AMS and DSS concepts in the Connected Corridors Program

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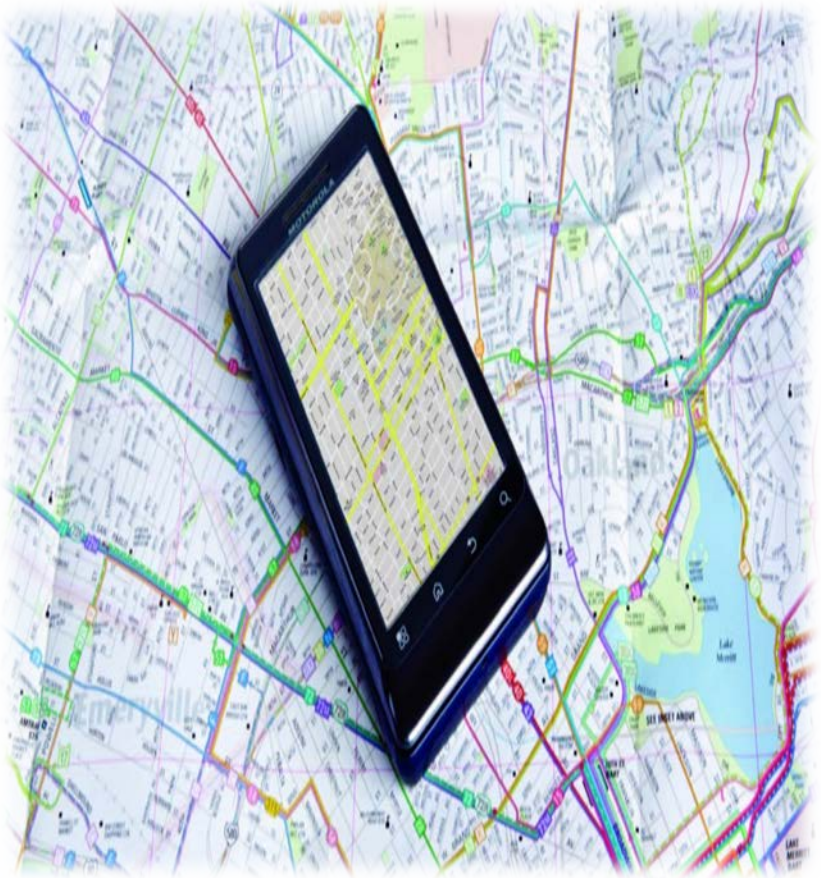
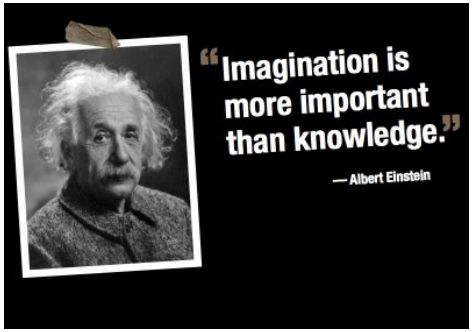
California Connected Corridors Vehicles, Information & People (CC-VIP) Pilot

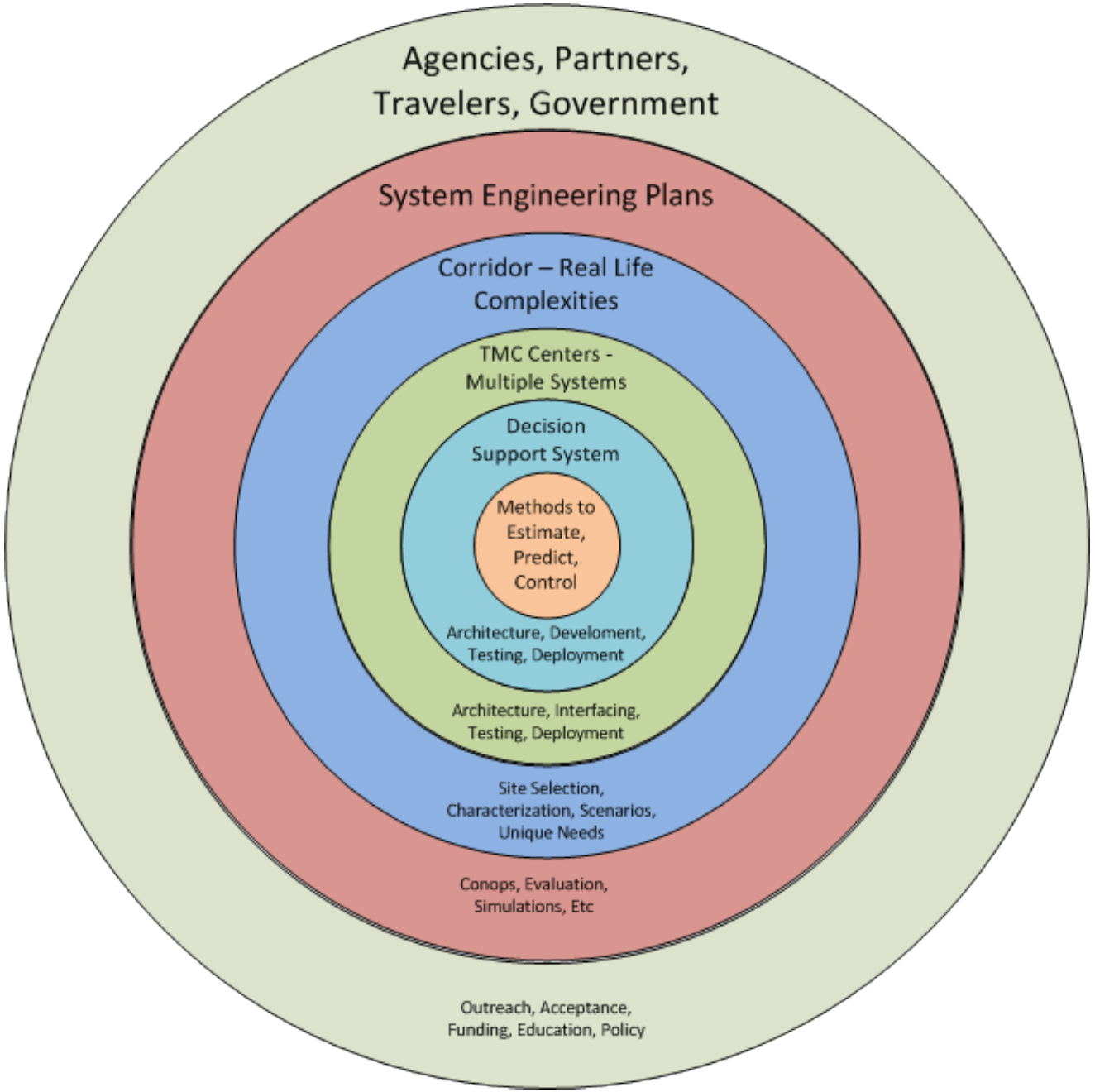
- Enable existing transportation infrastructure and vehicles to work together in a highly coordinated manner
- Deliver improved corridor performance (safety and mobility)
- Improve accountability
- Evolve Caltrans to Real-Time operations and management
- Enhance regional , local and private sector partnerships



Connected Corridors Program

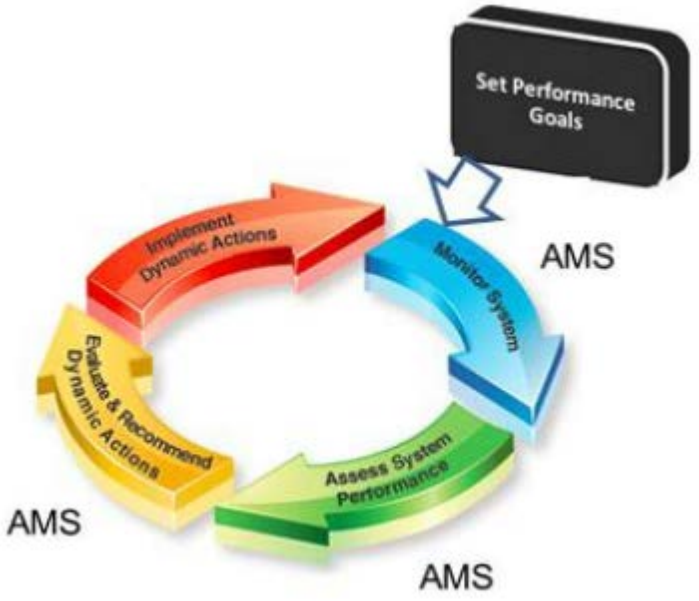
- Previous/Ongoing Efforts
  - USDOT ICM Efforts
  - PEMS – California Performance Measurement
  - TOPL – Tools for Operational Planning (Macro Modeling)
  - Mobile Millennium - Big Data fusion with probes
- Concurrent Efforts
  - Organizational Analysis for Corridor Mgmt
  - San Diego and Dallas ICM Implementations
  - Connected Vehicles
- New Research Efforts
  - Machine Learning
  - Corridor Control with highly fused data
  - Demand Mgmt with crowd sourced decisions
  - True Collaborative Commuting – People, Infrastructure and Vehicles




Agencies, Partners, Travelers, Government
System Engineering Plans
Corridor – Real Life Complexities
TMC Centers - Multiple Systems
Decision Support System
Methods to Estimate, Predict, Control
Architecture, Develoment, Testing, Deployment
Architecture, Interfacing, Testing, Deployment
Site Selection, Characterization, Scenarios, Unique Needs
Conops, Evaluation, Simulations, Etc
Outreach, Acceptance, Funding, Education, Policy

Some key concepts from the FHWA foundational research program

- Components
  - Scenario generator
  - Data generator
  - Network simulator
  - Decision gate
- Phases
  - Monitor
  - Assess system performance
  - Evaluate strategies
- Analysis plan: 4 packages



Freeway-Arterial coordination in CC

- We are taking a *proactive, dynamic, simulation-based* approach.
- Coordination to us means that,
  a) controllers on each side can access the measurements and calculations of the other side, and
  b) there is a high-level decider.
- Coordination *does not* mean that we solve a single, monolithic control problem.
- We will focus on four solving/simulating scenarios,
  1. Fwy congestion → suspend the onramp queue override,
  2. Fwy congestion → store more on the arterial,
  3. Art congestion → increase flow to the freeway,
  4. Freeway incident → divert traffic to the arterial.

Scenario #1

Trigger

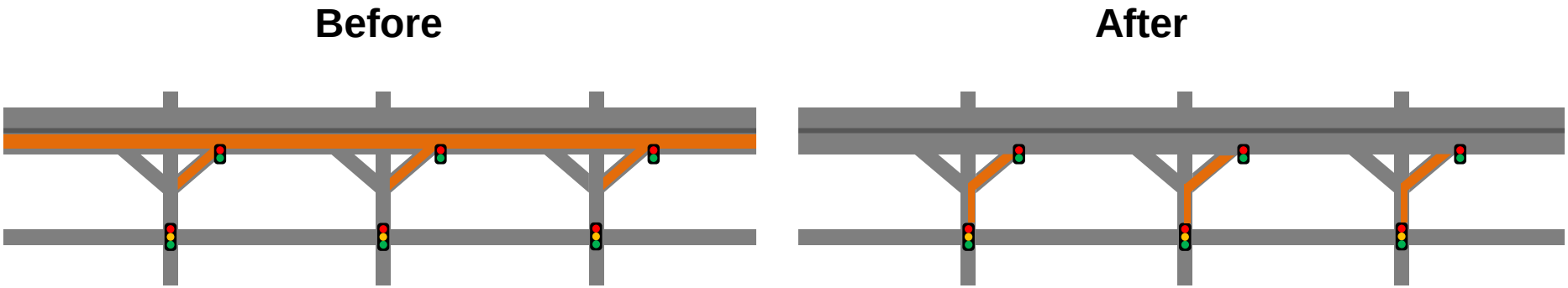
- The freeway is congested and the onramps are full.
- The queue override prevents ramp metering from being effective.

Action

- Suspend queue override; allow the queue to spill into the streets.

Predict

- Net effect on the system.



Scenario #2

Trigger

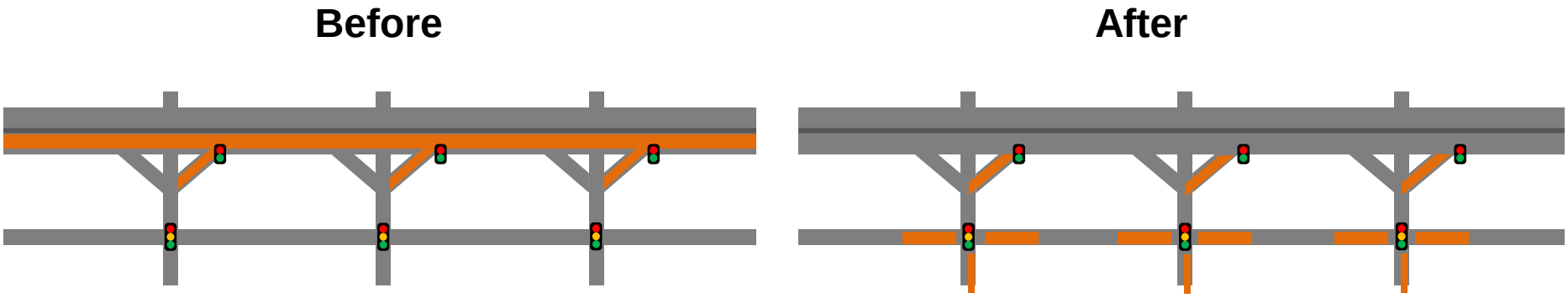
- The freeway is congested and the onramps are full.
- The queue override prevents ramp metering from being effective.

Action

- Adjust arterial signals to decrease the flow on critical onramps.

Predict

- Net effect on the system.



Scenario #3

Trigger

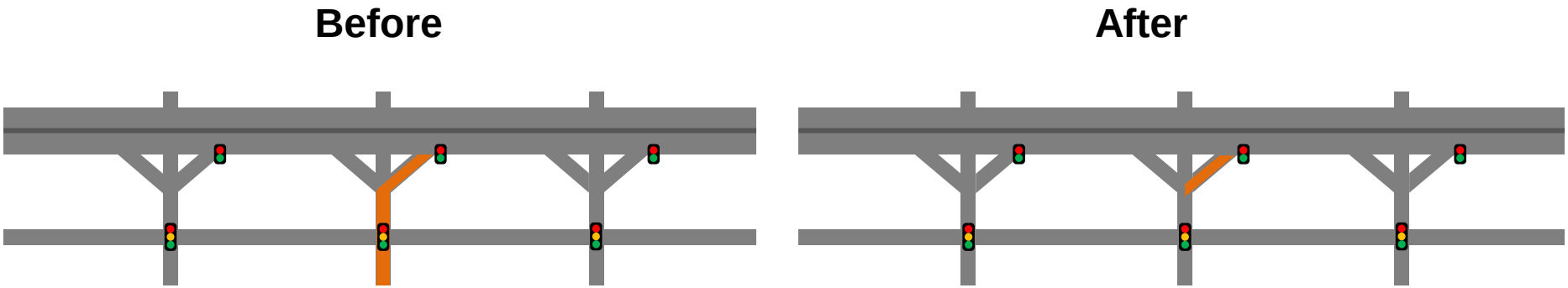
- Demand surges on the arterial (e.g. ball game is over).
- Ramp metering is responsive to freeway demand only.

Action

- Increase metering rate to accommodate the surge.

Predict

- Net effect on the system.



Scenario #4

Trigger

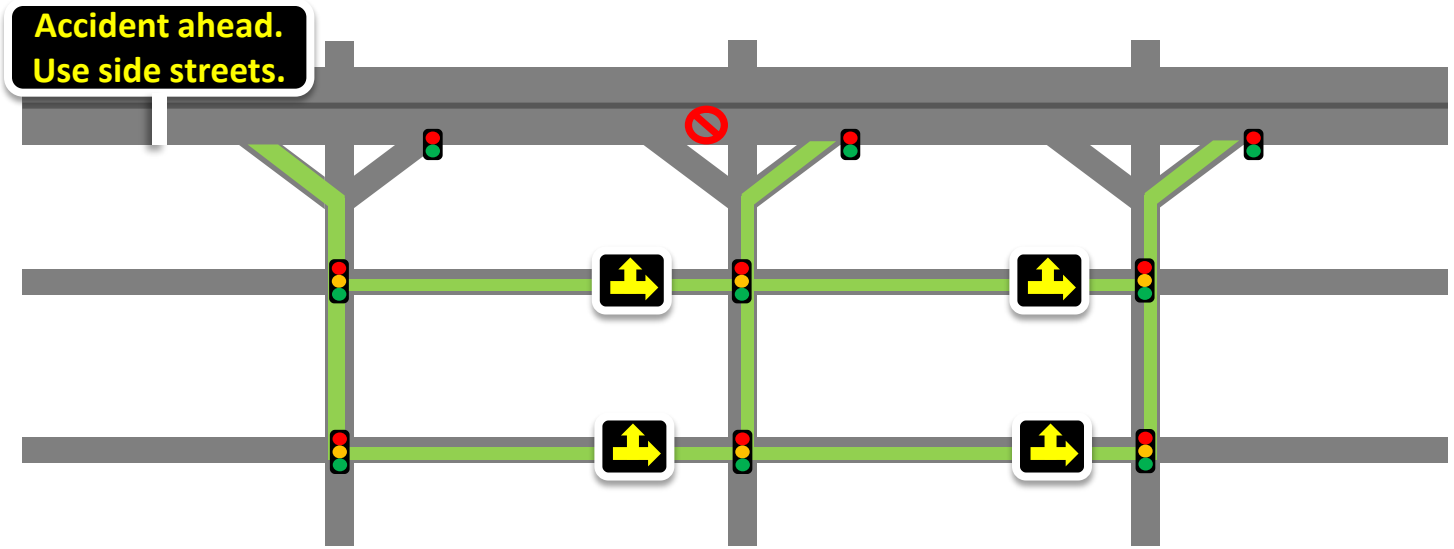
- Accident on the freeway.

Action

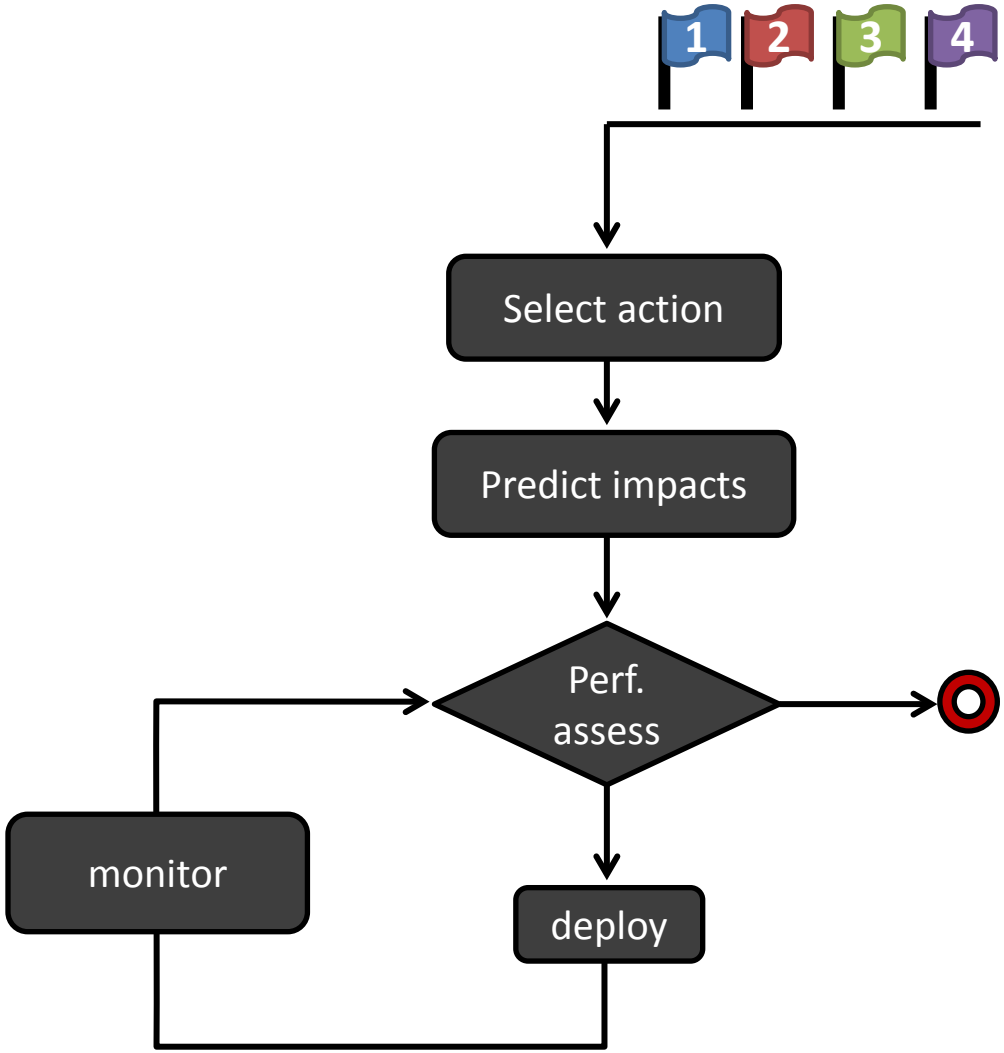
- Put a message on a freeway CMS.

Predict

- Response to the message, impact on the streets.



ATDM/DSS flow



How to define/measure activating events?

What are the actions related to each event?

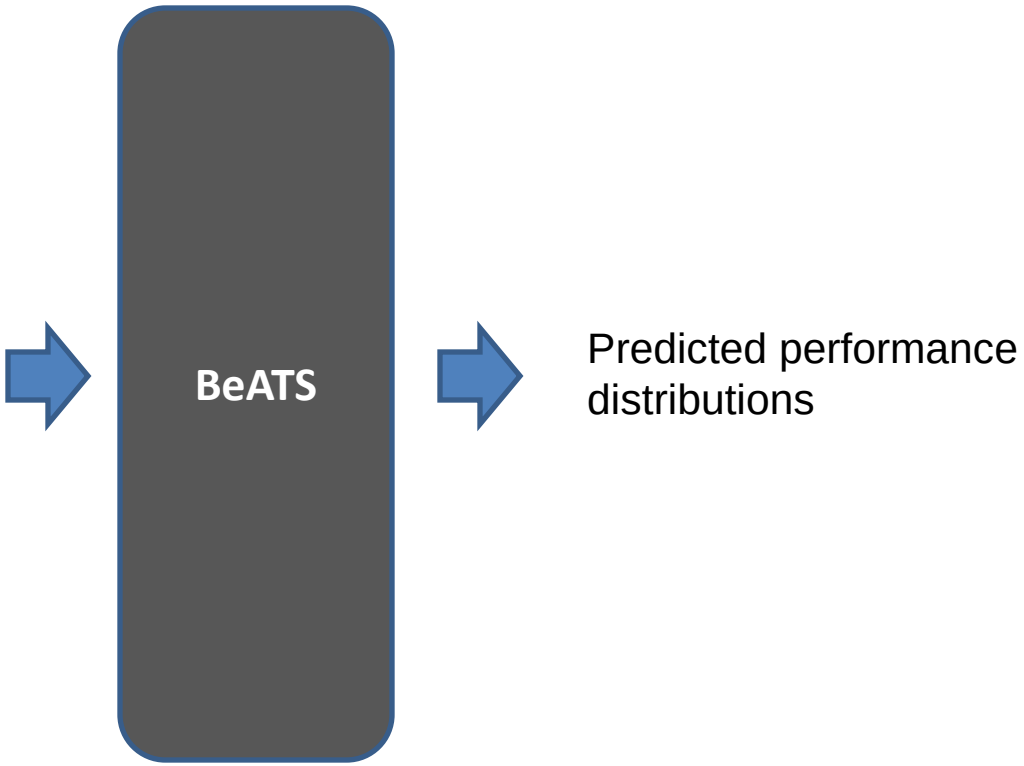
How do we predict the impacts of the actions?

What are the criteria for taking action?

Simulation environment

- BeATS : BErkeley Advanced Traffic Simulator.
- BeATS builds upon TOPL's Aurora Road Network Modeler.
- Based on the Link-Node Cell Transmission Model (LNCTM).

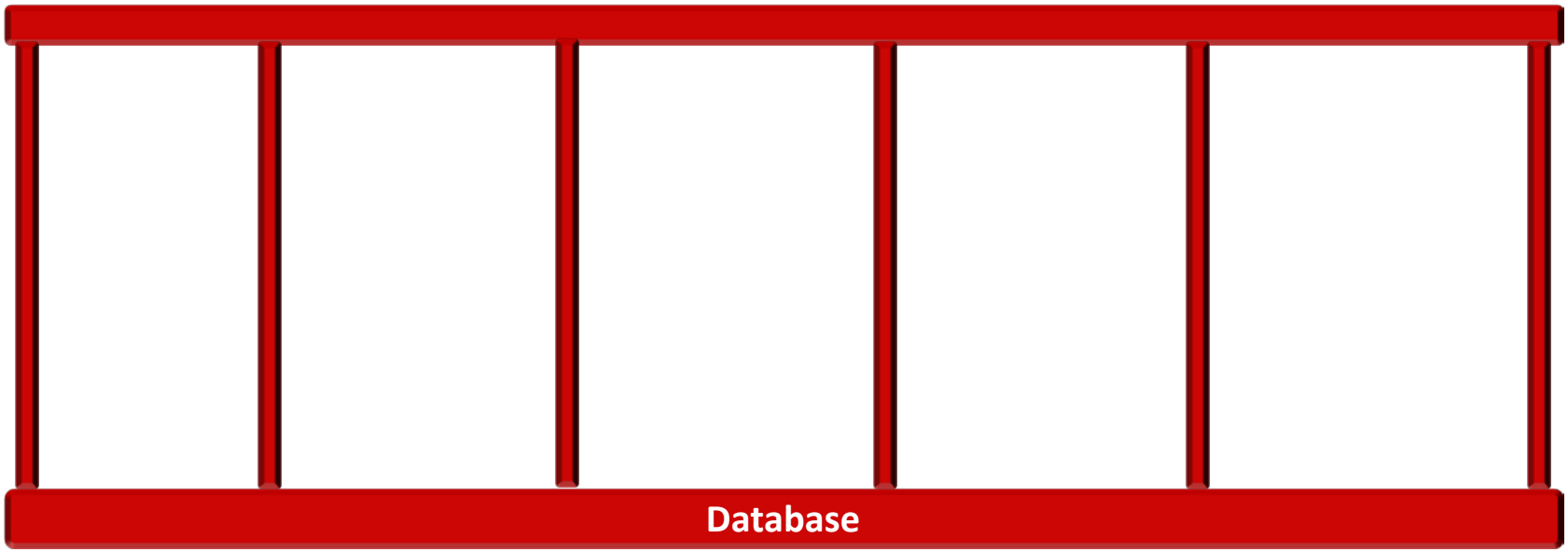
- Network
- Link parameters
  - capacity (*),
  - free-flow speed (*)
  - etc.
- Demand profiles (*),
- Split ratio matrices (*),
- Sensor locations,
- Freeway and arterial control,
- Events (e.g. accidents)



Predicted performance distributions

- Simulation start and end time,
- Number of runs.

Architecture



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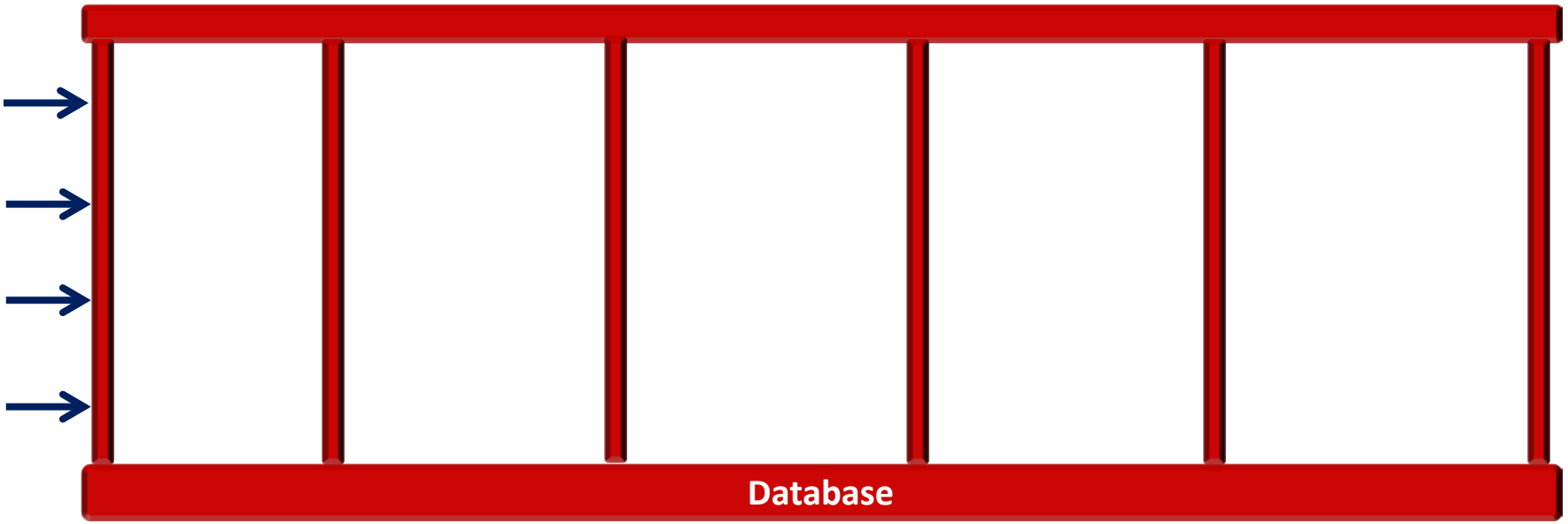
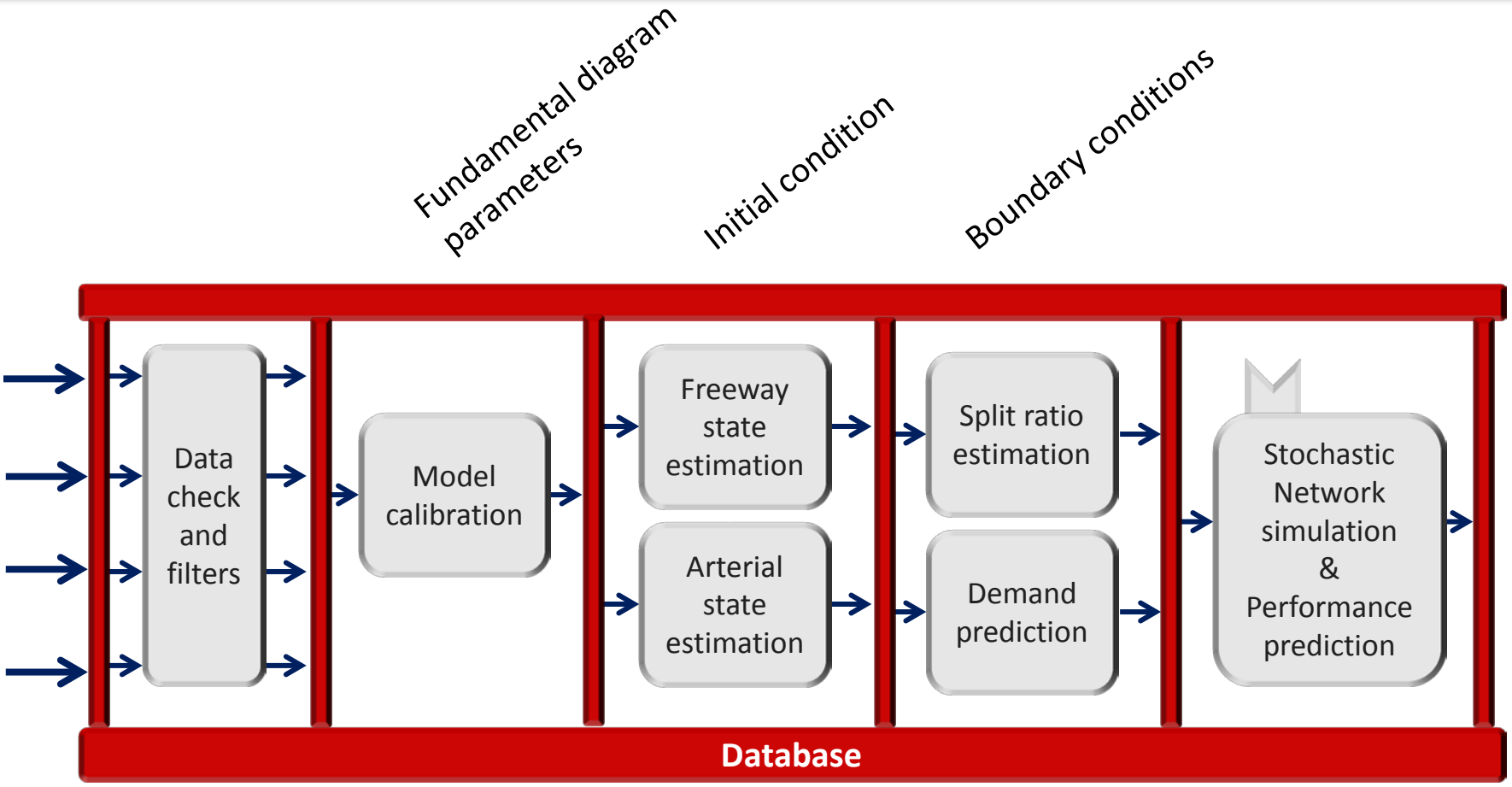


Raw data feeds:

- PeMS
- Probes
- Bluetooth
- Weather
- CHP
- etc…

Architecture



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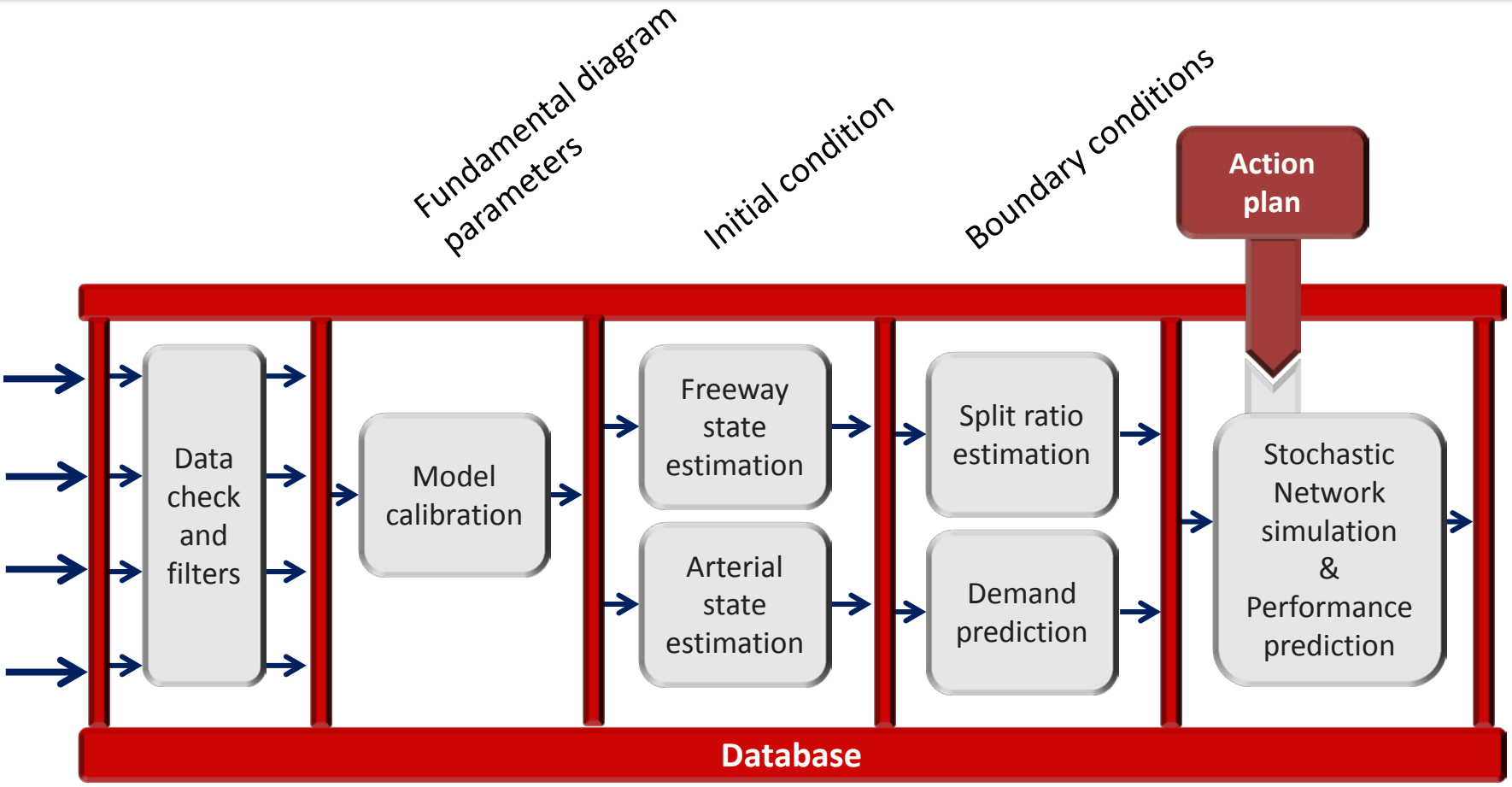

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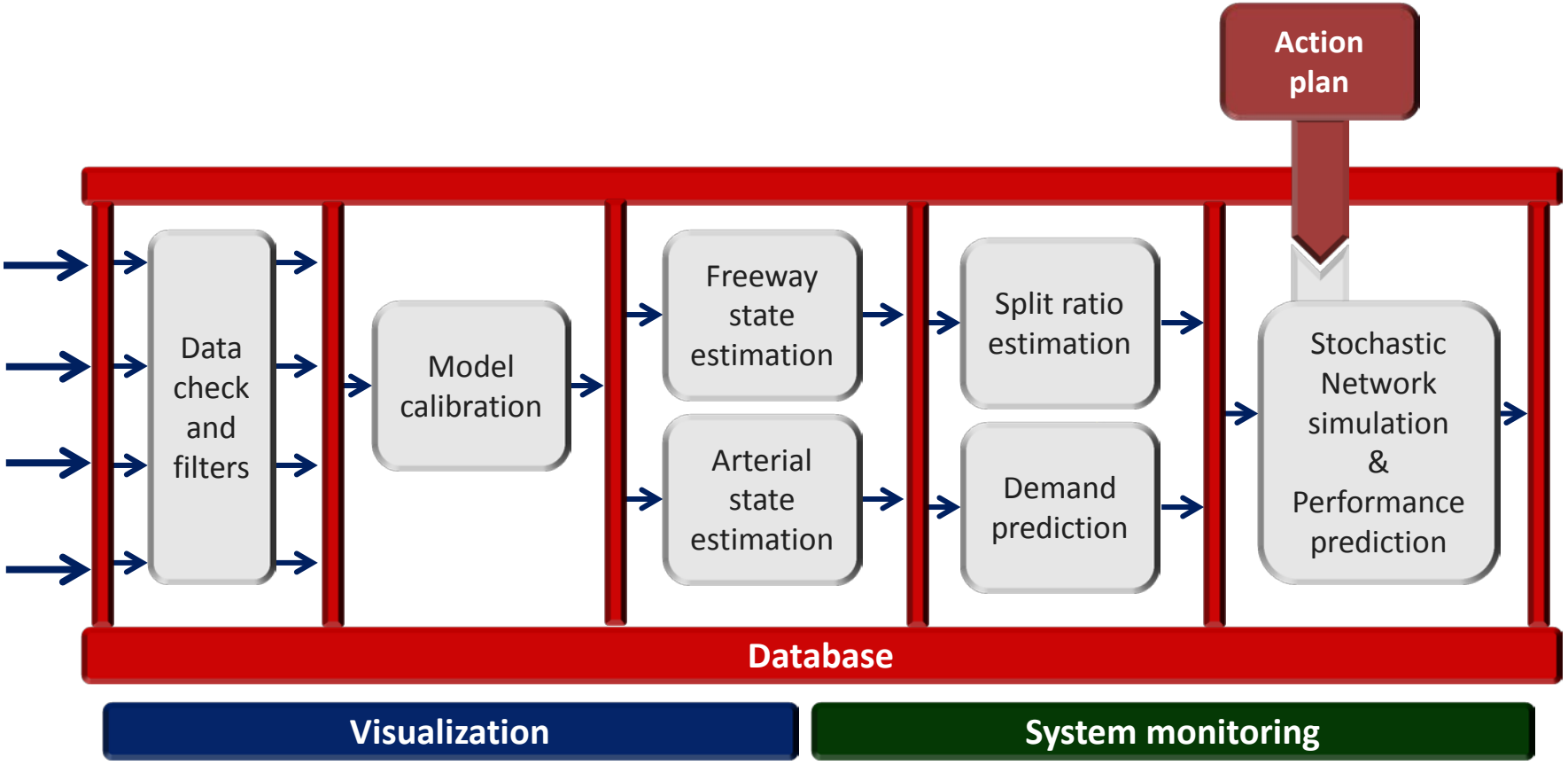
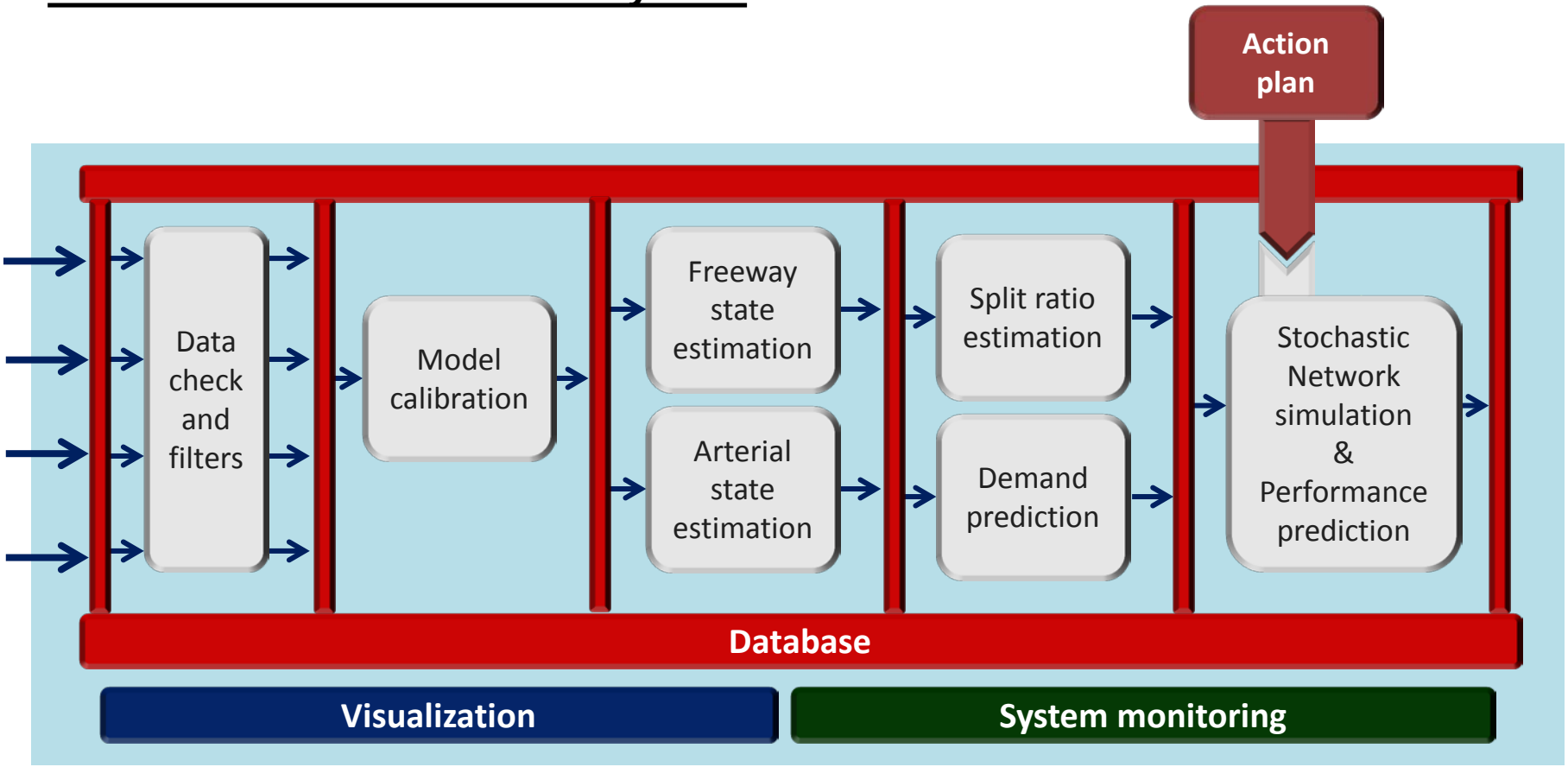


Architecture

Assessment and evaluation system



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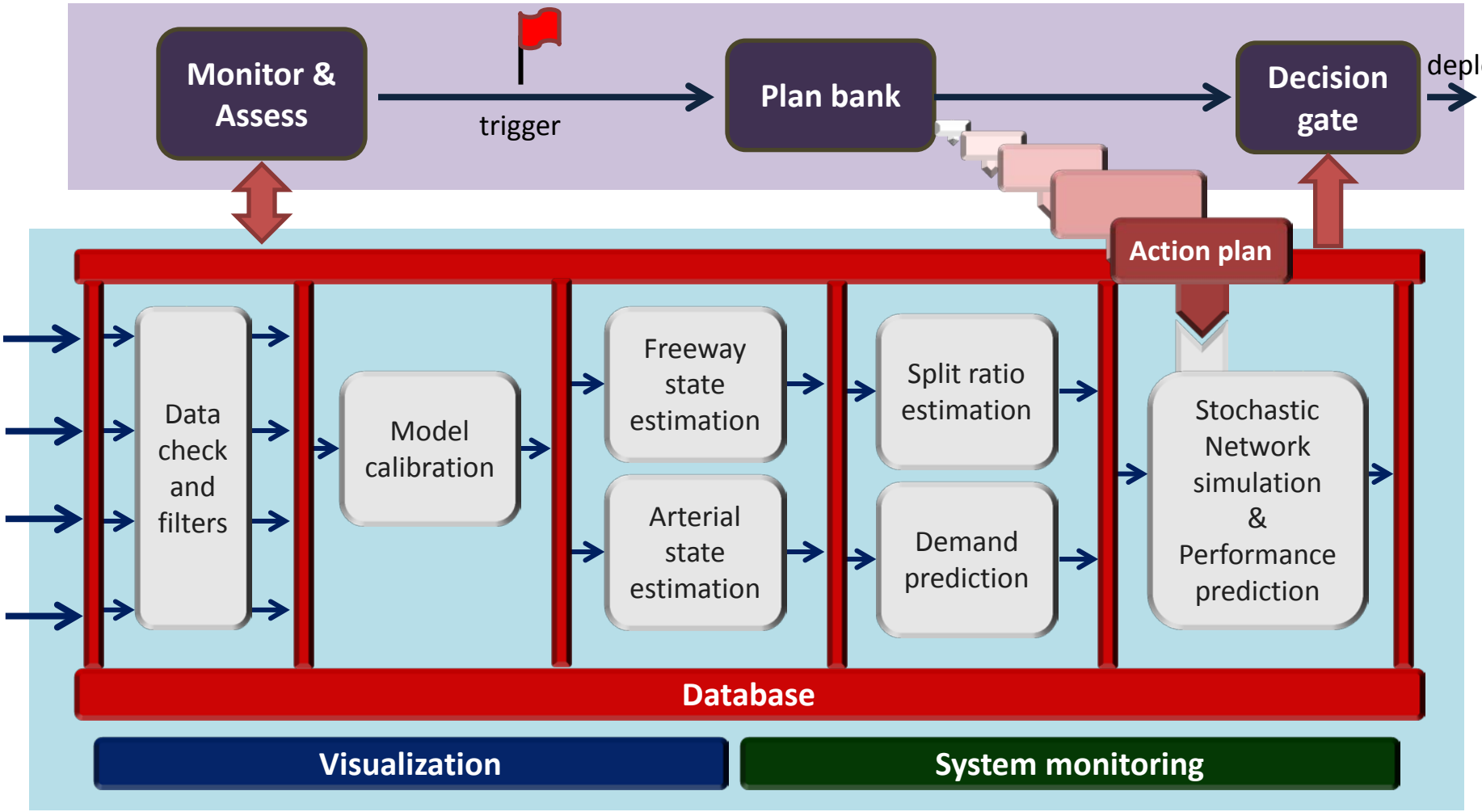

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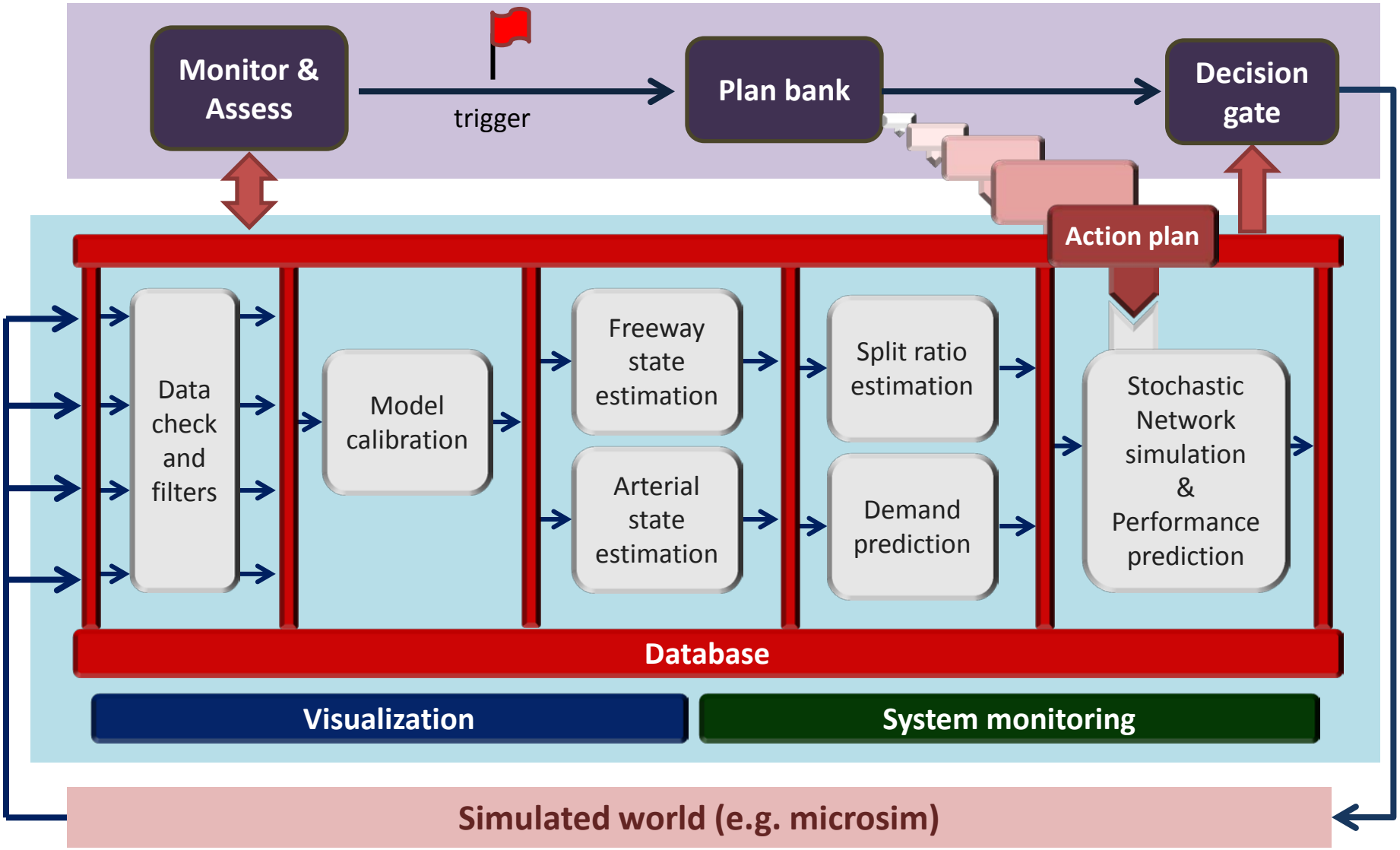

Summary

- Connected Corridors program
- TOPL's Aurora → BeATS
- Freeway/arterial coordination with 4 scenarios.
- Critical components,
  - Automatic model calibration,
  - Freeway and arterial state estimation,
  - Split ratio estimation,
  - Demand prediction,
  - Massive simulation,
  - Performance distributions.