Health
• Assets being within expected life cycle • Current target of 90 percent of assets are within expected life cycle • Focus of Division of Traffic Operations	• Assets being functionally available • Current target of 90 percent of assets are functionally available • Focus of Division of Maintenance

Table 5-44. Transportation Management Systems Performance Metrics

Performance Metrics	
Condition	**Criteria**
Good	Within expected life cycle and consistent functional availability
Fair	N/A
Poor	Beyond expected life cycle or is not meeting functional availability because of chronic down time

Chronic down time:
TMS units that are repeatedly failing and no longer can be fixed through maintenance resources to be flagged for permanent repair/replacement.

TMS Life Cycle Health

Program assets into following programs to replace asset and reset life cycle

- SHOPP
- Minor A, B
- Director's Orders
- HM4-TMS
- Rescope to accelerate the projects (PCR process)

TMS: Up-Time Health

Proactive measures

- Preventive Maintenance (PM) checks
  - Performed by Field Maintenance Crews
  - To Maintain the up-time health of the system
  - To achieve maximum service life of the TMS units
  - Entire TMS inventory requires over 80,000 PM checks and repairs annually
- Operational reviews
  - Performed by Traffic Operations Field Crew
  - To verify proper operation of the systems
- Recertification process
  - Review asset by the end of life cycle for field condition and functionality
  - Extend life cycle by no more than 10 years
  - Performed by Traffic Operations

TMS: Up-Time Health

Reactive measures

- Repairs
  - Performed by Field Maintenance Crews
- Service Contracts (TOSNET)
  - To enhance Field Maintenance Electrical Crews response for the repairs
  - As needed, after exercising their first right of refusal
- Flag as chronic
  - Assets that have reoccurring or beyond repair issue
  - Mark asset condition as Poor
  - Affect life cycle health
  - On the list for it to be programmed

TMS: Challenges

Limited funding

- Prioritize assets to collect data for safety analysis
- Prioritize assets for repair
- Prioritize assets for operational needs

Fast evolving technology

- Decide to adopt or wait

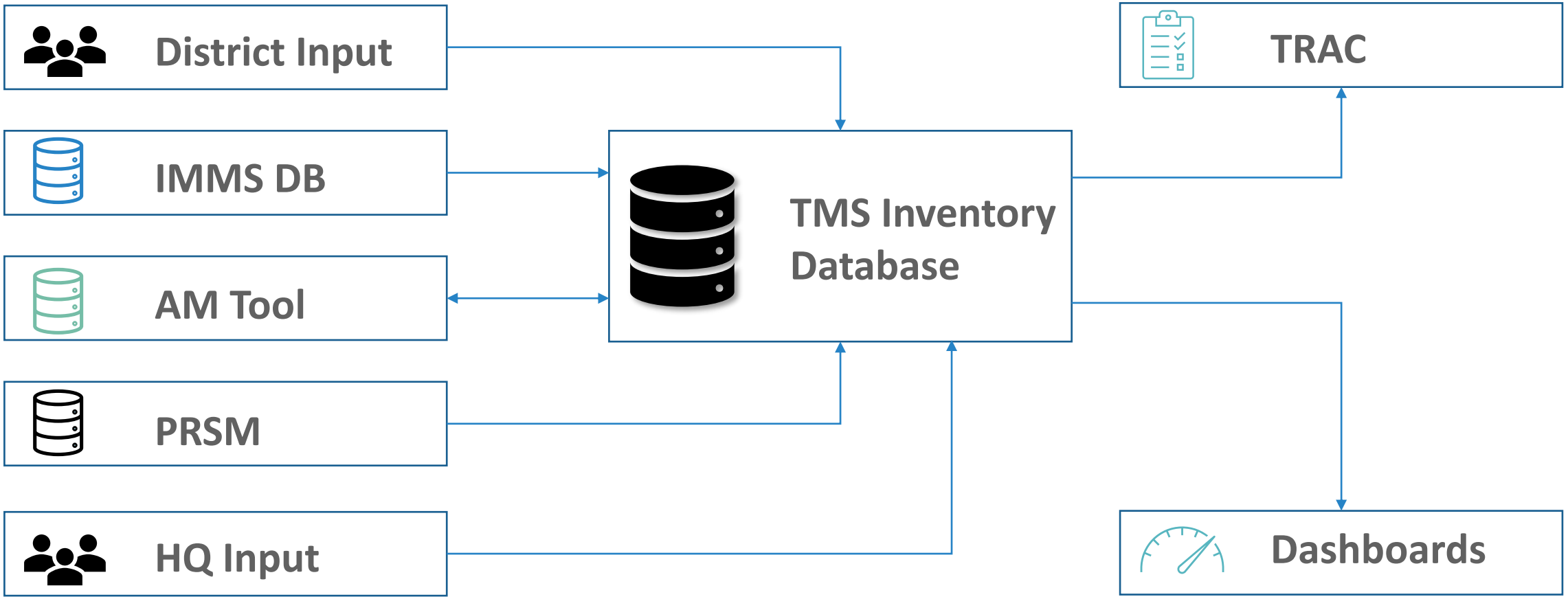
TMS: Data

Validation and Visualization

Data: Databases

- **TMS inventory database**
  - Maintain asset data for operations need, including life cycle tracking
- **Integrated Maintenance Management System (IMMS)**
  - Maintain asset data for maintenance needs
- **TRAC**
  - Issue tracking software
  - Used to track functionally unavailable assets and its repair
  - Used to flag assets as ‘Chronic’ when not repairable
- **Asset Management Tool**
  - Project asset information

Data: Flow Diagram



Data: Quality

Maintaining quality of these data is important:

- Accountability towards public
- SB1 commitments
- TMS Oversight
  - CTC
  - Auditor
  - Asset Management Team
- Funding constrains

Data: Validation

TMS Inventory Database

- Ensure valid manual data entry
- Cross check with other databases
- Quarterly certification of inventory data by districts

Validation checks

- Developing validation checks
- Checks data in record across fields for validity

Dashboards and data visualization

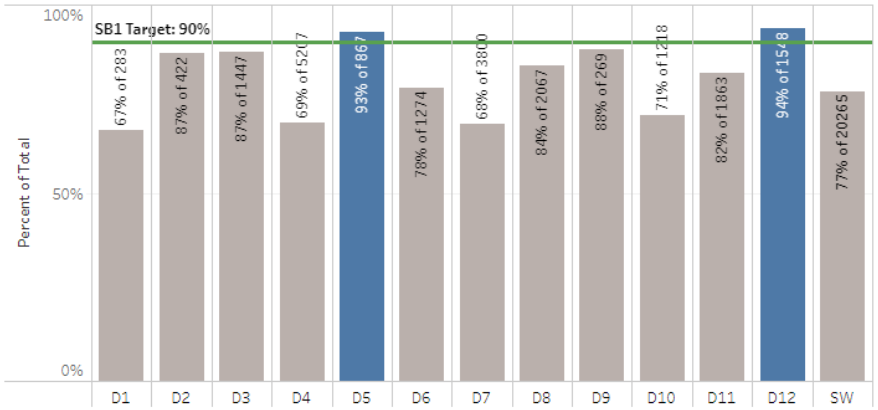
- Helps identify record or assets with issue

TMS Dashboard

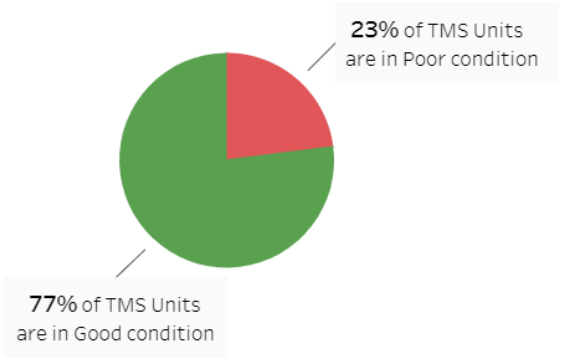
Intro TMS Lifecycle Status | TMS Current Lifecycle Status | TMS Projected Lifecycle Status | Intro types4&5 | Types4&5 | Version

Current Conditions - 2023

Current Percentage of All TMS Units in Good Condition
by District



Statewide Percentages of TMS Conditions



Return to Navigation Menu

Date: 5/25/2023

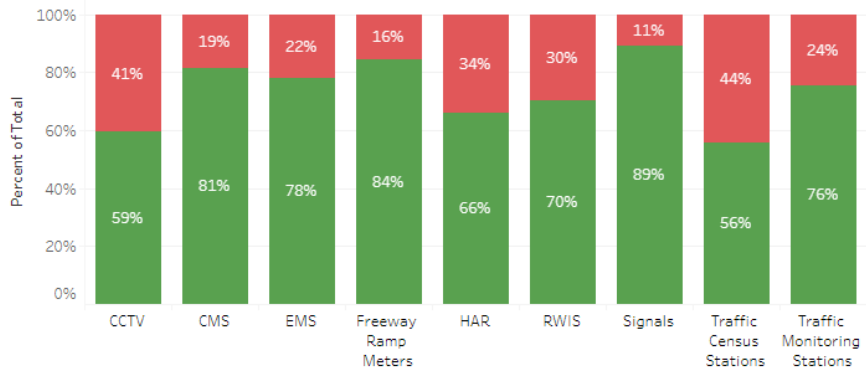
District: (All)

Overall Health
- >= 90% in Good condition
- < 90% in Good condition

Current TMS Condition
- Poor
- Good

Filter Tips:
Use the above drop-down District filter or the bar chart in the top-left quadrant to select a district: Click on the bar to select a specific district, click again to select ALL.

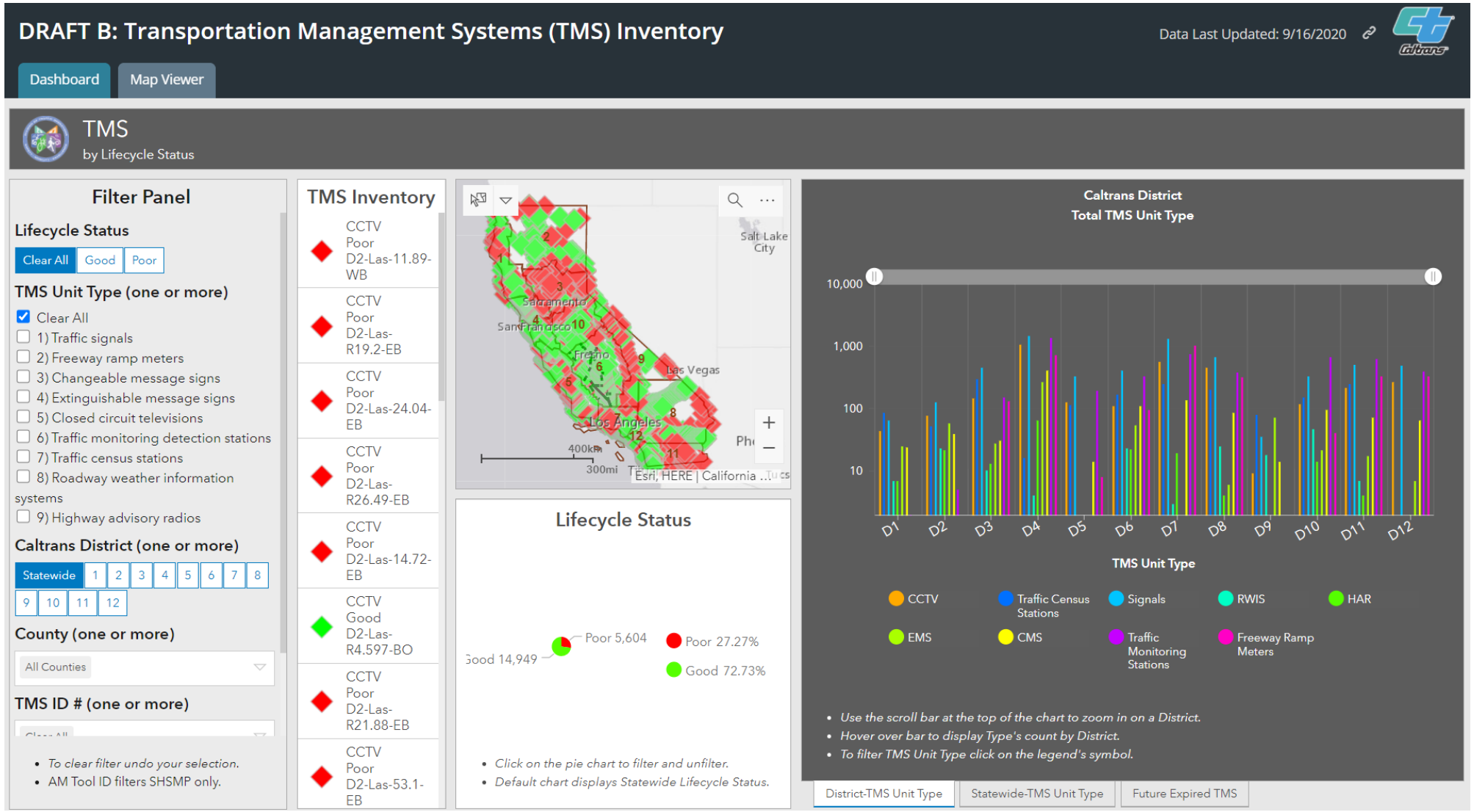
Current Percentage of TMS Condition Status
by TMS Type
District(s): All



TMS Condition Status
District(s): All

TMS Unit Type	Good	Poor	Total Inventory	Percent Good
CCTV	1,969	1,345	3,314	59%
CMS	956	221	1,177	81%
EMS	455	129	584	78%
Freeway Ramp Meters	2,564	473	3,037	84%
HAR	119	61	180	66%
RWIS	130	55	185	70%
Signals	5,337	660	5,997	89%
Traffic Census Stations	859	681	1,540	56%
Traffic Monitoring Stations	3,213	1,038	4,251	76%
Grand Total	15,602	4,663	20,265	77%

TMS GIS Dashboard



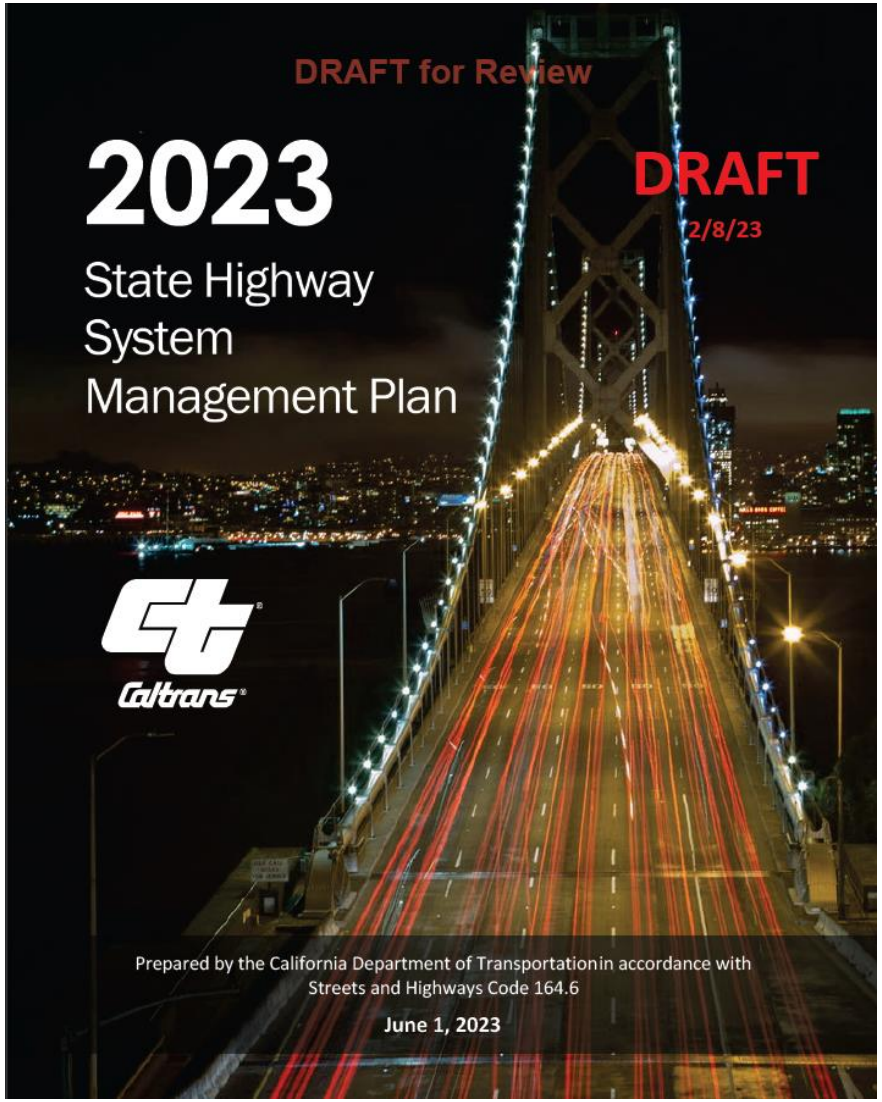
Data: Challenges

- Ensuring databases are in sync
- Minimizing duplicate data stored across databases
- Updating systems to match evolving needs

TMS: Guidelines

Guidelines: State Highway System Management Plan

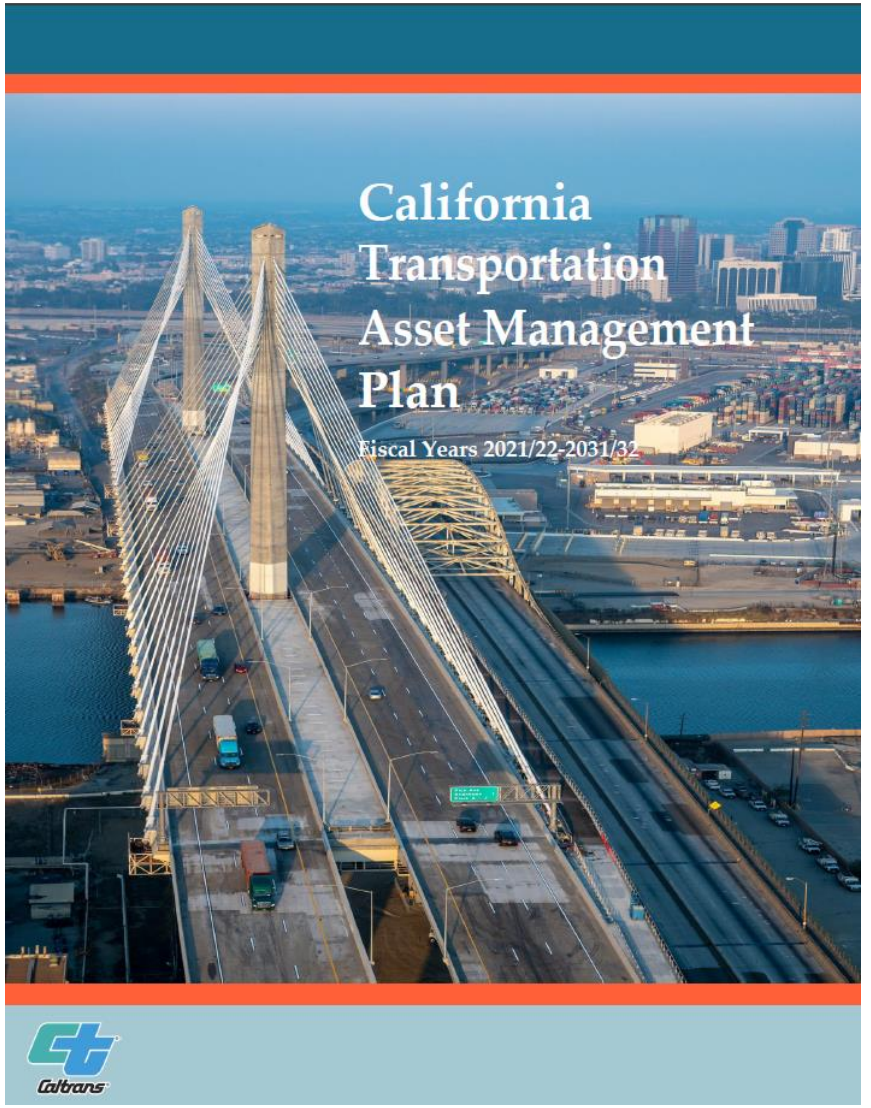
- SHSMP presents performance driven and integrated management plan for California's SHS
- SHS needs, investments and resulting performance projections for the 10-year period
- SHSMP aligns with
  - Caltrans Strategic Plan and
  - Climate Action Plan for Transportation Infrastructure (CAPTI)



Guidelines: Transportation Asset Management Plan

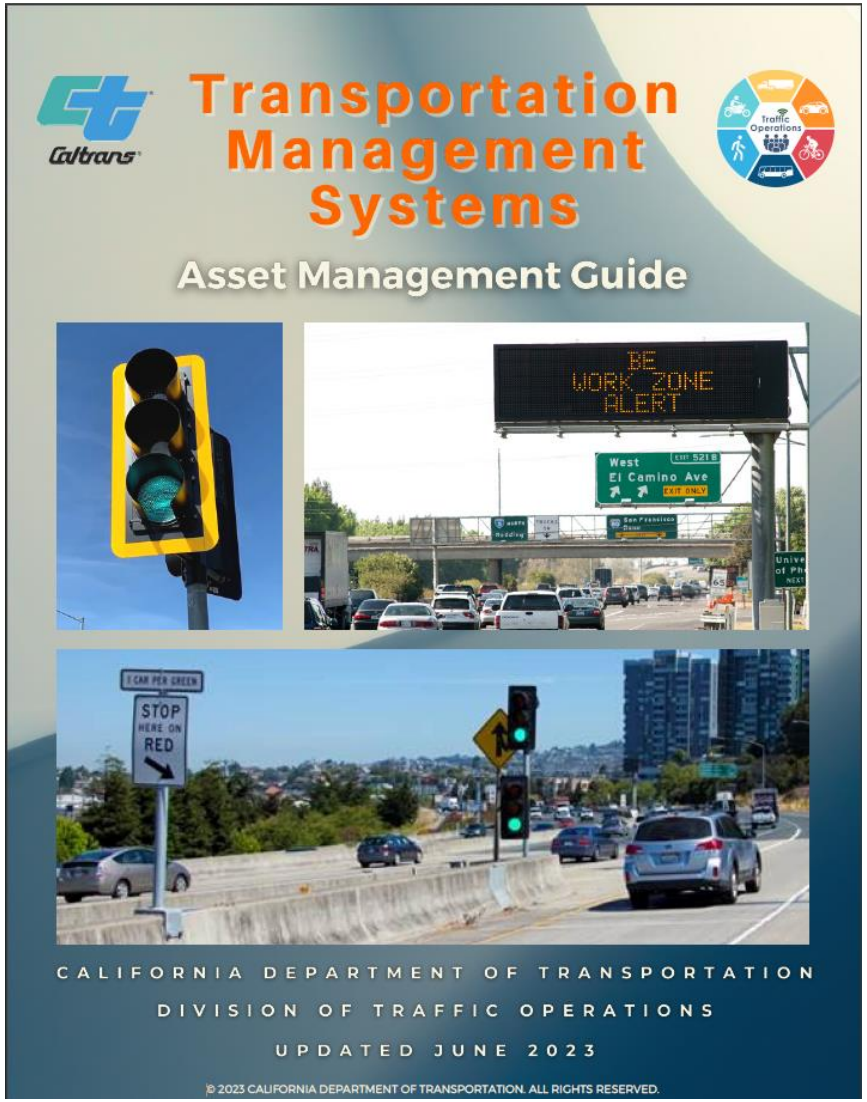
- Presents a coordinated plan by Caltrans and its partner agencies

- Presents plan to maintain California's highway infrastructure assets today and into the future.



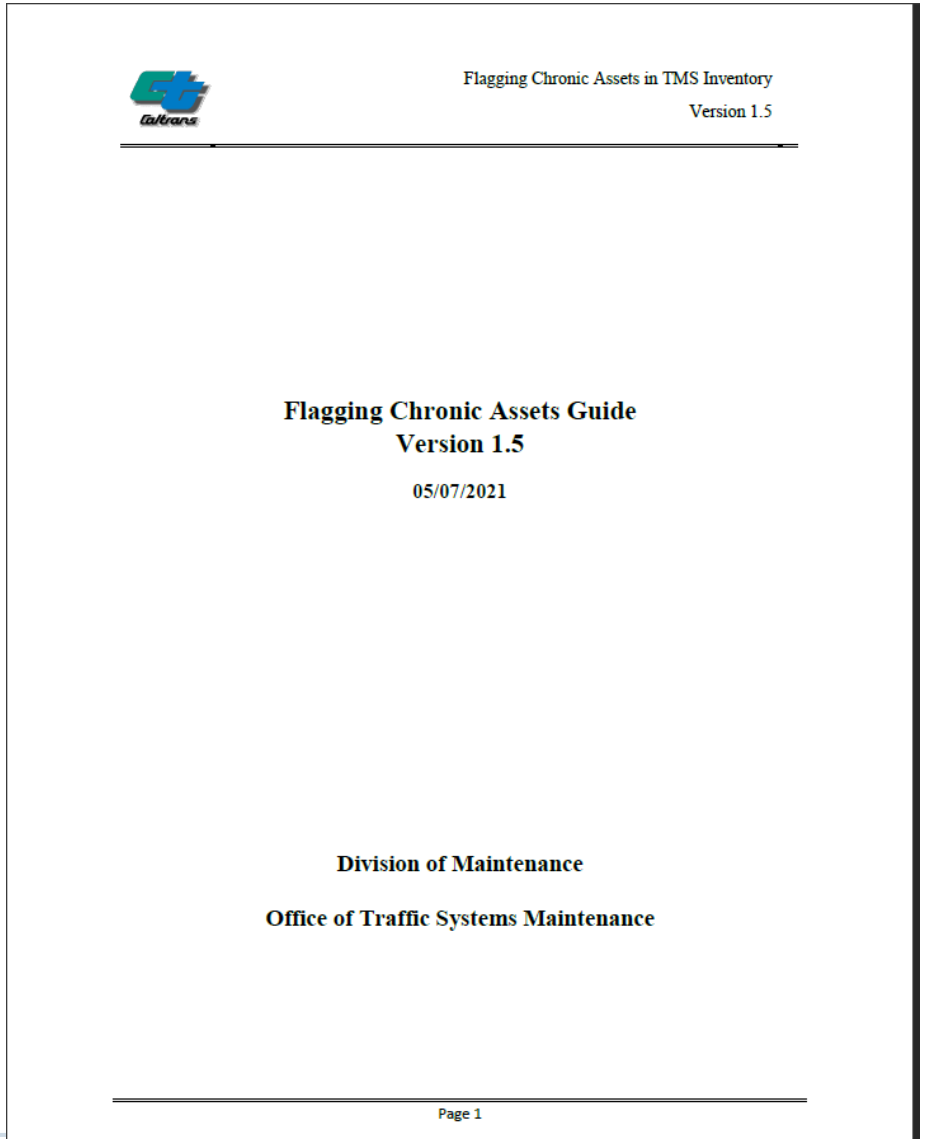
Guidelines: TMS Asset Management Guide

- Provides guidance to meet targets set forth by Senate Bill 1 (SB1), and as included in TAMP and SHSMP
- Provides consistent process to keep TMS inventory data updated
- Division of Traffic Operation's internal document
- Supplements SHOPP Guideline, TAMP, and SHSMP



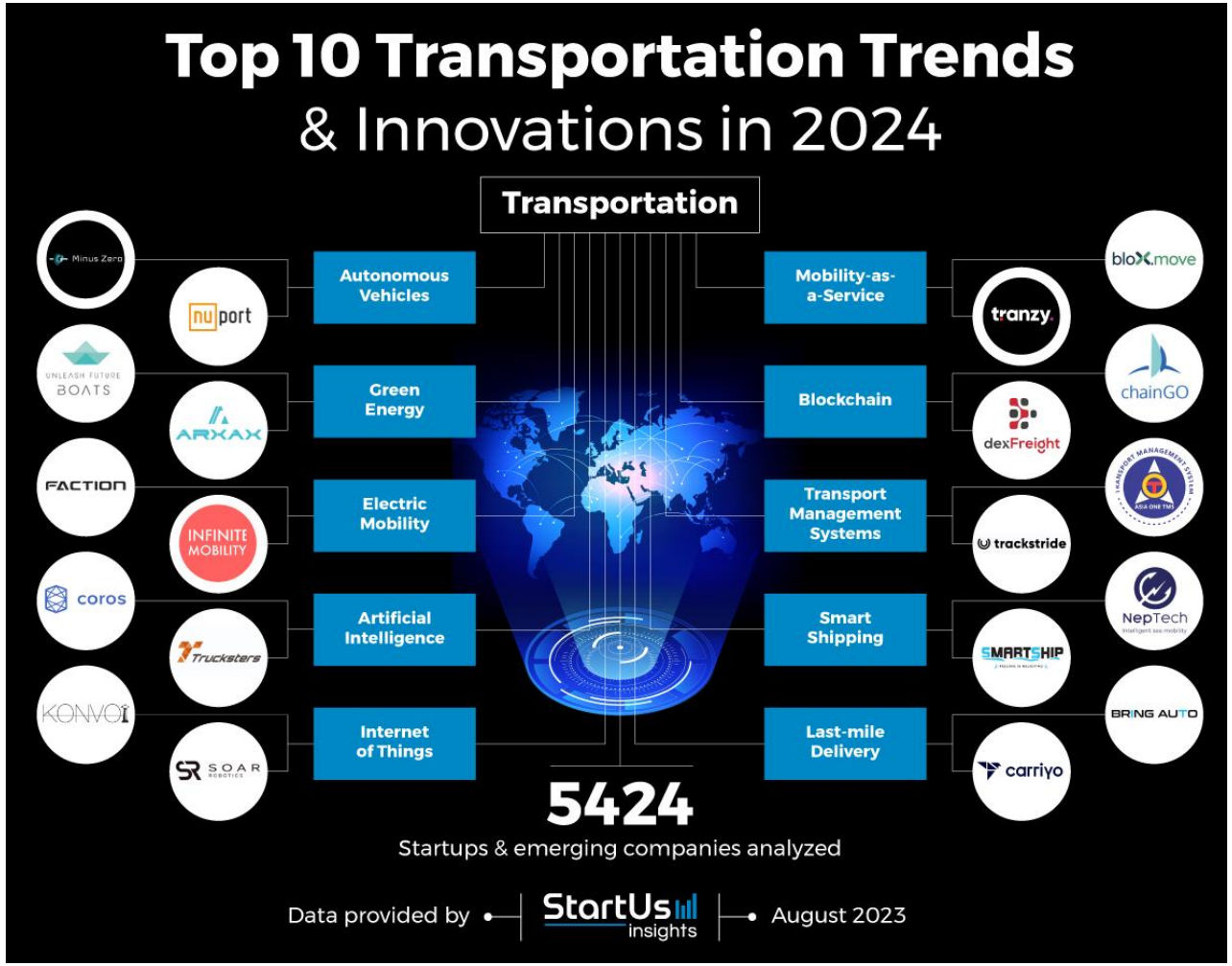
Guidelines: Chronic Guide

- Provides streamline process for flagging assets as chronic
- Division of Maintenance's internal document



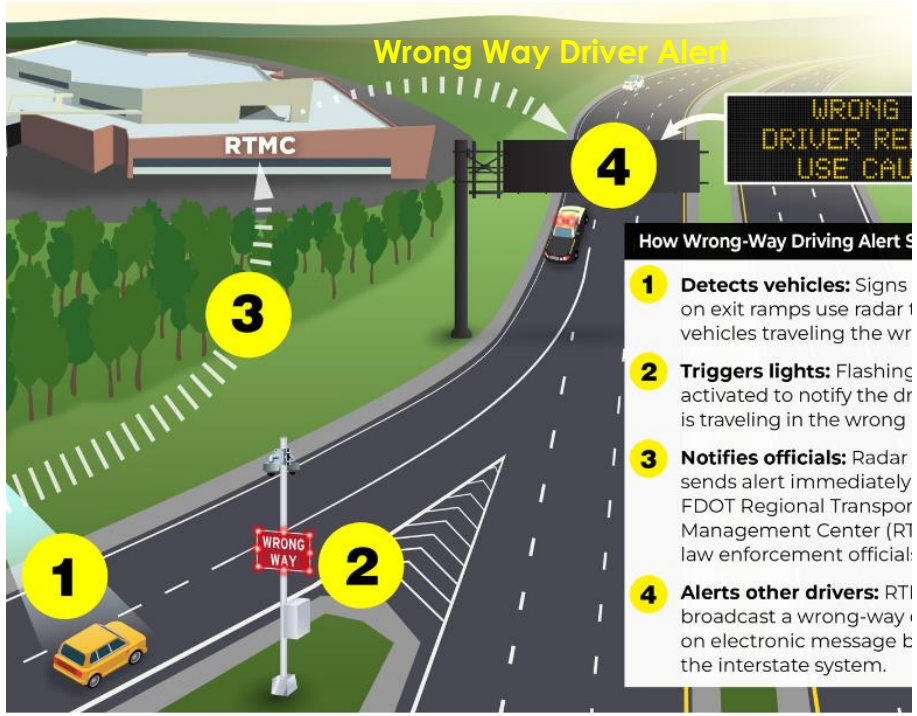
TMS: Innovative Ideas

Future technologies



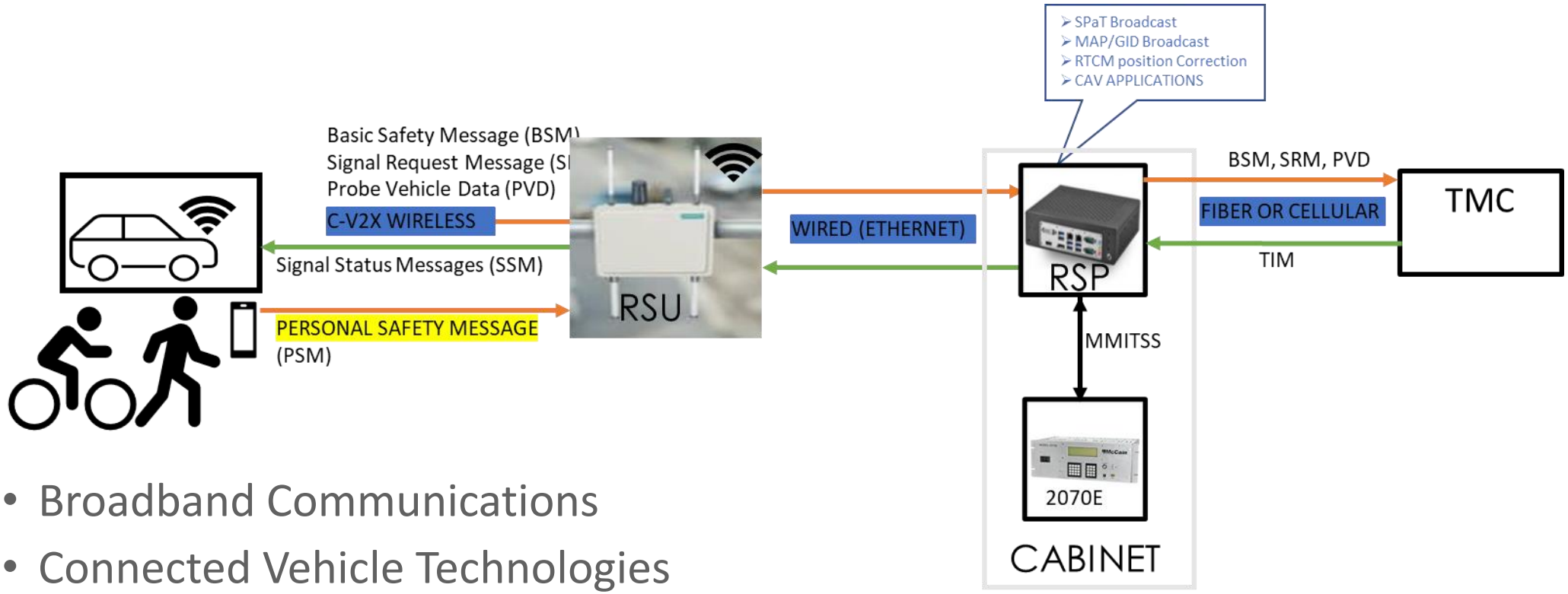
Connected Vehicles

TMS: Innovative Ideas, Future Technologies



Digital Infrastructure

TMS: Innovative Ideas, Future Technologies



- Broadband Communications
- Connected Vehicle Technologies
- Artificial Intelligence, Machine Learning
- Cloud computing, Data Management
- Cybersecurity

ITS Improvements

TMS: Innovative Ideas, Future Technologies

OFF PAVEMENT DETECTION TECHNOLOGY

- Improved construction safety
- Improved maintenance access
- Improved lane configuration (auto)
- Reduce footprint w/ consolidation

High Resolution Color DMS/CMS

- Improved visibility
- Unlimited graphic display functionality
- Long life
- Maintenance friendly

Questions?

Thank you