The Future of Urban Mobility: Opportunities and Challenges

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Outline:

- **A Historical Review**

- **Emerging Concepts and Technologies Shaping the Future of Urban Mobility**

- **An Overview of Transportation Research Activities at the Bobby B. Lyle School of Engineering**
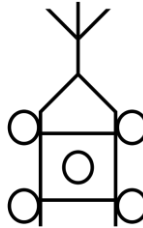
The start of the mobility story …

The Bronocice Pot

Discovered in Poland in 1974-1976

Dated to around 3400 BC

Image of the oldest well-dated representation of a four-wheeled vehicle in the world

The earliest evidence of wheeled vehicles in Europe and the Near East

JAN ALBERT BAKKER, JANUSZ KRUK, ALBERT E. LANTING & SARUNAS MILISAUSKAS*

The earliest evidence of wheeled vehicles dates to the Funnel Beaker (TRB) culture in Europe and the Late Uruk period in the Near East. Results of excavations and 14C determinations from Poland, Germany, Iraq, Syria and Turkey suggest that the appearance of wheeled vehicles was contemporary in Europe and the Near East.

Key-words: wheeled vehicles, 14C dating, Europe, Near East, pictographs, Uruk-Eanna, Ugarit, Bronocice III, Poland, Jebel Aruda, Arslantepe, Flintbek

SMU | BOBBY B. LYLE SCHOOL OF ENGINEERING

There has been always a room for bold ideas …

The Porta Rosa:
One of the first paved streets in the Greek Civilization

Road construction in the Romans era

Tar Paved Road
In Baghdad, Iraq

John Metcalf:
The father of modern highway design

Construction of the first macadamized road
(John Macadam)

400 BC   100 BC   8th Century   1717-1810   1823

There has been always a room for bold ideas …

First horse-drawn street railway line New York

World's First Hybrid Electric Car Is Invented Lohner-Porsche's Hybrid Vehicle

First mile of concrete highway in the world was built - Detroit, MI

Green-Red electric-based traffic signal Lester Wire, Salt Lake

Arthur Hall patented his design of the Cloverleaf Interchange

1832   1901   1909   1912   1916

There has been always a room for bold ideas …

The Transportation Research Board

First automobile park and ride lot and first bus-rail transfer facility - Philadelphia

The affordable automobile Ford Model T 15M vehicles assembled

Fully controlled access freeways Pasadena Freeway CA 110

Freeway with Toll Plaza The Merritt Parkway, CT

1920   1927   1938   1940   1940

There has been always a room for bold ideas …

Wardrop's principles: Understanding congestion in roadway networks

Traffic Management Centers

Ramp meter installed On Eisenhower Expressway in Illinois

Issuing first transportation research journal

Four wheeler on the moon EV Lunar Rover by Boeing and GM

1952　　　1960s　　　1963　　　1963　　　1971

There has been always a room for bold ideas …

Light rail system Edmonton, Alberta

Congestion pricing deployment orange county, CA

The No Hands Across America Project - Semi-Autonomous Vehicle (CM Univ.)

First secure retail transaction over the Web
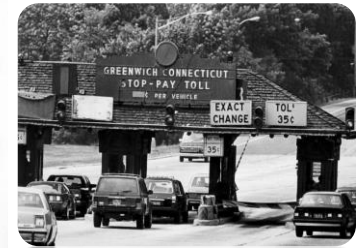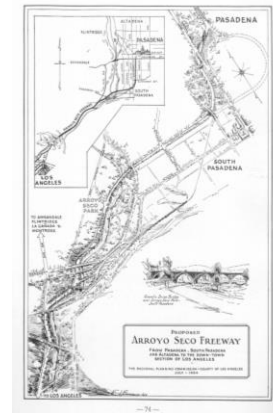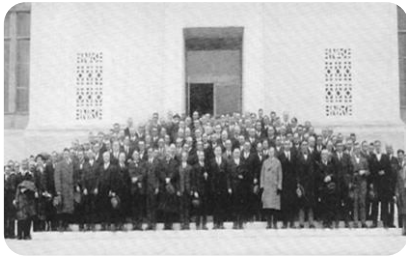
First mass-produced hybrid – Toyota's Prius

1978   1995   1995   1995   1997

There has been always a room for bold ideas …

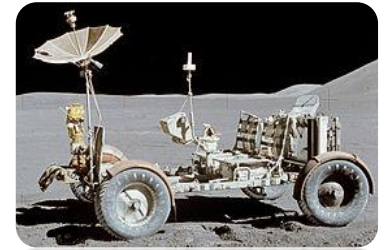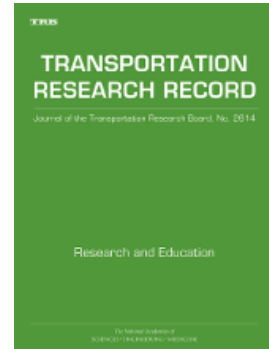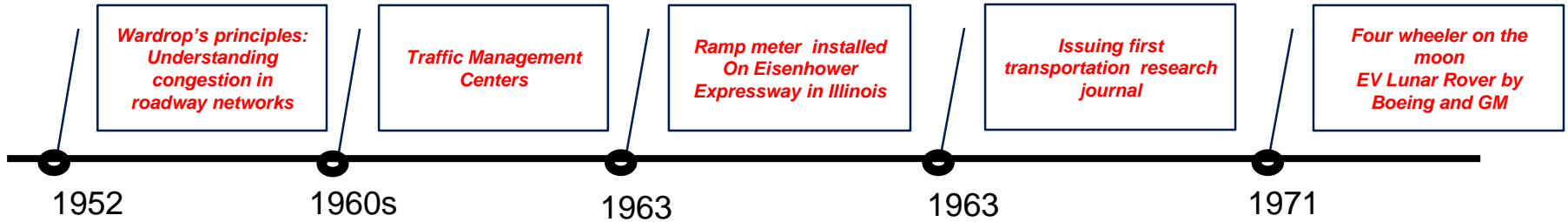FCC: 5.9 GHz band to be used by intelligent transportation systems

Google's self-driving Vehicle project started

Transportation network companies

Crowdsourcing phone applications in transportation

Testing self-driving drone taxi in Dubai, UAE

1999   2009   2009   2010   2017

Reflecting on the Past …

- Good ideas were adopted at a very large scale.

- Across-domain technology transfer frequently occurred.

- Moore's law seems to apply.

Q1: Was it hard to anticipate most mobility-related problems that we are facing today?

Q2: Was it possible to consider better policies to avoid today's congestion problems?
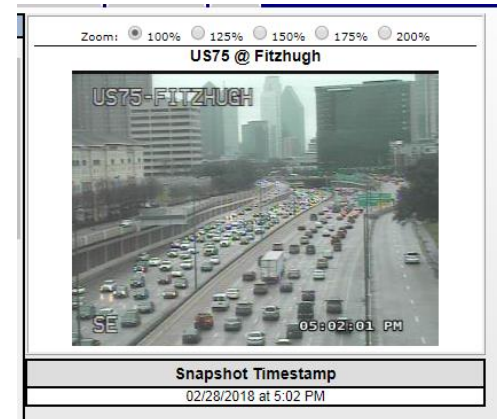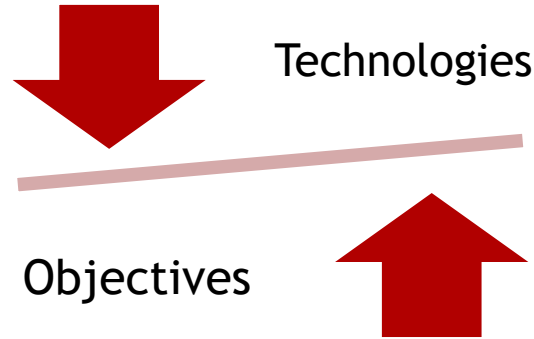
The Cost of Traffic Congestion

- Congestion is estimated to cost U.S. motorists about $300 billion yearly

- Traffic jams cost U.S. drivers an average of $1,200 a year in wasted fuel and time

Driving Forces…

Objectives

Technologies

Efficiency

Safety

Reliability

Sustainability

Equity

Resiliency

Security

Technologies

Objectives

Robotics
Machine Learning
Analytics
Cloud Computing

Electrification

Communications

Surveillance

V/A Reality

Shared Economy

Personalization

More Automation …

New In-Vehicle Experience
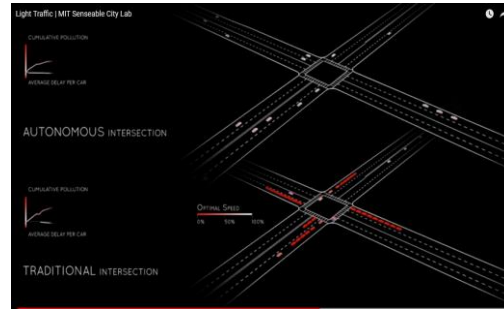
Autonomous Intersections

Efficient Platooning
Automated Highways

Self-Driving Vehicles & Self-Managing Infrastructure

From 2D to 3D & Faster …

Traffic Straddling Bus

Flying Taxi

Hyperloop Systems

High Speed Monorail skyTran

Truck-Drone Integration

More Shared Economy…
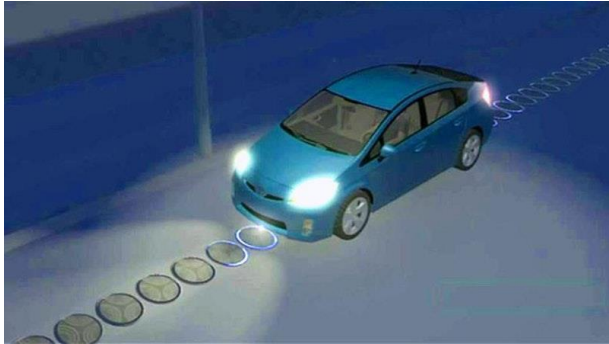

Car/Bike Sharing

Ride Sharing

Parking Sharing

Information Sharing (Crowdsourcing)

Transportation Electrification …

Wireless Vehicle Charging

Renewable Resources

HOW STORES HARNESS ENERGY FROM THE CAR PARK

2 Plates are pushed down by the weight of the vehicle

3 This creates a rocking motion under the road surface which turns generators

1 Cars drive over the plates placed in the surface of the car park

4 The generators create energy which is captured, redirected back to the store and used as power for the checkouts
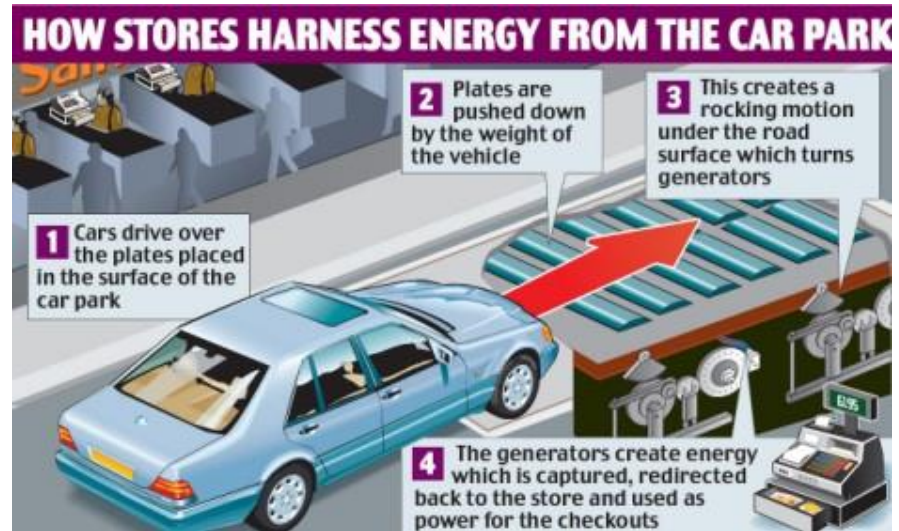
Energy Harvesting

More Personal …

number of occupants
tone of their voices
body language
facial expressions
choice and volume of music
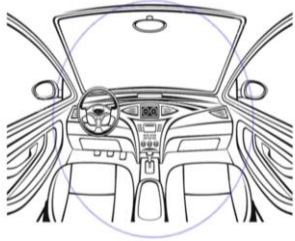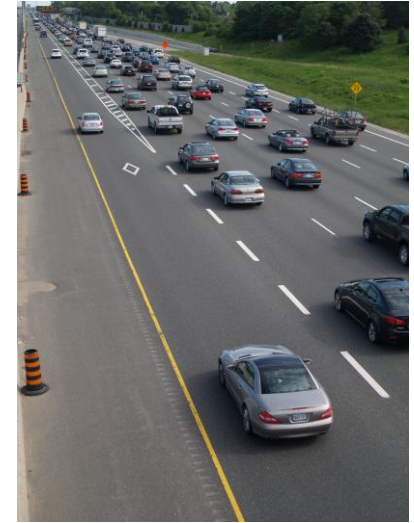
More than a machine, a partner.

The leader of our CONCEPT-i Series, TOYOTA CONCEPT-i uses artificial intelligence to connect with its driver—learning, protecting and inspiring them on the road ahead.

Human-machine interactions

Providing incentives for travel behavior change

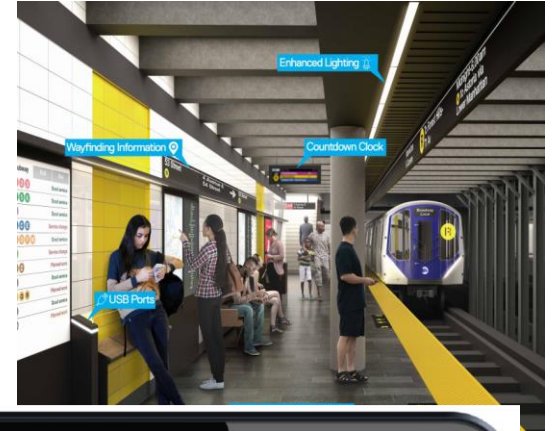**Systems that allow capacity reservation**

Living the Virtual World …

Future Download Seminar

Classroom of the Future

Augmented Reality for Advanced Traveler Information Systems

Business Models

The Amazon Model

↓

Aggregator of Third-Party Services

↓

Develop capabilities as a single point of access to services provided by third parties

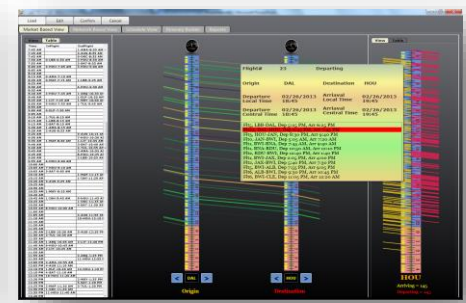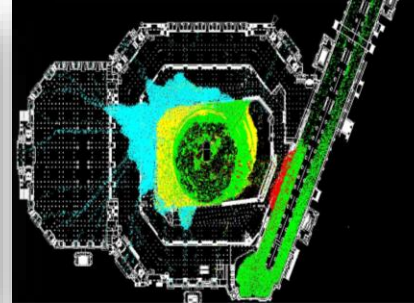**The Apple Model**

↓

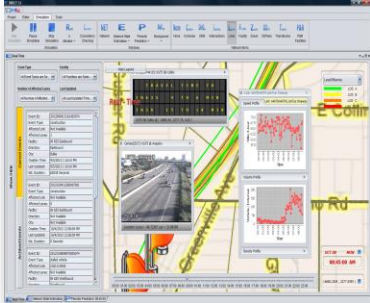Deep Integration of Services

↓

Develop capabilities to provide all services needed by the user to achieve seamless user experience

Research Highlights

Transportation Research Laboratory
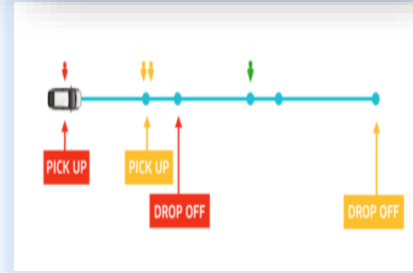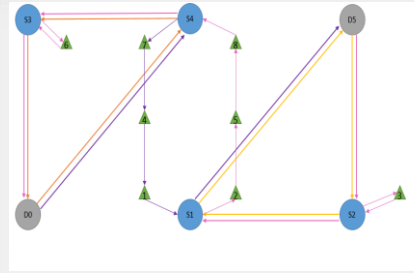# @ Lyle/SMU

Research Highlights

ITS/Real-Time Traffic Management Systems

Autonomous and Connected Vehicles

Crowd Dynamics in Mega Facilities

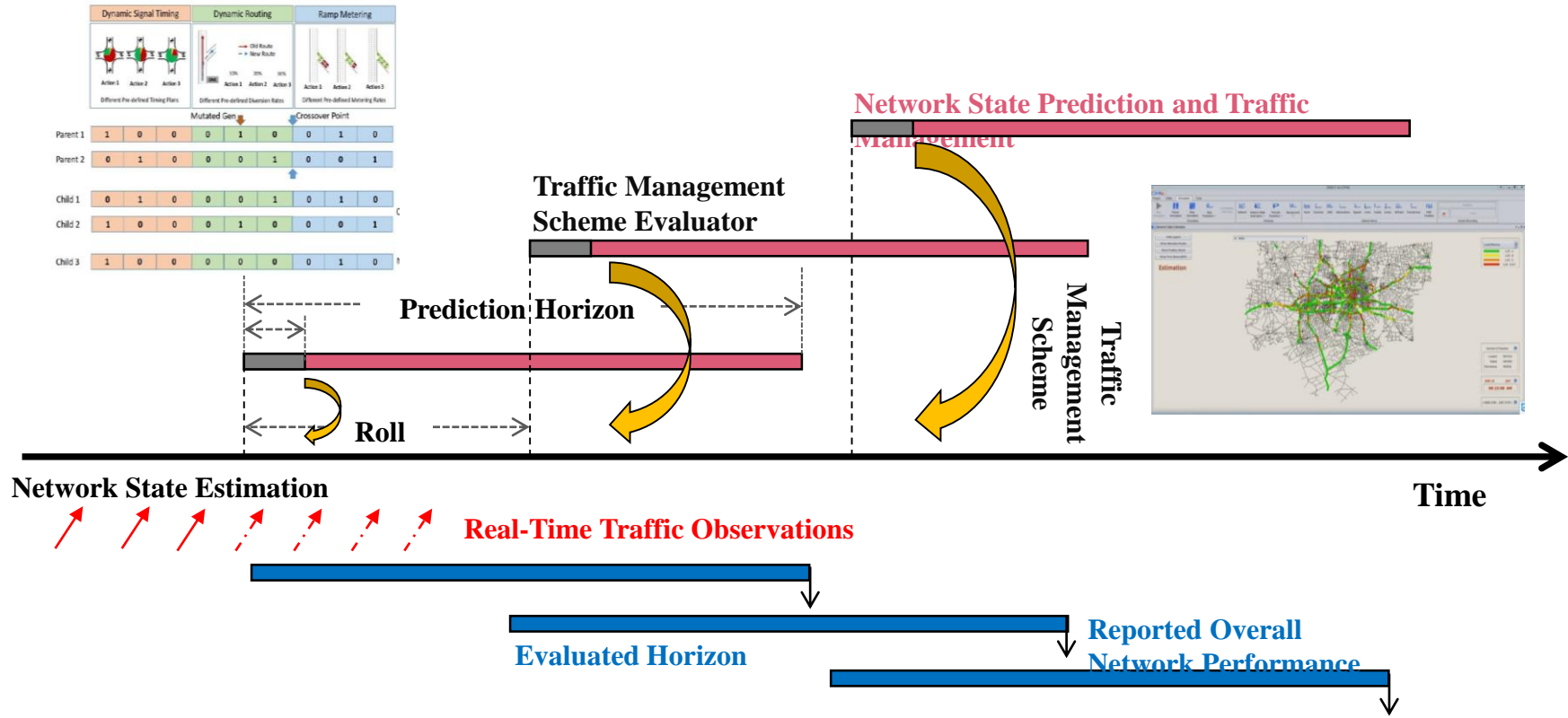Airlines Strategic Planning and Operations Management

Score-Based Approach for Traffic Management

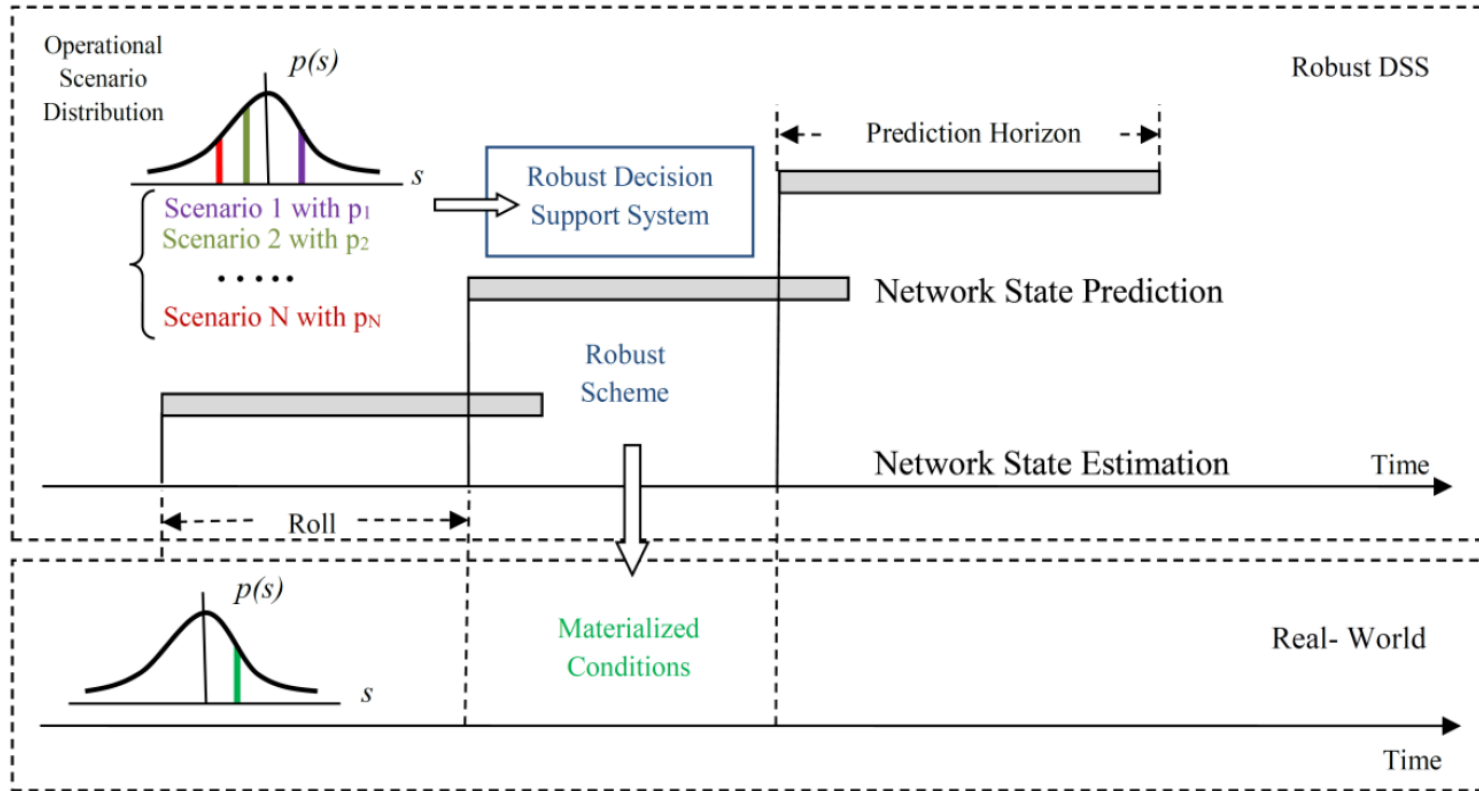Integrated Truck-Drone Routing for Delivery Services

On-Demand Mobility: A Shared Economy Approach
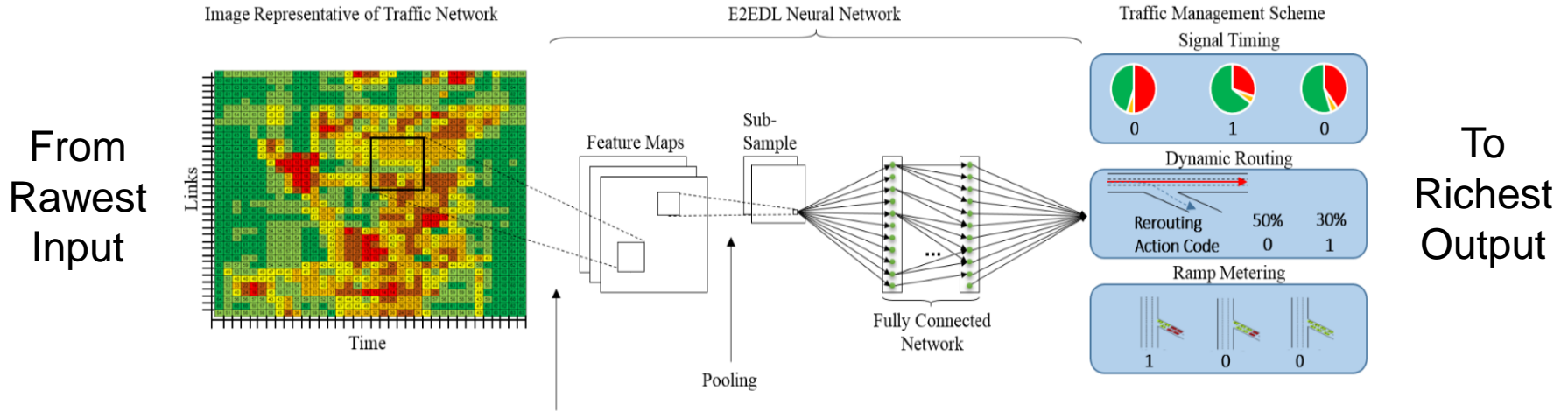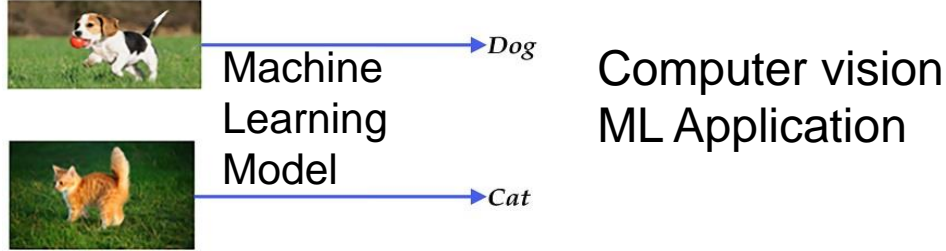
Transportation Network Electrification

Real-Time Traffic Network Management Systems

DSS for Proactive-Robust Traffic Network Management

End-to-End Deep Learning for Traffic Management

Machine Learning Model

Dog

Cat

Computer vision ML Application

From Rawest Input

To Richest Output

Image Representative of Traffic Network

E2EDL Neural Network

Traffic Management Scheme

Links

Time

Feature Maps

Sub-Sample

Fully Connected Network

Pooling

Signal Timing

0   1   0

Dynamic Routing

Rerouting   50%   30%
Action Code   0   1

Ramp Metering

1   0   0

Autonomic Architecture for Traffic Management

Moving the intelligence to the infrastructure side
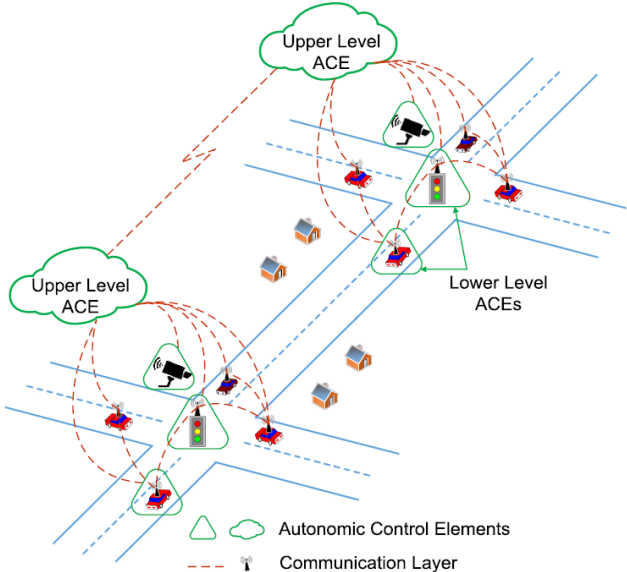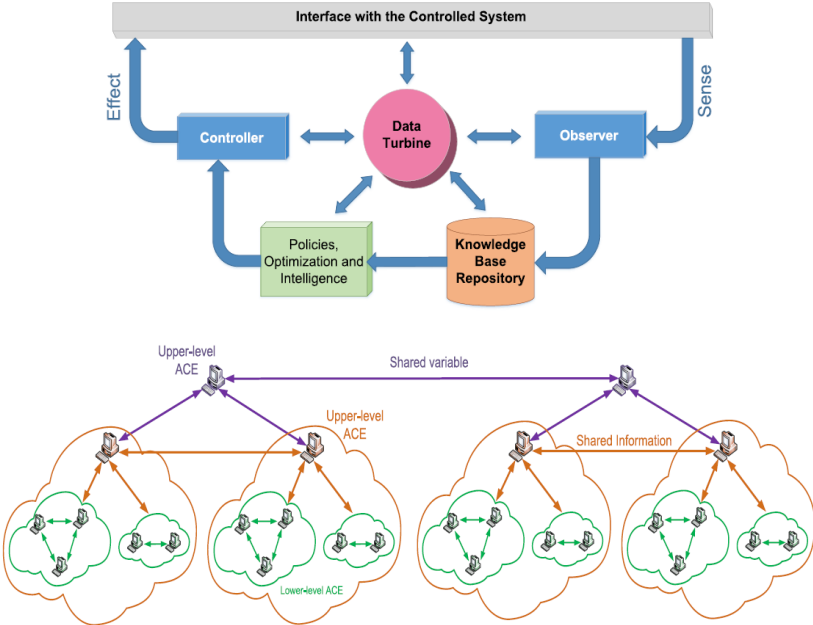
Conclusion:

- **New concepts and technologies present great opportunities and also present great challenges.**

- **Increasing need for interdisciplinary education/training for the next generation of engineers and researchers.**

- **Great things are happening in the DFW area. However, we still have a lot of work to do.**

While being listed as the fifth most congested city in the U.S. is bad, not being on the top of the list as the most innovative city in fighting this congestion is even worse.

Thank You!!