

Trends in Traffic Management Systems

SOUTHWEST RESEARCH INSTITUTE®

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Agenda

- Introduction
- Background
- Current Trends
 - Data Analytics and Machine Learning
 - Integrated Corridor Management
 - Connected Vehicles
 - Incident Management/Response Planning
- Looking Forward
 - The “Age of Data”
 - AI
 - Cybersecurity

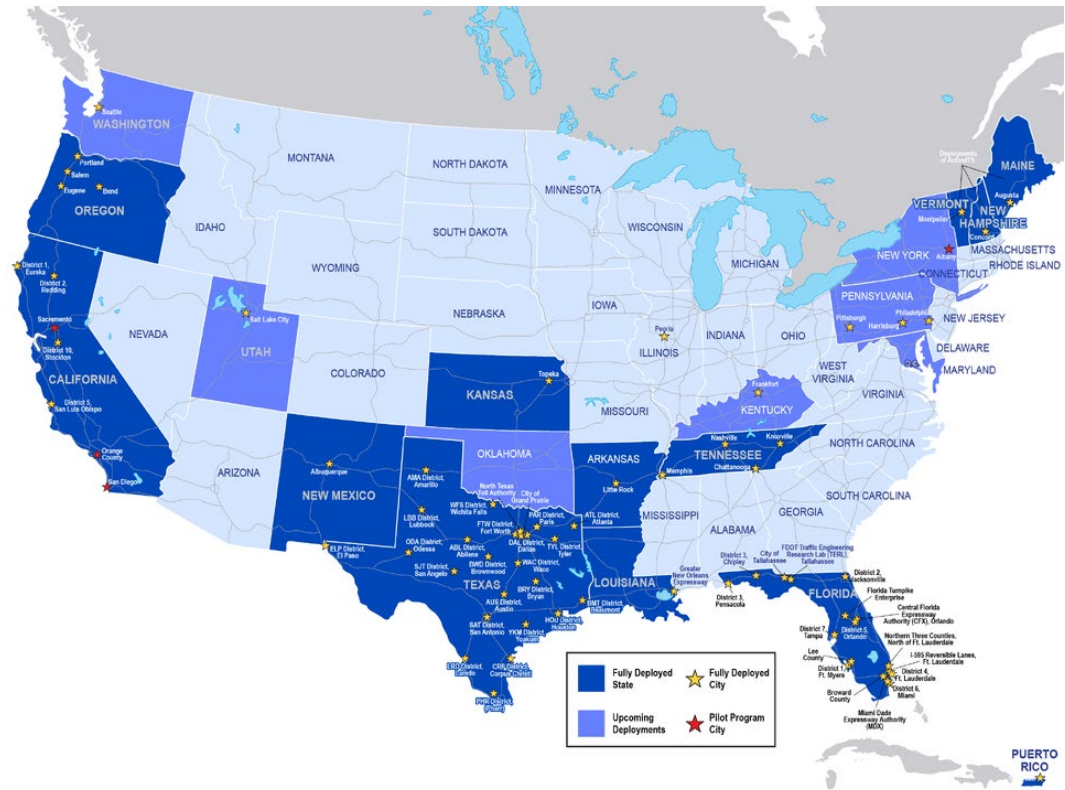
Introduction

- Southwest Research Institute
 - Independent non-profit R&D firm
 - Have over 25 years of ITS industry experience in ATMS, ICM, CV/AV, and more
- AJ Skillern
 - Oversees the Transportation Management Systems Group
 - Computer Scientist with over 10 years of software development experience
 - Technical Lead on ATMS solutions for statewide solutions in 6 states and has worked on software development projects for over 10 state DOTs

Introduction – Cont'd

- ActiveITS

- Represents over 25 years of statewide ATMS development
- Over 52 deployments in 15+ states
- Our variety of DOT operations and deployments keep us on the cutting edge of ITS industry trends and tech



Where did ATMS start?

- ATMS started with basic traffic management functions.
- Original goals of ITS and ATMS systems were to apply computers, communications, and sensor technology to surface transportation.
- Focus was on integration of multiple software systems used by the Traffic Management Centers.



Camera Control



Incident Management



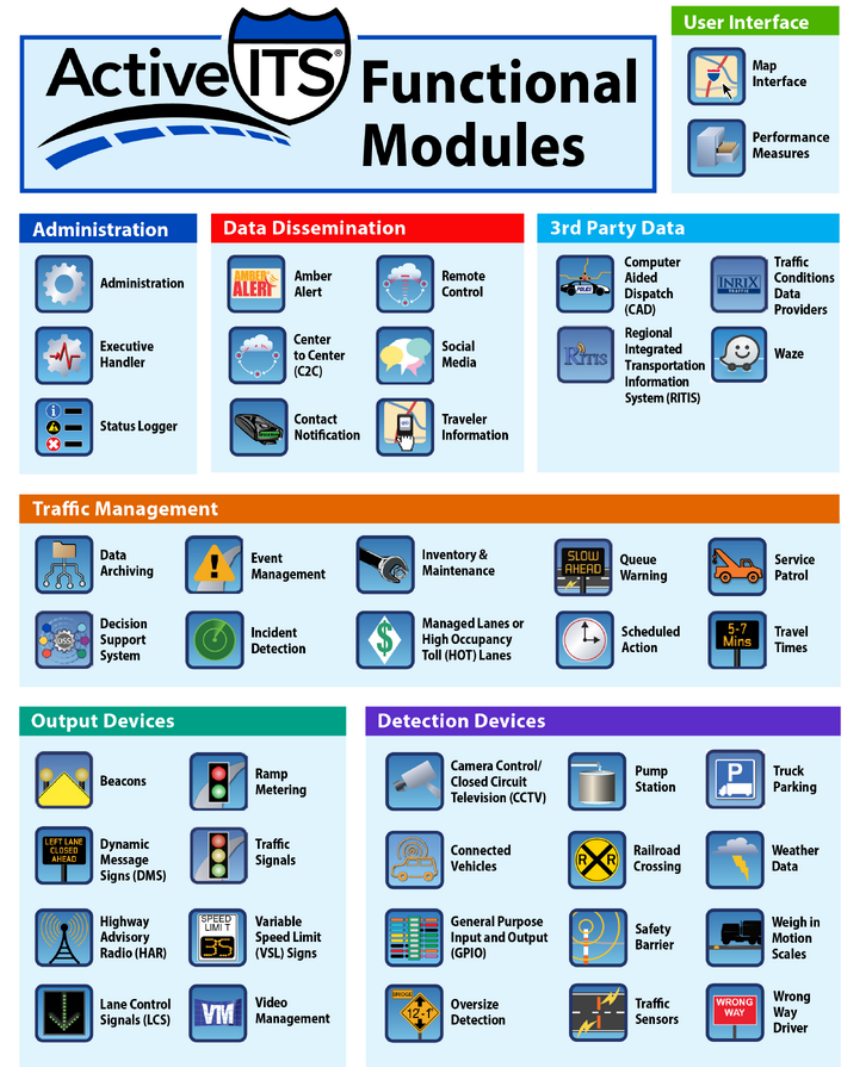
Message Boards



Traffic Sensors

Where is ATMS today?

- Improved hardware, software, and networking to connect the two have led to explosion of new capabilities in the last few years
- Growth in
 - Detection capabilities
 - Traffic management strategies
 - Information dissemination
 - Archiving and Storage



Changes in ATMS Purpose

Device Control

Reactive Incident
Management
Data Collection

Data Analysis
Proactive
Detection/Planning

Where is ATMS going?

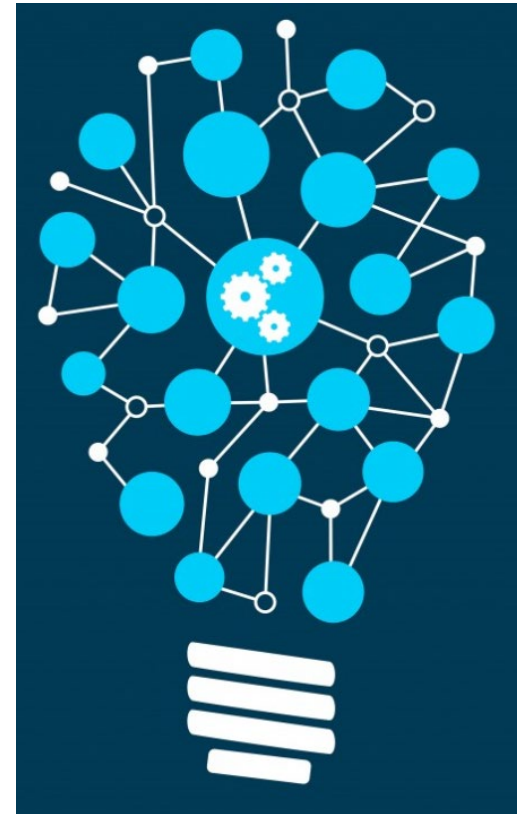
- Data Analytics / Machine Learning
- Integrated Corridor Management
- Connected Vehicles
- Incident Management / Response Planning

Data Analytics / Machine Learning

- Data analytics, or data science, extracts value from existing data sets
 - Defines new business problems
 - Focuses on understanding the data involved in the problem
 - Can provide analytics to solve the problem
 - Provide answers to city planners or roadway safety
- Machine learning focuses on learning from the data science insights
 - Applies past experiences to extrapolate predictions
 - Algorithms are formulated to learn from data
 - Can continue to evolve from new data
 - Real-time/Predictive insights resulting in faster information

Trends in Data Analytics/Machine Learning

- Today's ITS innovations are largely driven by applying data analytics or machine learning to give existing tech new functions
 - Traffic Pattern prediction
 - Edge computing
 - Evaluations of Multi-modal transportation options
 - Traffic Anomaly Detection

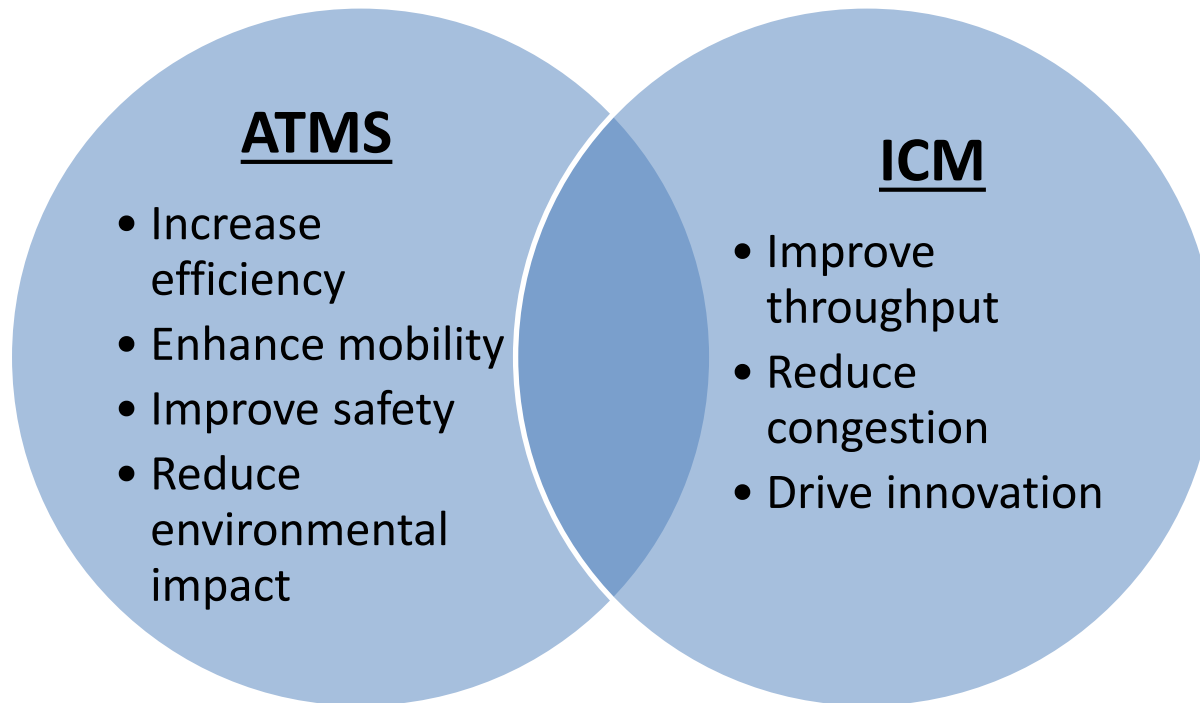


Use Cases for Analytics/Machine Learning

- **Camera analytics**
 - Use machine learning to analyze static camera feeds
- **Wrong way detection**
 - Use camera feeds, radar detection, and more to monitor
- **Accident prediction**
 - Looking back at prior incident data can provide key insights into their causes and factors for predicting occurrences
- **Signal timing optimization**
 - Analyzing data sets can improve efficiency of traffic signal light timings to reduce congestion and environmental emissions
- **Debris/Abandoned Vehicles/Pedestrian**
 - Detecting objects that shouldn't in the roadways

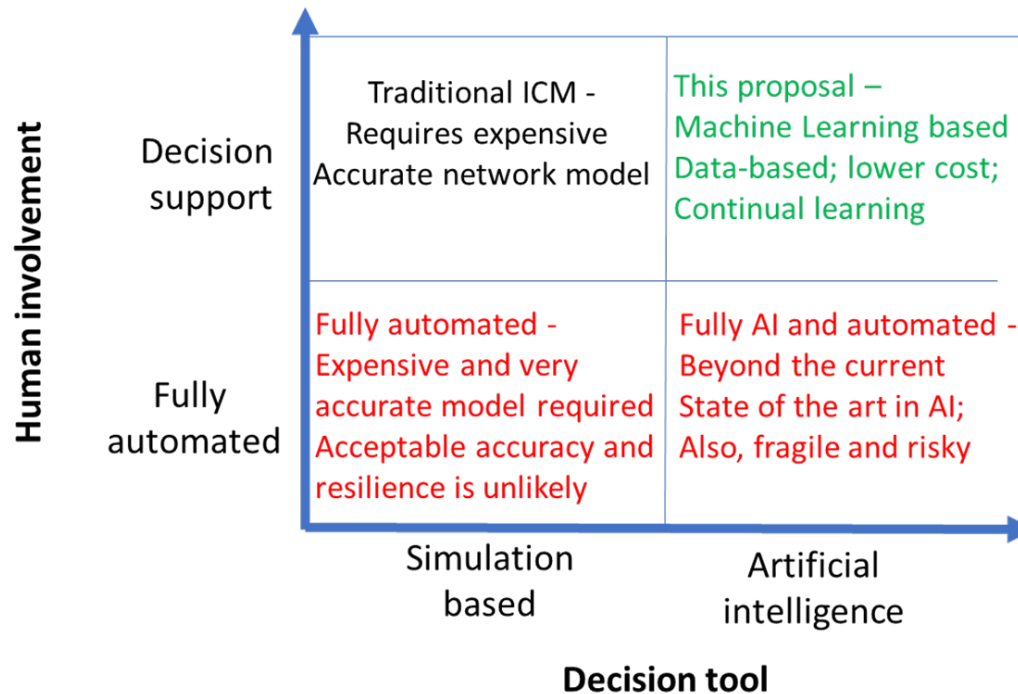
ICM Objectives

- Originally seen as separate, complementary system
- Both ATMS and ICM share similar goals



Evolution of ICM

- ICM systems are tending towards direct integration with ATMS
 - Decision support systems (DSS) modules can provide ICM functionality as part of normal ATMS operations
- Another trend is looking at replacing simulation as a main driver



Future of ICM



- Changes to decision making:
 - Artificial Intelligence based Decision Support (AI-DSS)
 - Enhanced modeling / simulation
 - Predictive ICM
- Increased automation (Less operator review)
- Increased device support
 - Parking
 - Incentivization
- Big data inclusion/analysis

Connected Vehicles

- Connected vehicles are not new technology
 - They have been evolving and growing since the mid-90s
- Applications of connected vehicles continue to grow and evolve
 - Infotainment integrations
 - Integration with autonomous vehicle functions
 - Personalized traveler information
 - Fleet applications
 - Safety warnings

Trends in Incident Management / Response Planning

- Incident management and response planning have seen incremental improvements and trends in the history of ATMS
 - Limiting factors are usually device count and type deployments
- Some of the biggest improvements have come from the benefits of other trends
 - Data analytics / machine learning
 - ICM
 - Connected vehicles

Analytics in Response Planning

- Data analytics is able to use the results of prior response plans to determine effectiveness
- Machine Learning applies these concepts and trains the software what data points matter in a response.
 - Continual analysis can improve accuracy and efficiency
- Primarily used as a supplement to existing operator control
- Allows more intelligent message selecting and faster activation of a complete response to an incident

ICM in Response Planning

- ICM response plans are integrated with normal response plans
- Data driven decision making
- Recommendation are already vetted and approved by stakeholders
- Responses improve over time with more data points

Connected Vehicles in Response Planning

- As CV deployments grow, so has their usage in incident management
- Traveler Information Messages (TIMs) can be used to provide per-vehicle notifications
- Emergency vehicle prioritization helps responders get on-scene faster
- Work zone deployments combine ATMS and CV devices resulting in safer work zones

- The “Age of Data”
- Artificial Intelligence
- Cybersecurity



The “Age of Data”

- DOTs have been collecting data for decades
- Not just the amount of data, but the types of data that are being collected are continuing to grow
 - DMS, traffic conditions, RWIS, parking, RSUs, OBUs, etc.
- What are they doing with the data?
 - Safety
 - Planning
 - Performance measures
 - Environmental assessment
 - Signal timing
 - Policy development/impact



<https://www.devops.ae/whats-big-data-analytics-its-workings-benefits-and-challenges/>

AI in ITS

- Expanding on other trends in AI/ML, private Generative Pre-trained Transformers (GPT) models are being requested to help solve specific ITS problems
- Custom models can
 - Be integrated with ITS software
 - Solve complex traffic engineering problems
 - Provide user-friendly solutions



ChatGPT



COPILOT

Cybersecurity

- DOTs are a prime target for cybersecurity attacks
- Cybersecurity practices and processes should be at the forefront of
- Transitions to cloud-based services opens new attack vectors

BREAKING

MOVEit Cyber Attack: Personal Data Of Millions Stolen From Oregon, Louisiana, U.S. Agency

Transportation Dept. cyber breach exposes data of federal employees

The M.T.A. Is Breached by Hackers as Cyberattacks Surge

TxDOT Hacked in 2nd Attack on Texas Government Systems

Questions?