International Webinar
Integration City Planning and Sustainable Development in The Capital City Indonesia

21 Dec. 2021

Oleh: Prof. Haryo Winarso

Penanggap:
Murshal Manaf

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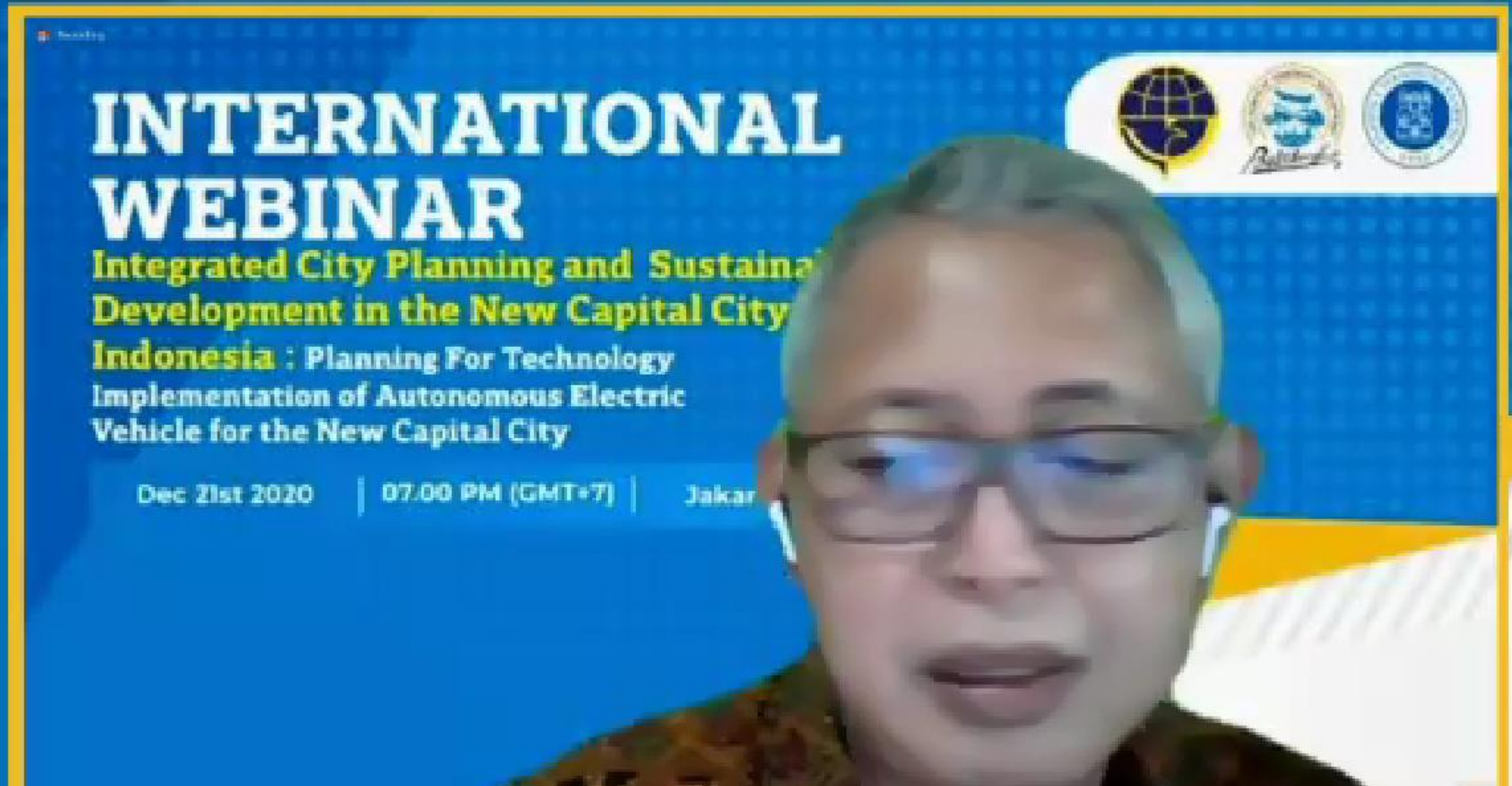
EBINAR

Integrated City Planning and Sustainable Transport
Development in the New Capital City of
Indonesia : Planning For Technology
Implementation of Autonomous Electric
Vehicle for the New Capital City



WEBINAR

Indonesia : Planning For Technology Implementation of Autonomous Electric Vehicle for the New Capital City

KEMENTERIAN PERHUBUNGAN
REPUBLIK INDONESIA

INTERNATIONAL WEBINAR

THE MINISTRY OF TRANSPORTAT
STRATEGIC PLANNING TO SUPPO
THE NEW CAPITAL CITY OF INDO

Jakarta, 21 Desember 2020

POPULATION DENSITY

57% of Indonesia's population is concentrated on th
island of Java

ECONOMIC INEQUALITY

The uneven National GDP, where currently 58.49% of
the National GDP is contributed by Java Island

HEAVY LOAD IN JAKARTA

The heavy burden is borne by Jakarta as the center o
government and economic center.

This resulted in a decrease in the carrying capacity of
environment and the amount of economic losses face

New Capital City as Nation Identity of Indonesia

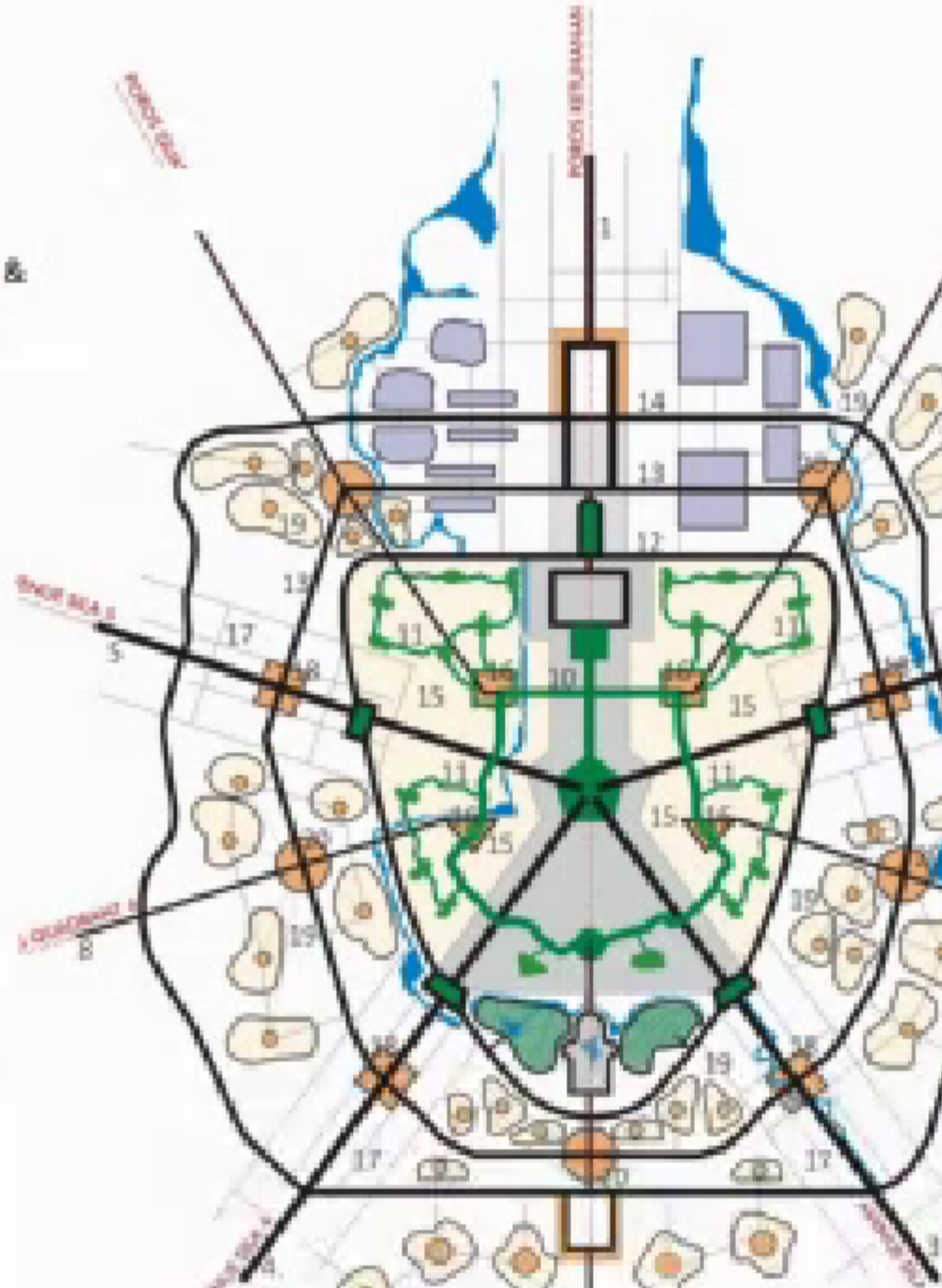
Smart City

Green City

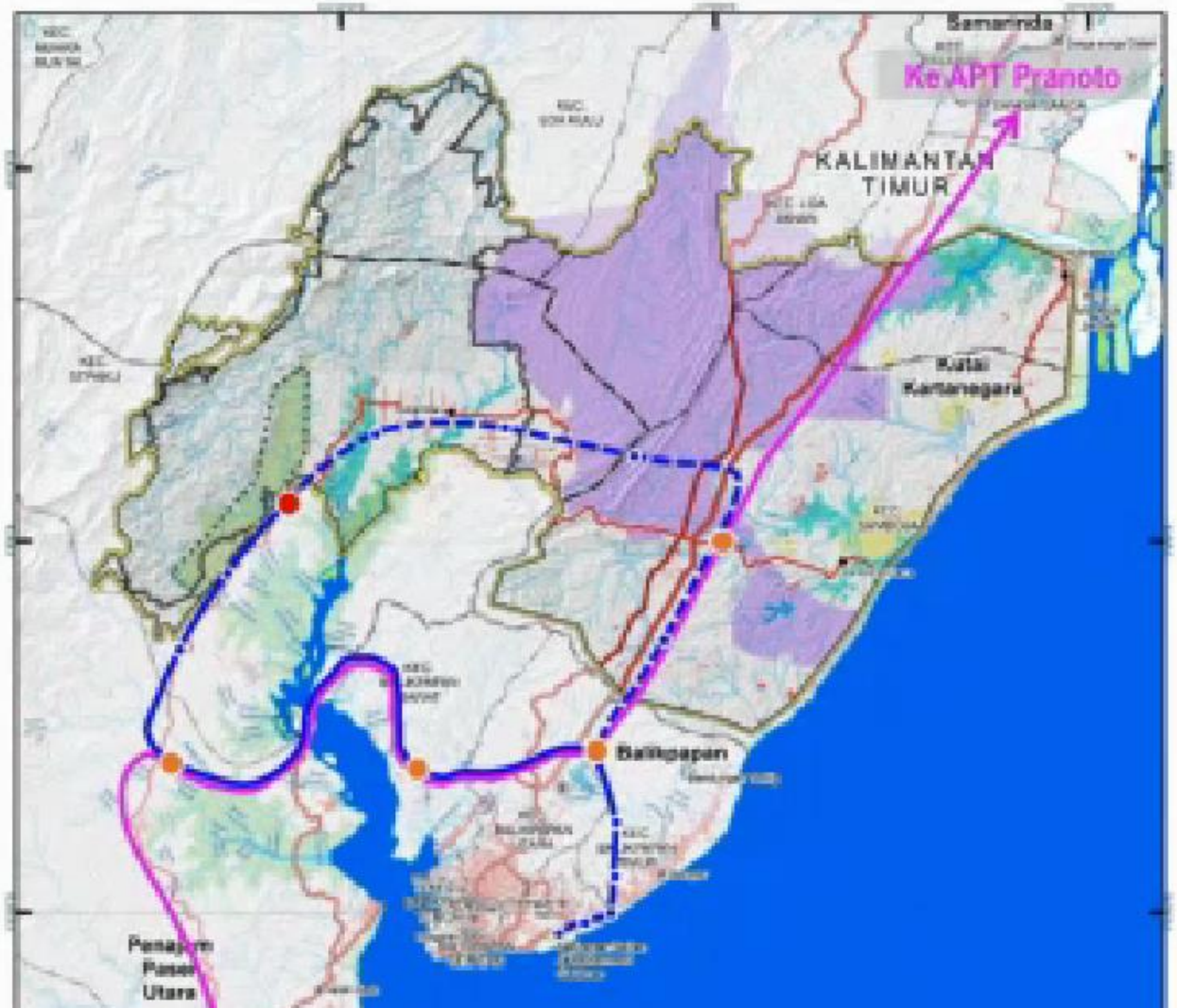
Sustainable City

- Prepare legislation and regulations that su
  the National Capital
- The Capital City Authority Agency (Badan
  Ibu Kota) resolves institutional issues rela
  relocating the nation's capital
- Designing a new capital city with mass
  transportation will use autonomous vehic
  private vehicles will also use autonomous
- Prepare 256 thousand hectares of land (s
  medium term) and 410 thousand hectare
  (long term)
- The government works on the basic infras
  and government clusters. Beyond that, w
  give it to the public private partnership (P
  process or it is done by investment.
- The concept of the capital city is Negara R
  Nusa. This means that there is an obligati
  improve the environment from bad to go
  damaged forests become rehabilitated fo

Road System	Definition
I. RING ROAD	
Cycle Road	Connecting 4 CBD and residential areas
Capital City Ring Road (Perisai)	Connection Road 5 Avenue to Botanical Garden & Zoo,Sport Centre, Cultural Park, non-Ministerial Government Agencies
CBD Ring Road	Connecting between CBD
Urban Village Ring Road	Connection Road between Urban Village, Governor Office, Mayor Office, University, and Techno Park
Metropolitan Ring Road	Connecting intercity
Outer Ring Road	As the outer ring of the nation's capital and connecting between town
II. AXIS ROAD	
NKRI Boulevard	Connecting monuments, museums & galleries, government agencies, ministry offices, and forest park
Avenue Sila	Connecting Pancasila's Monument, Religious Compound and Region Area
Poros Quadran	Connecting CBD in each quadran



The Concept of Railway Access Planning in the New Capital City (IKN)



Railway Access of the New Capital City

1. Capital City Circle Urban Train
(Sepinggan – Buluminung – IKN – Samboja – Sepinggan)

2. Intercity Train with existing trace

- : Intercity Trains Trans Kalimantan
- : Capital City Circle Urban Train phase 1 (Sepinggan – Karang Joang – Buluminung – Inti IKN)
- : Capital City Circle Urban Train phase 2 (Inti IKN – Samboja - Sepinggan)


INTERNATIONAL WEBINAR - INTEGRATIED CITY PLANNING ANS SUSTAINABLE TRANSPORT - 21 12 2020 -BALITBANGHUB - Microsoft PowerPoint
Zoom Webinar
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The Concept of Airport Development in the New Capital City (IKN) (1/2)
Multi-Airport System Concept and the Support
The airport carries the concept of AEROTROPOLIS which is SMART, INTEGRATED and pays attention to ENVIRONMENTAL ETHICS
An intermodal integrated transportation system that connects airports, both land, sea and railways.
The farthest airport distance from the city center (IKN) can be reached no more than 30-45 Min or with a maximum distance of 20 km
Supported by reliable transportation (LRT, toll and bridges) that connect within airports and airports to IKN
1
Sepinggan Balikpapan Airport will be developed to have a runway length of 3,250 x 60 m, with a maximum terminal capacity of 30 million passengers / year
2
APT Pranoto Samarinda Airport will be developed to have a runway length of 3,000 x 45 m with a terminal capacity of 20 million passengers / year.
3
Planned to build a New VIP Airport, a maximum of 30 minutes travel time from the Core Area of the National Capital. The airport will function as a state airport (VVIP) and military base.
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Q&A
Indonesian
Leave
SLIDE 9 OF 23
NOTES
COMMENTS
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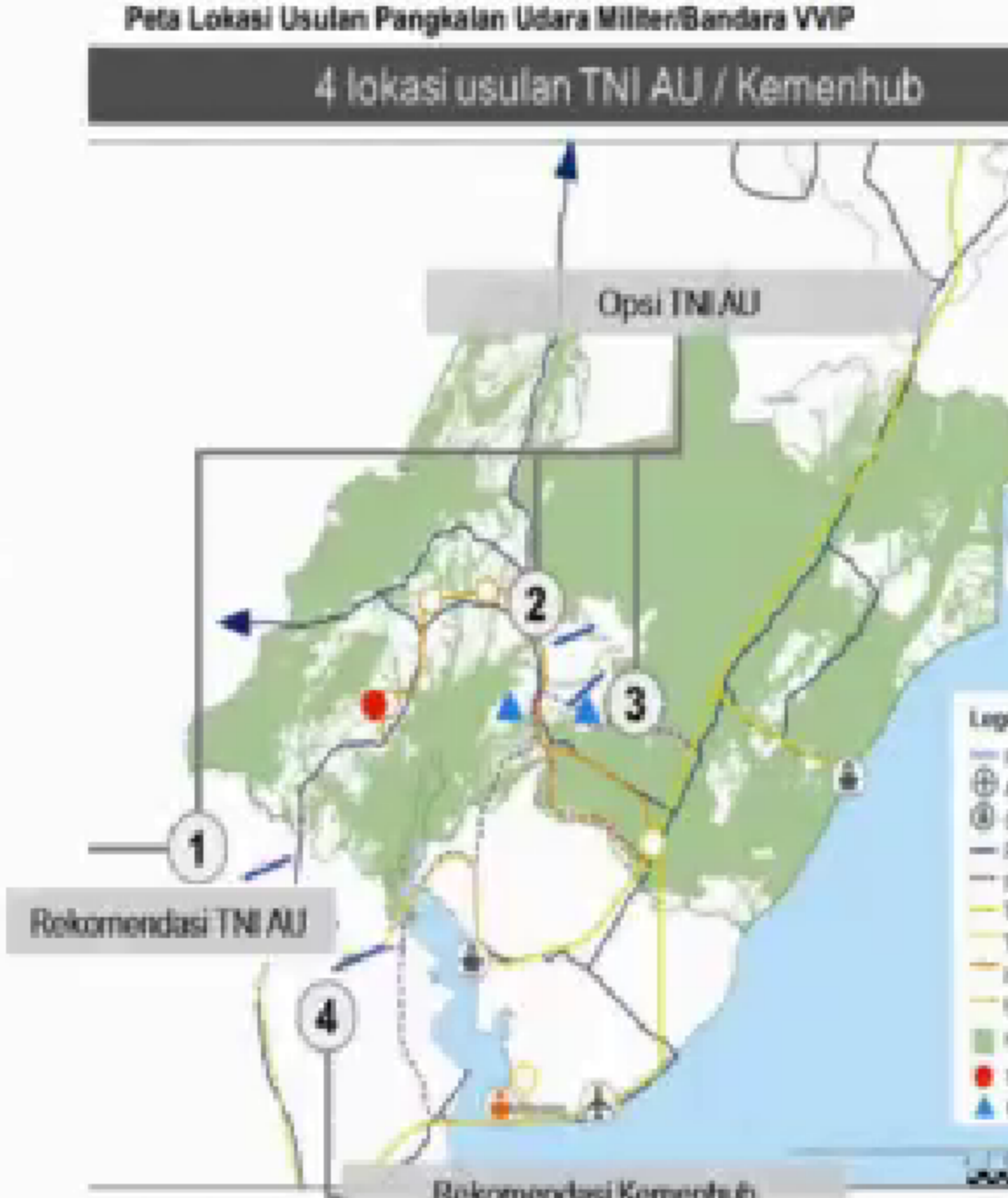
12/21/2020

VVIP airport is categorized as a civil airport, so its location determination must follow ICAO aviation standards related to civil aviation safety (obstacle / topography).

The recommendation of the Ministry of Transportation for VVIP Airport to location No.4 with an area of around 400 Ha has paid attention to ICAO standards and considers the existence of obstacles (hills) and affects the overall height limit for infrastructure built around the site.

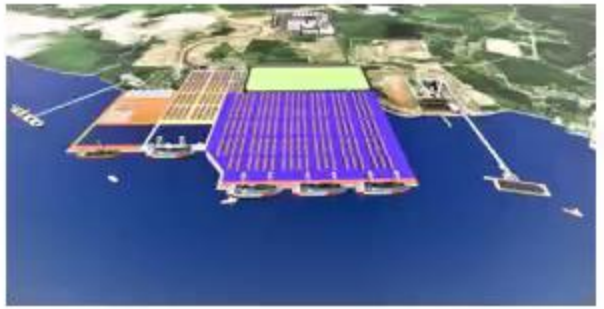
Indonesian Air Force Option Recommendation No. 1, 2 and 3. VVIP Airport requires a land area of ± 2,740 Ha including for military facilities (from the point of view of state sovereignty and security). Based on the meeting on November 3, 2020, it has narrowed down to the location option No. 1.



The Concept of Port Development in the New Capital City (IKN)

Balikpapan Shipping Lanes

❑ THE DEVELOPMENT OF KARIANGAU TERMINAL (Container and Non-Container)



➢ Kaltim Kariangau
- Depth 15 meters
- Maximum capacit /year
- The development million TEUs /year

❑ THE DEVELOPMENT OF SEMAYANG TERMINAL (Passenger)

➢ Development of terminals, wareh expansion of sta

The research for the development of new port and

Vehicle for the New Capital City

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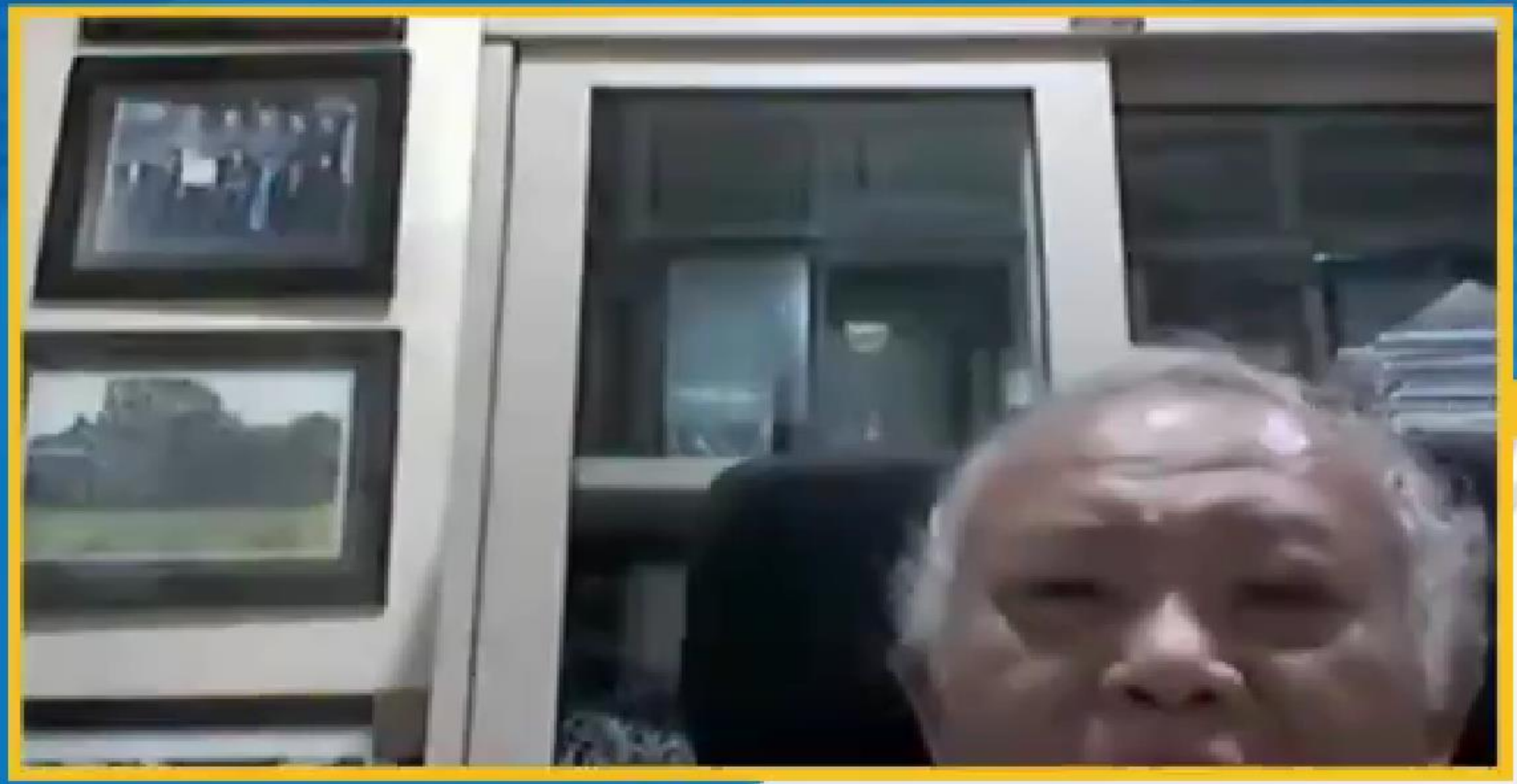

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Vehicle for the New Capital City


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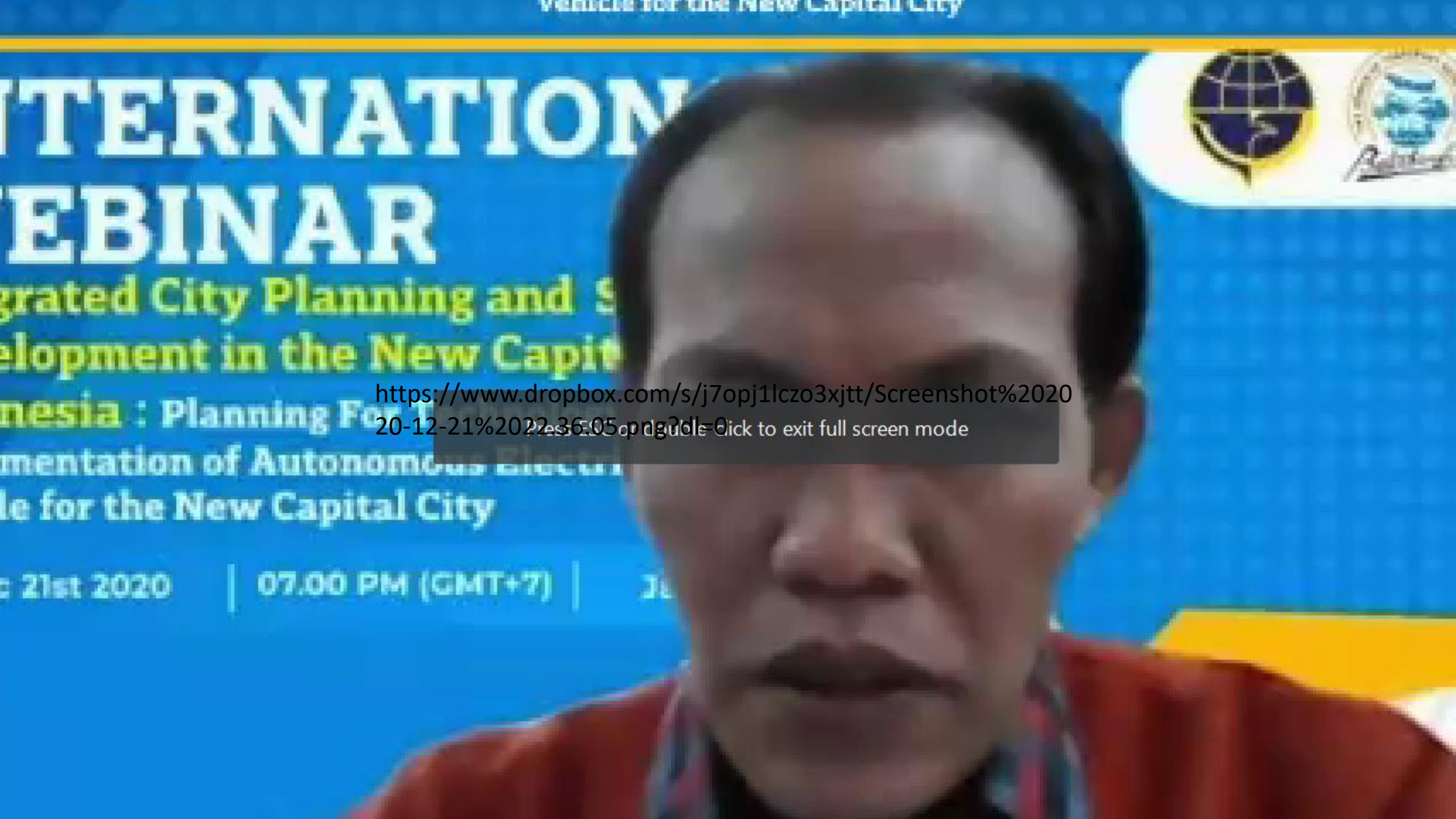
Vehicle for the New Capital City
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21st 2020
07.00 PM (GMT+7)
https://www.dropbox.com/s/j7opj1lczo3xjtt/Screenshot%2020
20-12-21%2022.36.05.png?dl=0
Click to exit full screen mode

Capital City (IKN) development vision

- Vision '*Smart, Green, Beautiful,* dan *Sustainable*'
  - Concept of *forest city* with *smart and intelligent city*.
- Expected to be the city of modern and social inclusion, with maintain the nature and environment

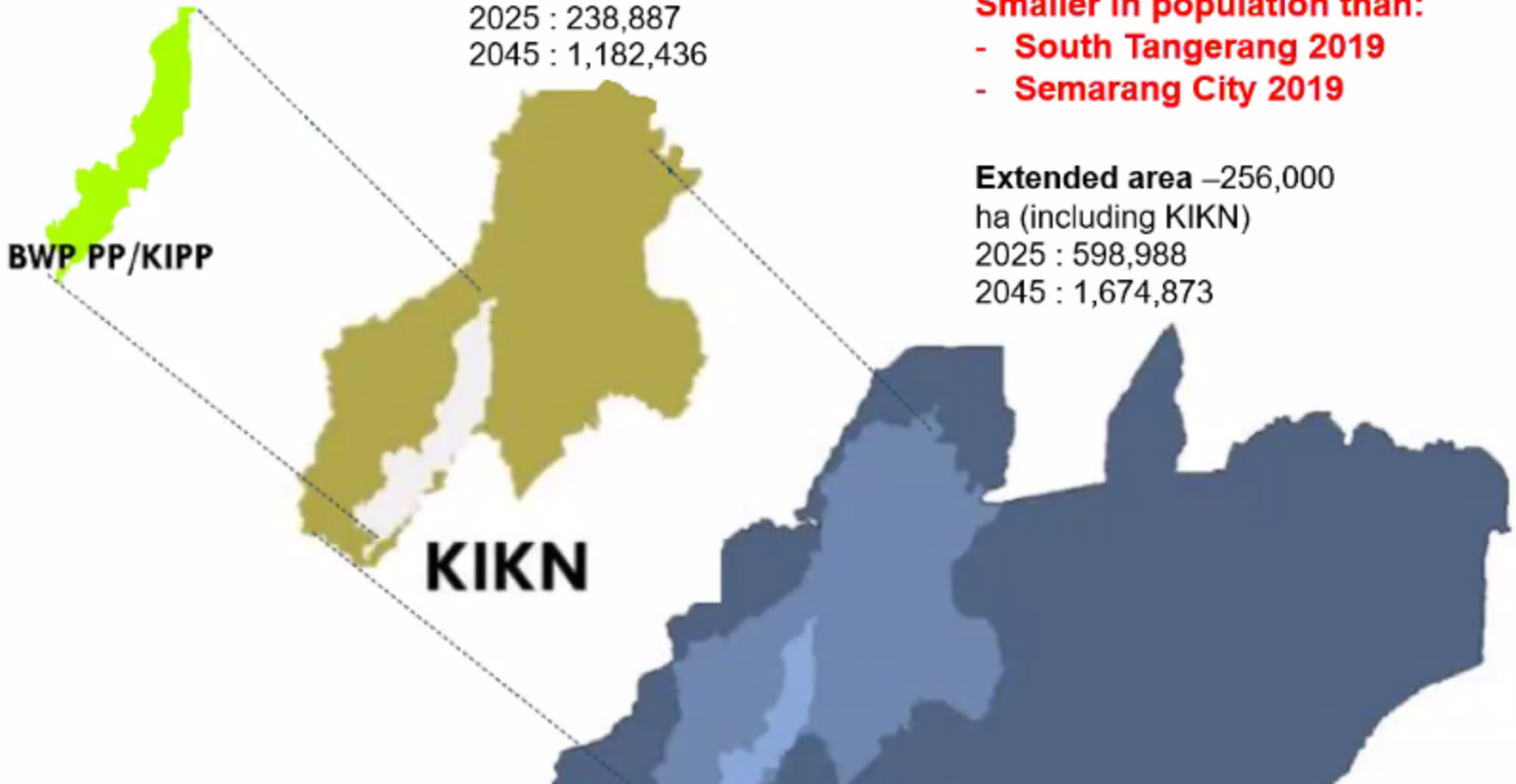
IKN Population plan

KIPP (Center of Government) population:
2025 : 118,424(52,000 civil servant)
2045 : 462,000(210,000 civil servant)

KIKN (New capital area) population -56,000 ha (including KIPP):
2025 : 238,887
2045 : 1,182,436

Smaller in population than:
- **South Tangerang 2019**
- **Semarang City 2019**

Extended area –256,000 ha (including KIKN)
2025 : 598,988
2045 : 1,674,873



Cluster	Pop
No of Pop inside 56,000 ha area	**23**
Governmental	11
Civil servant	5
Family member	6
Education	
High education	
Student	
Family member	
Health	
Pharmacy products	
Health service	
Family member	
R&D, Industry, Tech	7
Solar energy	2
Digital industry	
Biodiesel	
Agriculture 3.0	
Family member	3
Tourism	3
Tourism employee	1
Family member	1
No of pop outside IKN 56k ha area	**36**
Industry	**16**
Oil and gas	
Petrochemical	
Other sector	16
Existing city	**19**
Samboja county	7

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Connectivity

BASIC INFRASTRUCTURE

Challenge: Accessibility and Mobility

Provision of Transport Mode Options (road, rail, air, water)

The transport mode provision will provide people with many options to transport

Air, sea, land transport capacity improvement

Capacity improvement is very important to provide transport for increase number of

Strengthen the connectivity to Java, Bali, Sumatera and to other country

Most traffic is predicted from outside the island, therefore need to strengthen the

Sa

K

Bali
Cit
Ka

Challenge: New Transport Infrastructure Developme

Location and system choice

Location choice of new VVIP airport, national and toll road planning, railway system

Anticipation of new and unpredictable development

Anticipation of new and unpredictable development need to be identified now, by

Funding

Funding aspect has to be identify, especially related to sustainable and continuity while

Challenge: Air Transport Development

Capacity improvement

Improve the capacity of existing airports (Sepinggan, APT Pranoto airport) to

Development of new VVIP Airport

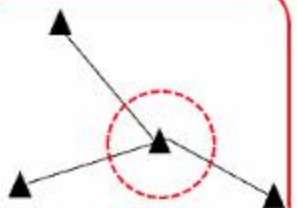
VVIP/state flight needs airport with small capacity but with high capability to handle

Multi airport system

The airports must be operated as multi airpo with coordination in te of air space, flight

Airport System

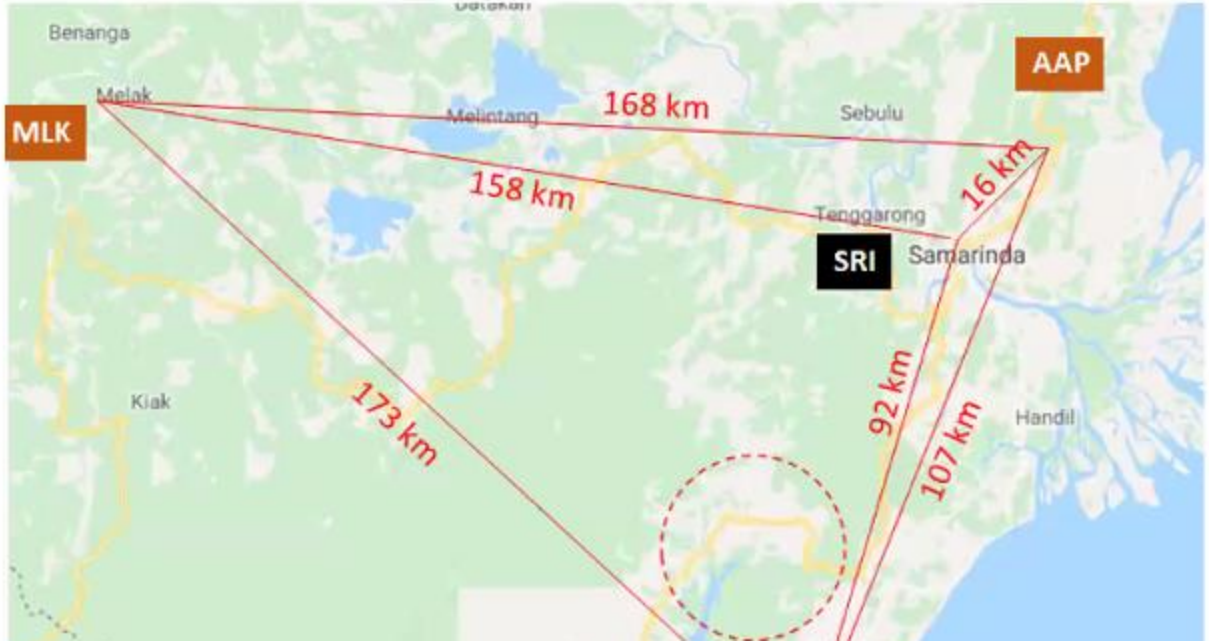
MULTI AIRPORT SYSTEM



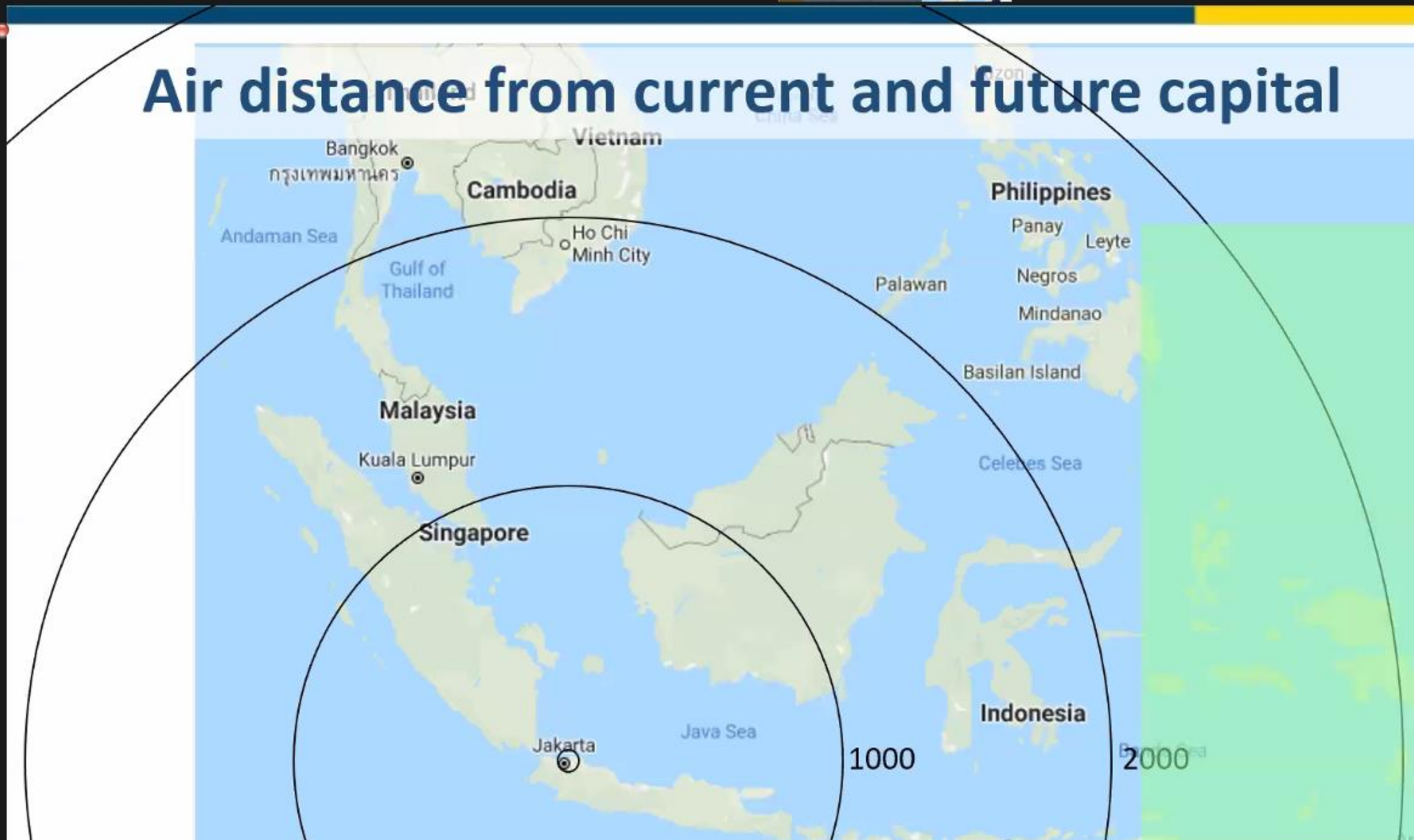
RUANG UDARA KHUSUS

KAPASITAS CUKUP

- **Pintu gerbang negara**
- Kegiatan kenegaraan dan pemerintahan
  - Pergerakan pesawat tamu dari luar negeri, pemerintah di tingkat utama
  - Pergerakan perjalanan pejabat negara: presiden/wakil presiden, DPR/
  - Homebase untuk pesawat-pesawat negara
  - Pangkalan TNI AU/AD/AL
- Kegiatan sipil/komersial
  - Pegawai pemerintah baik pusat maupun daerah
  - Masyarakat umum pengguna angkutan udara



Air distance from current and future capital



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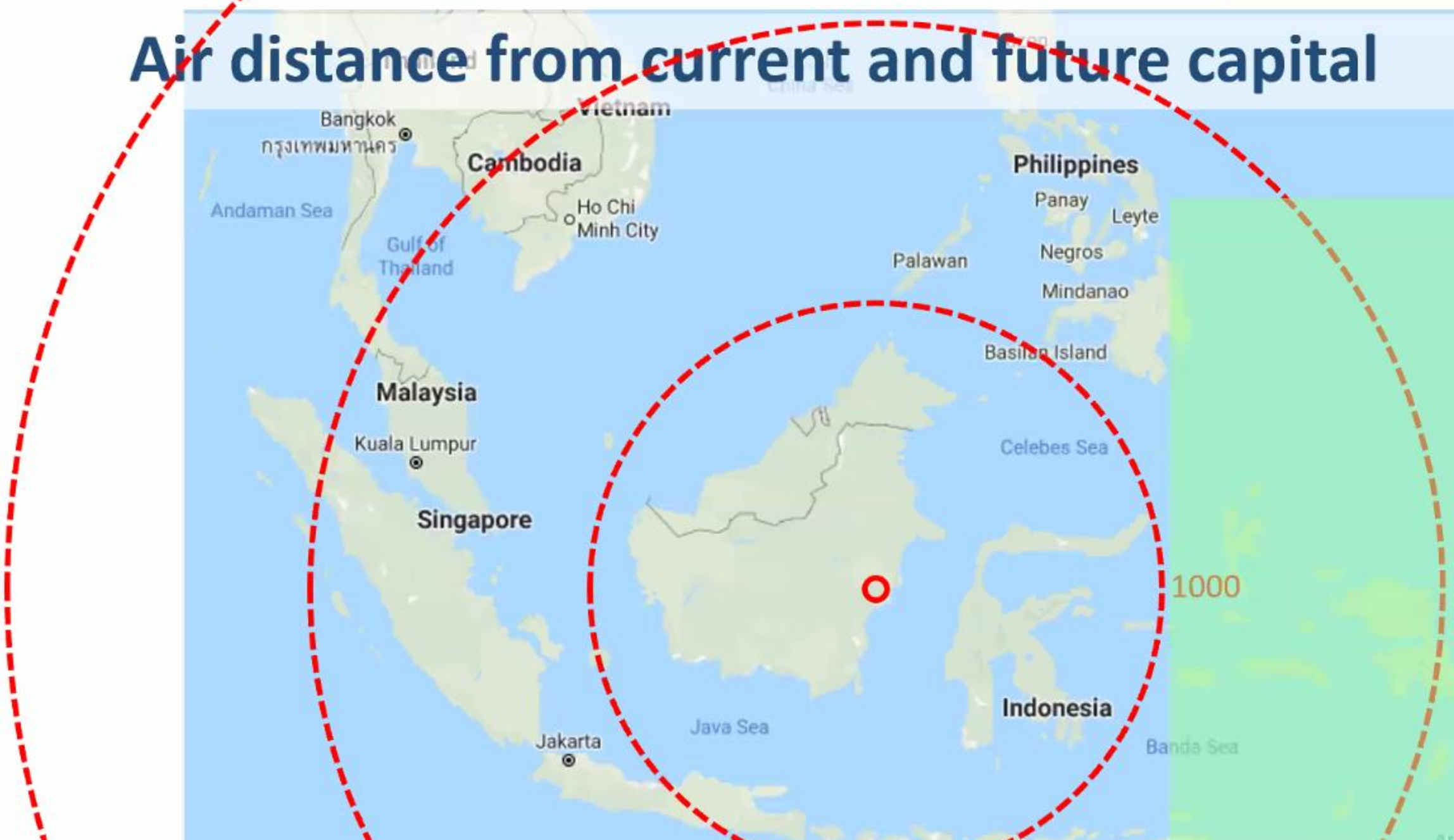

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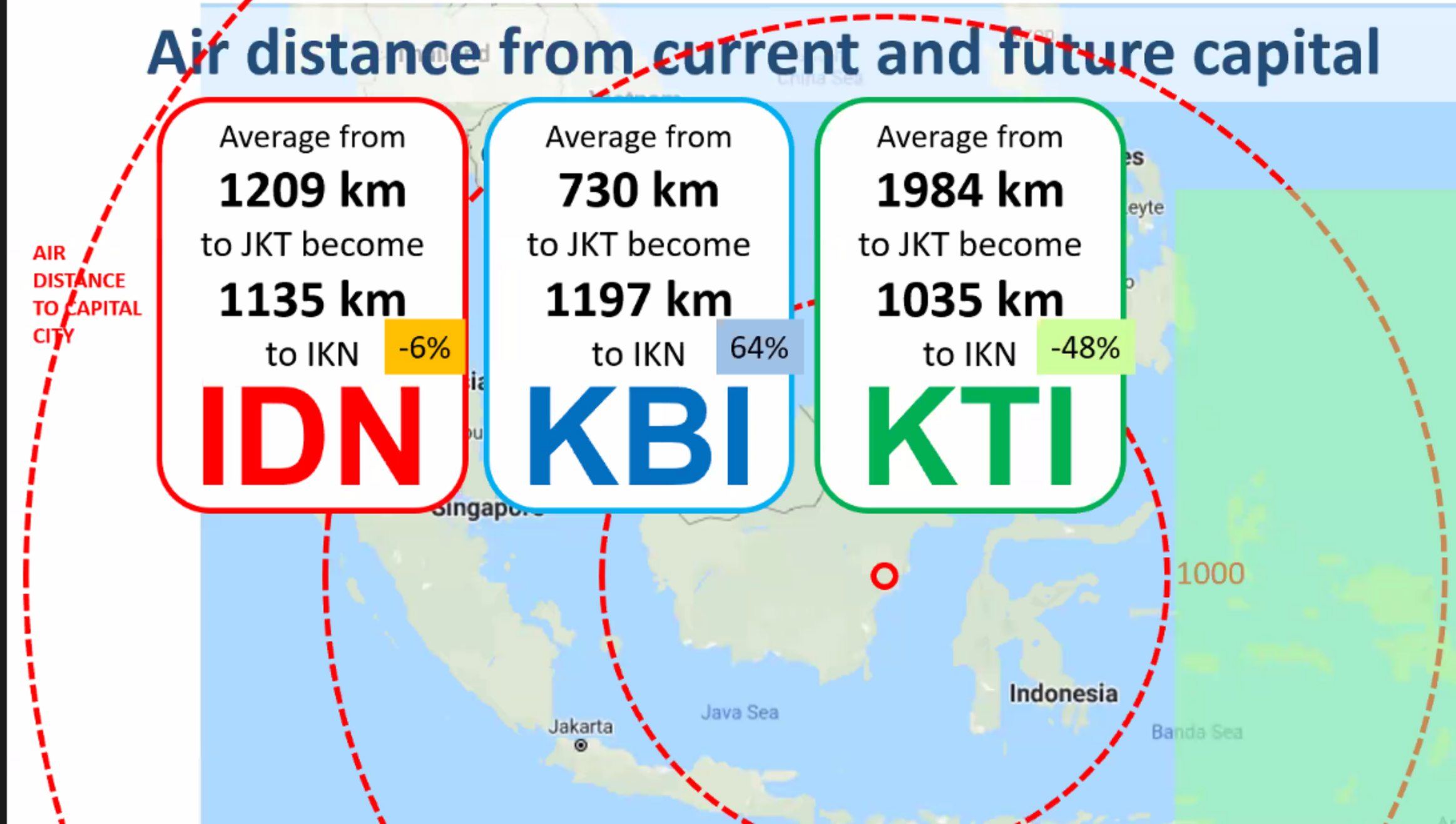

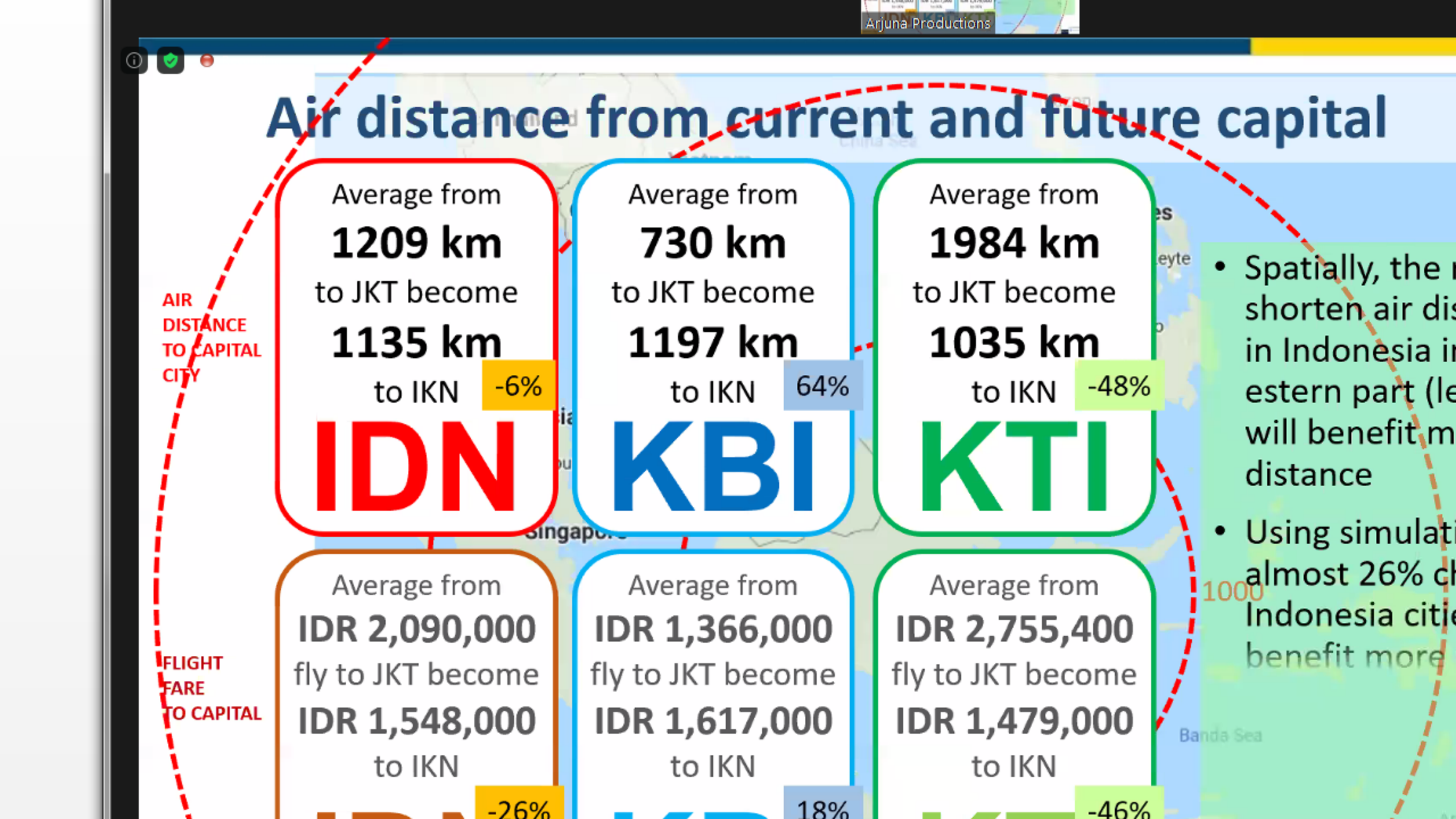
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Air distance from current and future capital
AIR DISTANCE TO CAPITAL CITY
Average from
1209 km
to JKT become
1135 km
to IKN
-6%
IDN
Average from
730 km
to JKT become
1197 km
to IKN
64%
KBI
Average from
1984 km
to JKT become
1035 km
to IKN
-48%
KTI
FLIGHT FARE TO CAPITAL
Average from
IDR 2,090,000
fly to JKT become
IDR 1,548,000
to IKN
-26%
Average from
IDR 1,366,000
fly to JKT become
IDR 1,617,000
to IKN
18%
Average from
IDR 2,755,400
fly to JKT become
IDR 1,479,000
to IKN
-46%
• Spatially, the
shorten air dis
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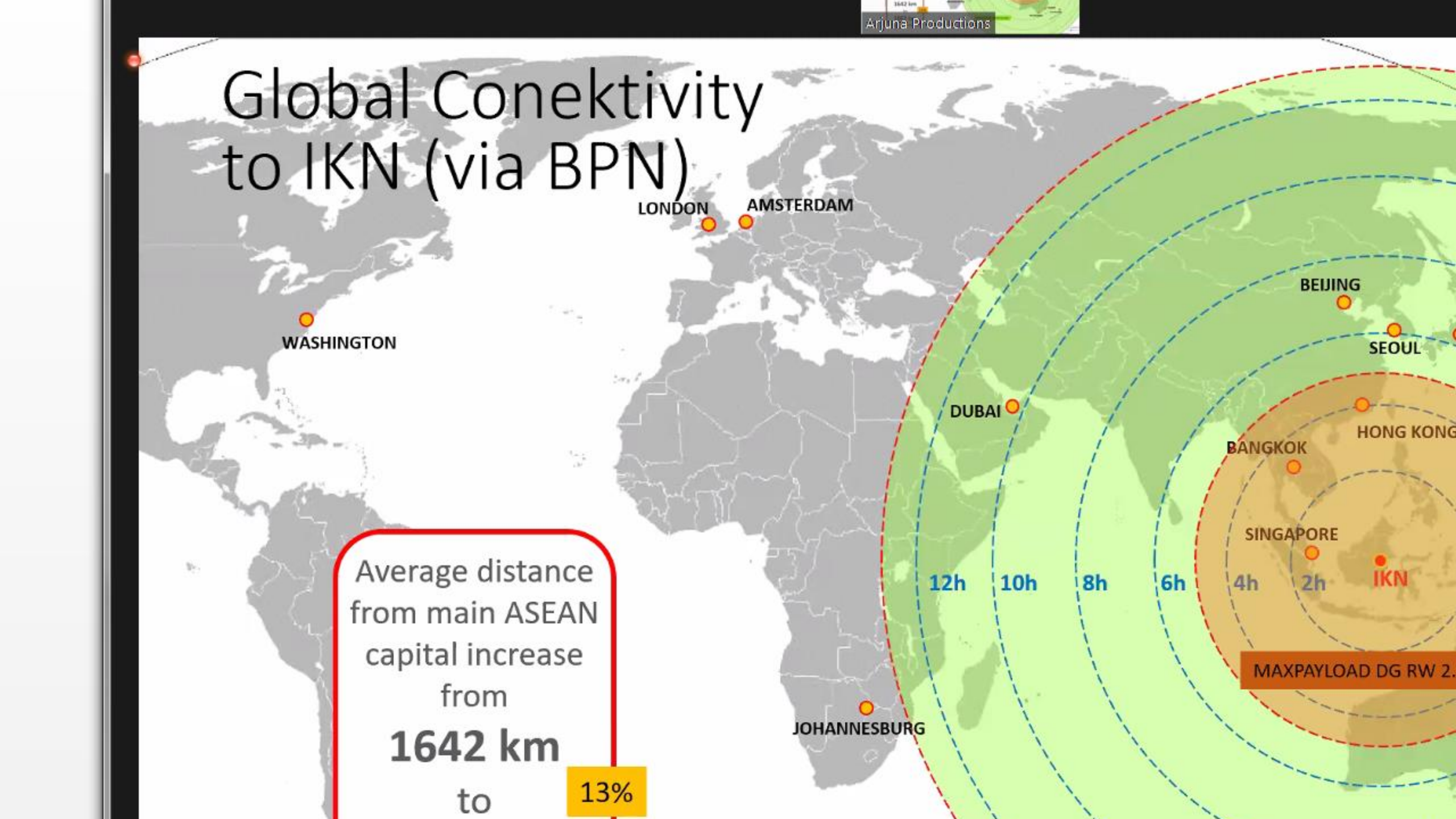
estern part (le
will benefit m
distance
• Using simulati
almost 26% ch
Indonesia citie
benefit more
1000
Banda Sea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Global Conektivity to IKN (via BPN)
LONDON
AMSTERDAM
WASHINGTON
BEIJING
SEOUL
DUBAI
HONG KONG
BANGKOK
SINGAPORE
IKN
12h
10h
8h
6h
4h
2h
MAXPAYLOAD DG RW 2.
JOHANNESBURG
Average distance from main ASEAN capital increase from
1642 km
to
13%

Challenge: Public Transport Development

Public transport city

Planning for city with public transport in

City for active transport

Planning for city with convenient distance for

Landuse control

Landuse control is ver important to make sure

Comparation of Public Transport Modes

System			Cost	Capacity	Development time	Adaptability
Light railway			High	Big	Long	Low
Maglev Rail Transit			High	Relatively big	Relatively long	Low
Medium capacity	Straddle-type monorail		Relatively high	Rather big	Relatively long	Low
	Suspended monorail		Relatively high	Medium	Relatively long	Low
	Trem modern	Trem	Medium	Medium	Medium	Medium
		ART	Low	Medium	Relatively short	Relatively high
BRT system			Low	Low	Short	Relatively high
Traditional bus			Low	Low	Short	High

Challenge: Effective and Efficienct Logistics System

Support for IKN Construction

Logistics system for material supply for construction really needed as most material will be

Support for the operation of IKN

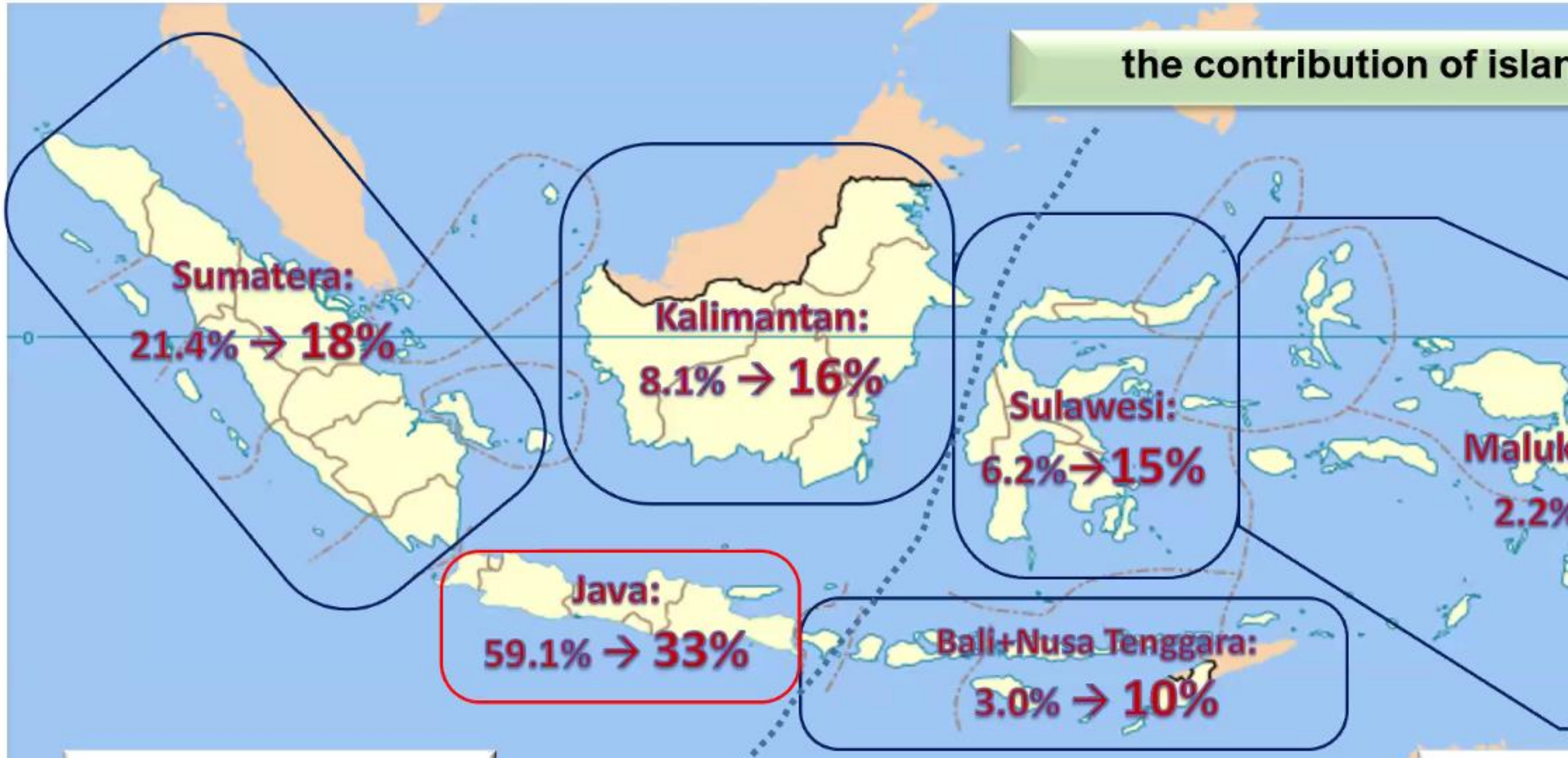
Just in time logistics for supporting the operation of IKN with careful plan-ning of logistics facility, and

Freight transport infrastructure, including logistics hub

Mainly the development of sea, a transport for outer access, and water,

Impact of IKN on Realizing High-Quality and Same-Standard Transportation Infrastructure Service to Solve Disparity

Source : Pustral UGM (2020) and MTI (2020)



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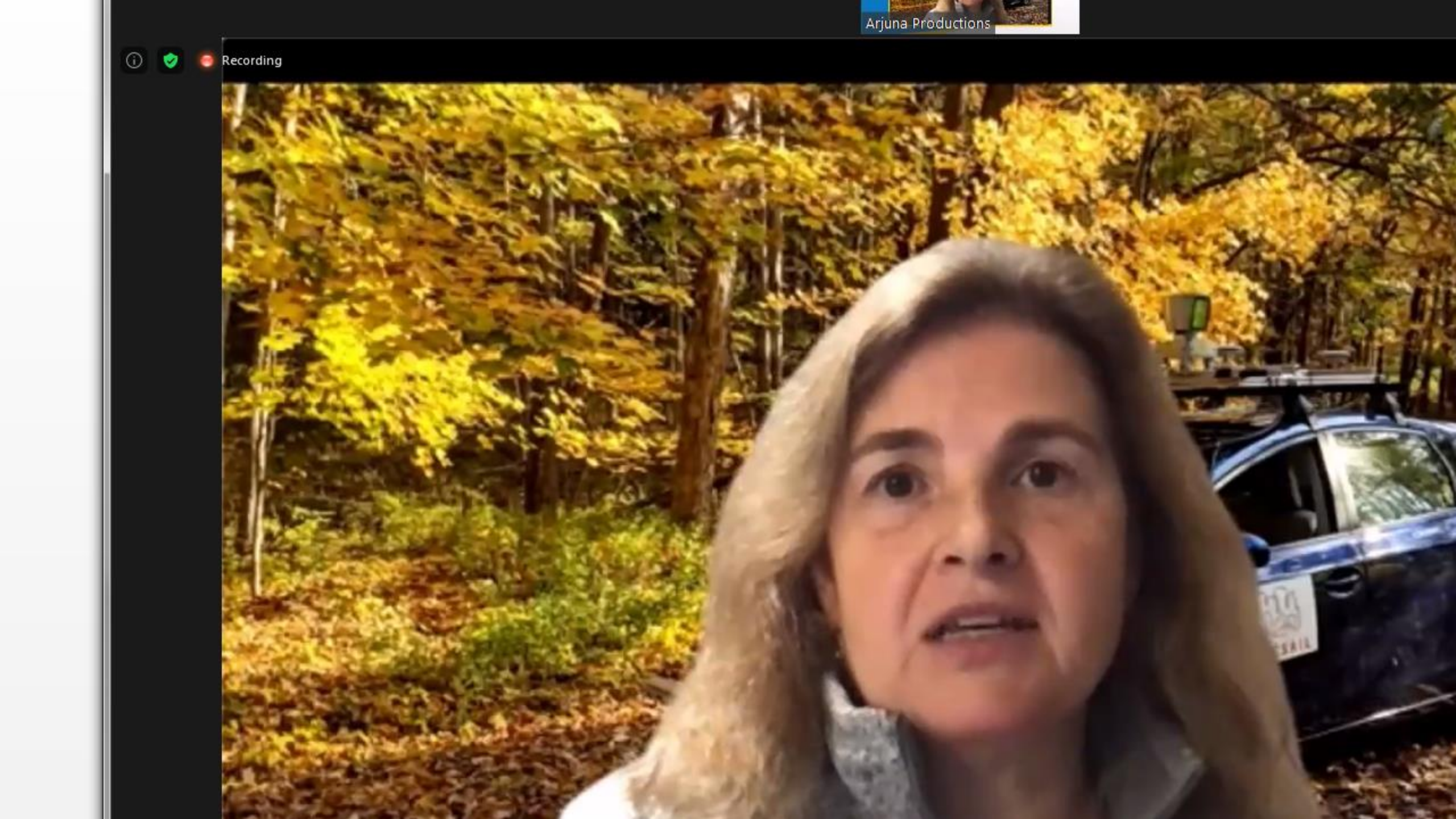
PUSTRAL UGM

Thank you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Recording

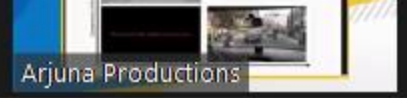
Risk and Social Behavior for Decis
Making for Autonomous Vehicl

Daniela Rus

(with Alexander Amini, Igor Gilitschenski, Teddy Ort, Alyssa Pierson
Wilko Schwarting, Sertac Karaman)

CSAIL, MIT

SMART, MIT



Recording

Autonomous Vehicles: Where are they?

Complexity of Environment

RoboTax

Outline

How can we enable self-driving vehicles to operate in more complex environments?

How can we incorporate risk in the control loop?

How can we handle congestion and interactions with human-driven cars?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Increased Capabilities:
Learning to Drive from Hum

Classical autonomous driving pipeline

Separate problem into smaller sub-modules, tackle each independe

Sensor Fusion
What's happening around me?

Detection
Where are obstacles?

Localization
Where am I relative to the obstacles?

Planning
Where do I go?

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Learning our autonomous controller

Autonomous systems need the ability to handle a wide range of sc
using raw and complex perception sensors

Night-time Driving

No Lane Markings

Rainy We

Leveraging large datasets, we **learn** an underlying representation
driving based on how **humans drive in similar situations**

End-to-End Learning

Learn the control directly from raw sensor data

Learning Algorithm

Sensor Fusion
What's happening around me?

Learned Model
Underlying representation of how humans drive

Slides

ious driving pipeline

nomous controller

ing

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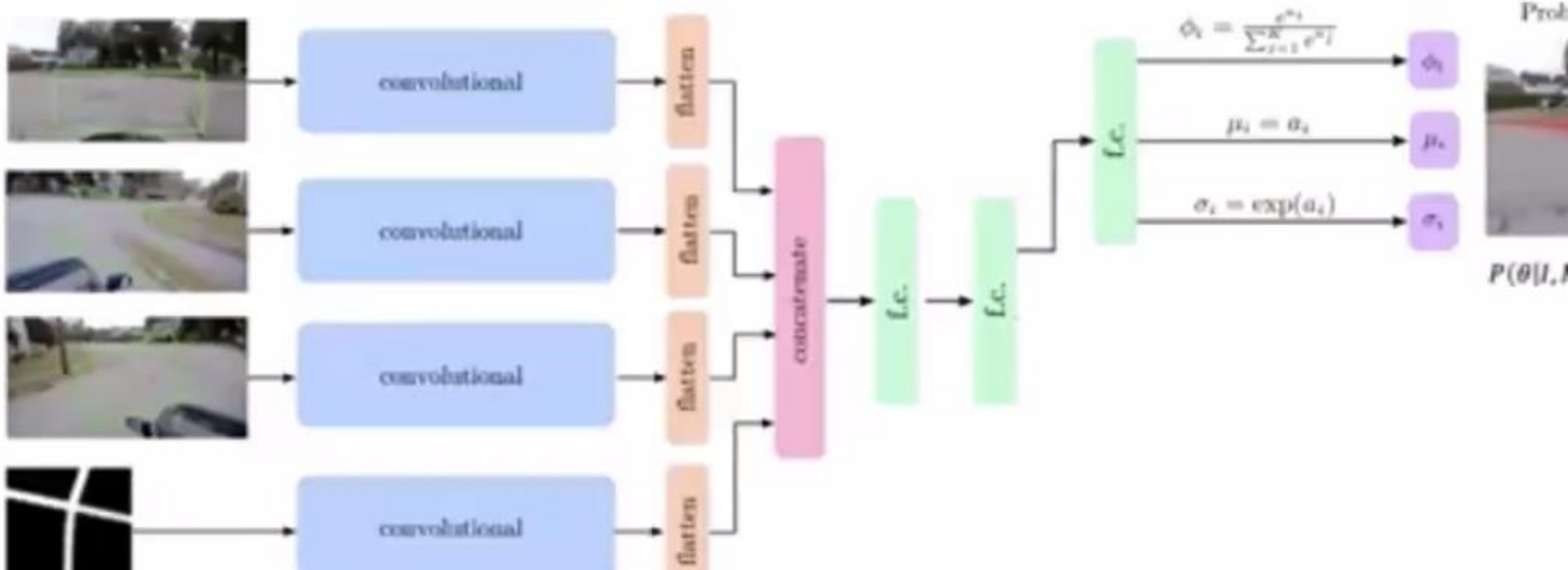
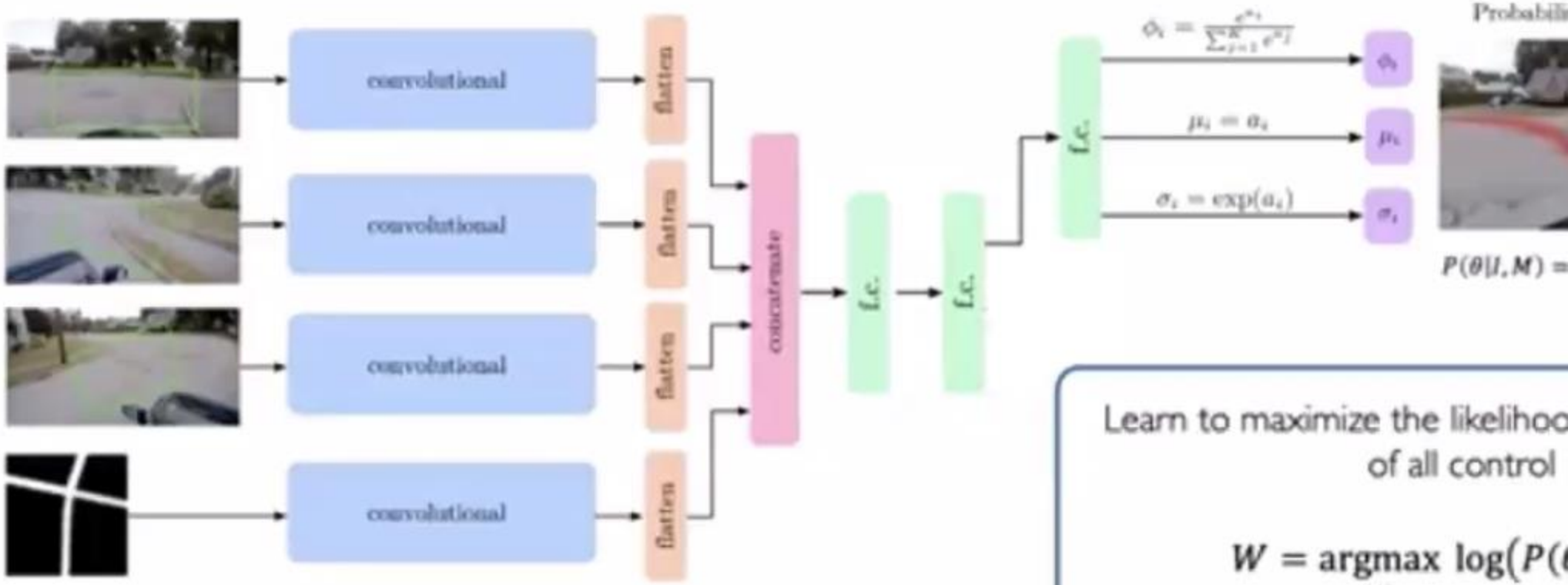
End-to-end optimization formulation

Learn a continuous probability distribution over the space of all control



End-to-end optimization formulation

Learn a continuous probability distribution over the space of all control $P($

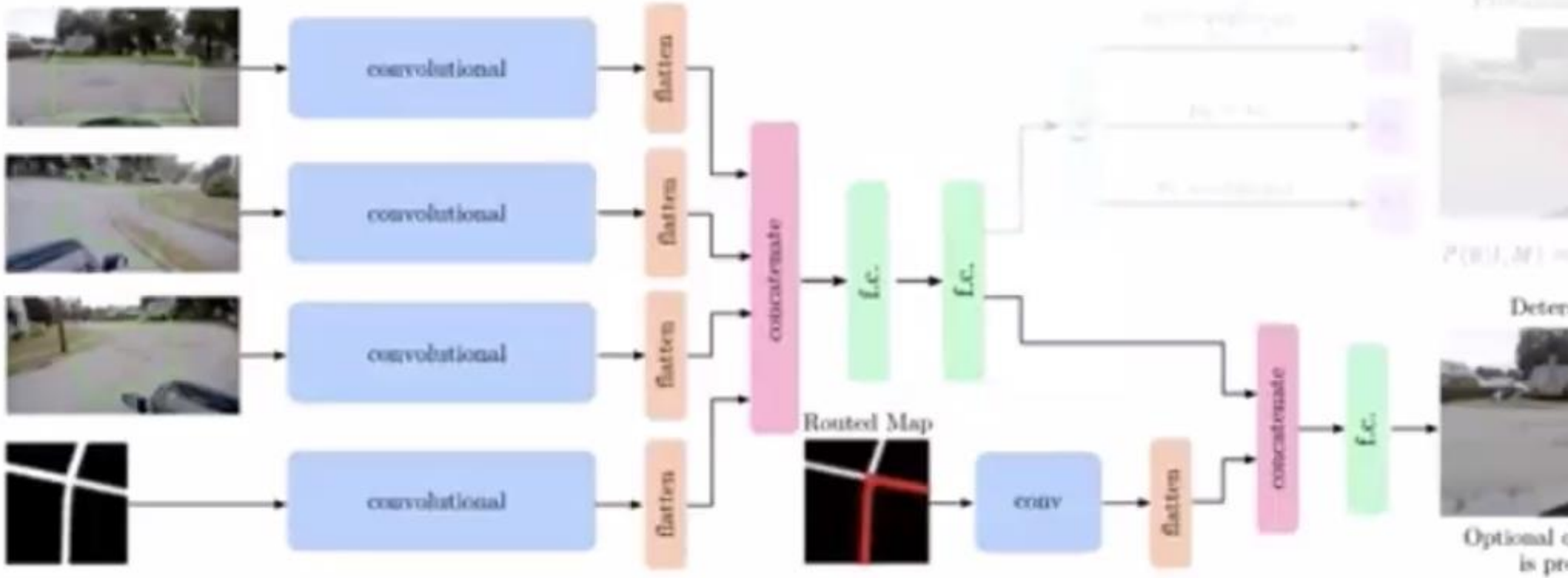


Learn to maximize the likelihoo
of all control

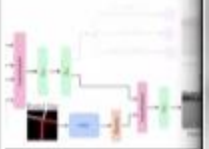
$$W = \underset{W}{\text{argmax}} \log(P($$

End-to-end optimization formulation

Input a route to compute a **deterministic control command** for navig



tion formulation



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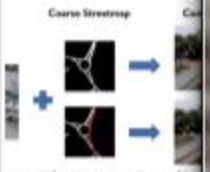

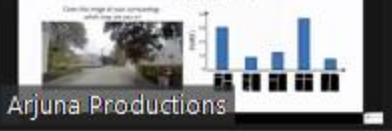

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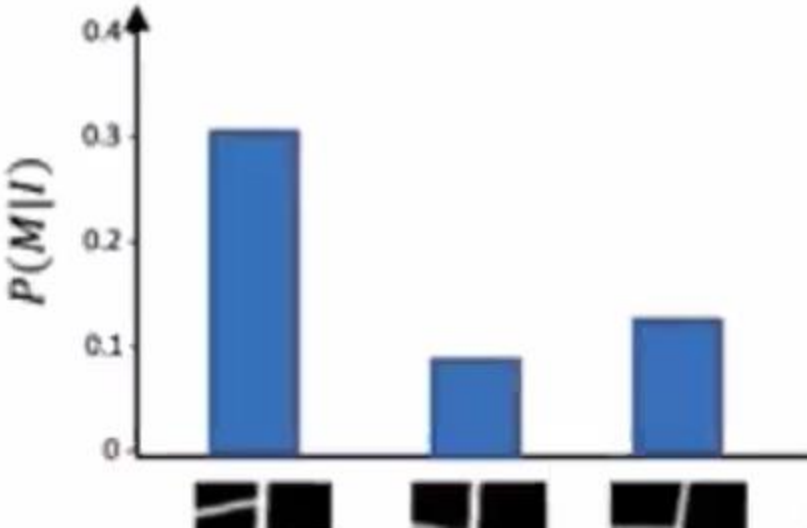
Correcting pose based on visual perceptio

What do we do when our GPS is not accurate or even not available? ⇒ *Vo*

$$P(M|I) = \mathbb{E}_{\theta}\left[\frac{P(\theta|I,M)}{\mathbb{E}_{M'}P(\theta|I,M')}P(M)\right]$$

Given this image of your surroundings
which map are you in?

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Auto OFF

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Increasing Scope of Training with Sim-to-Rea

- End-to-end perception-to-control learning
- Imitate human driving through supervised learning
  - Dangerous to collect data from situations vehicles must be able to handle
  - Requires large amounts of "gold-standard" human driving
  - Difficulty in transferring to new domains, edge cases

- Allow agents to autonomously navigate and learn how to drive **without human supervision**
- Real world edge-cases and safety-critical scenarios

Related Works

Model-based Simulation

- Lacks photorealism
- Does not capture semantic complexity
- Does not transfer to real world (current state of art)
- [CARLA] Dosovitskiy et al (2017)
- [Torcs] Wymann et al (2000)

Domain Transfer

- Possible to transfer to real world
- Transfer limited to textures
- Lacks photorealism and semantic complexity
- [Wayve] Bewley et al (2018)
- Pan et al (2017)

Data-Drive

- Photorealist
- Not scalable driving envi
  - [Gibson] Xia
- Deformities realistic ass
  - [NVIDIA] Bo

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Approach

1. **Photorealistic data-driven simulation** eng
for synthesizing new control trajectories.

2. **Real-world transferable reinforcement le**
End-to-end without human imitation.

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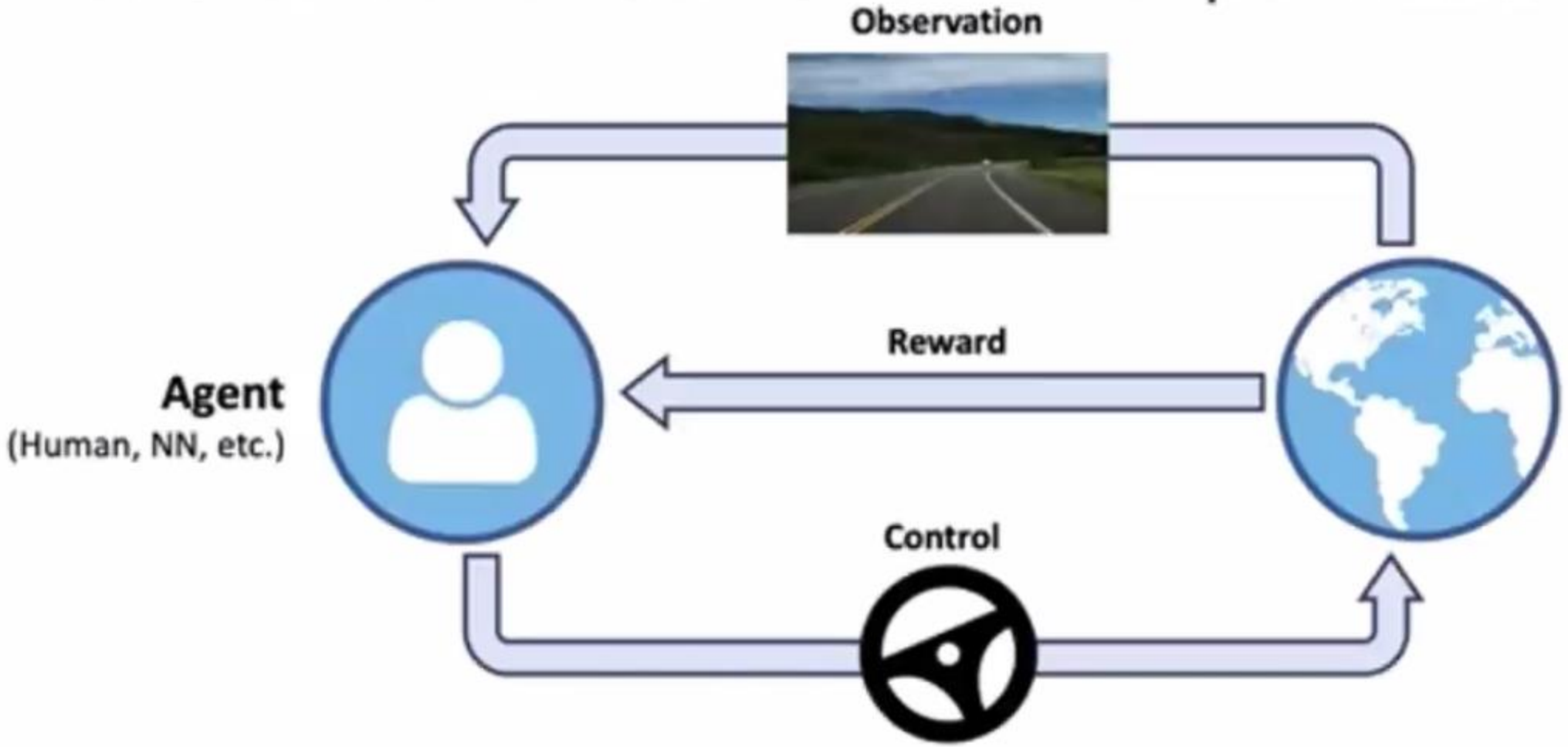
End-to-end without human supervision



Optimizing high level reward functions

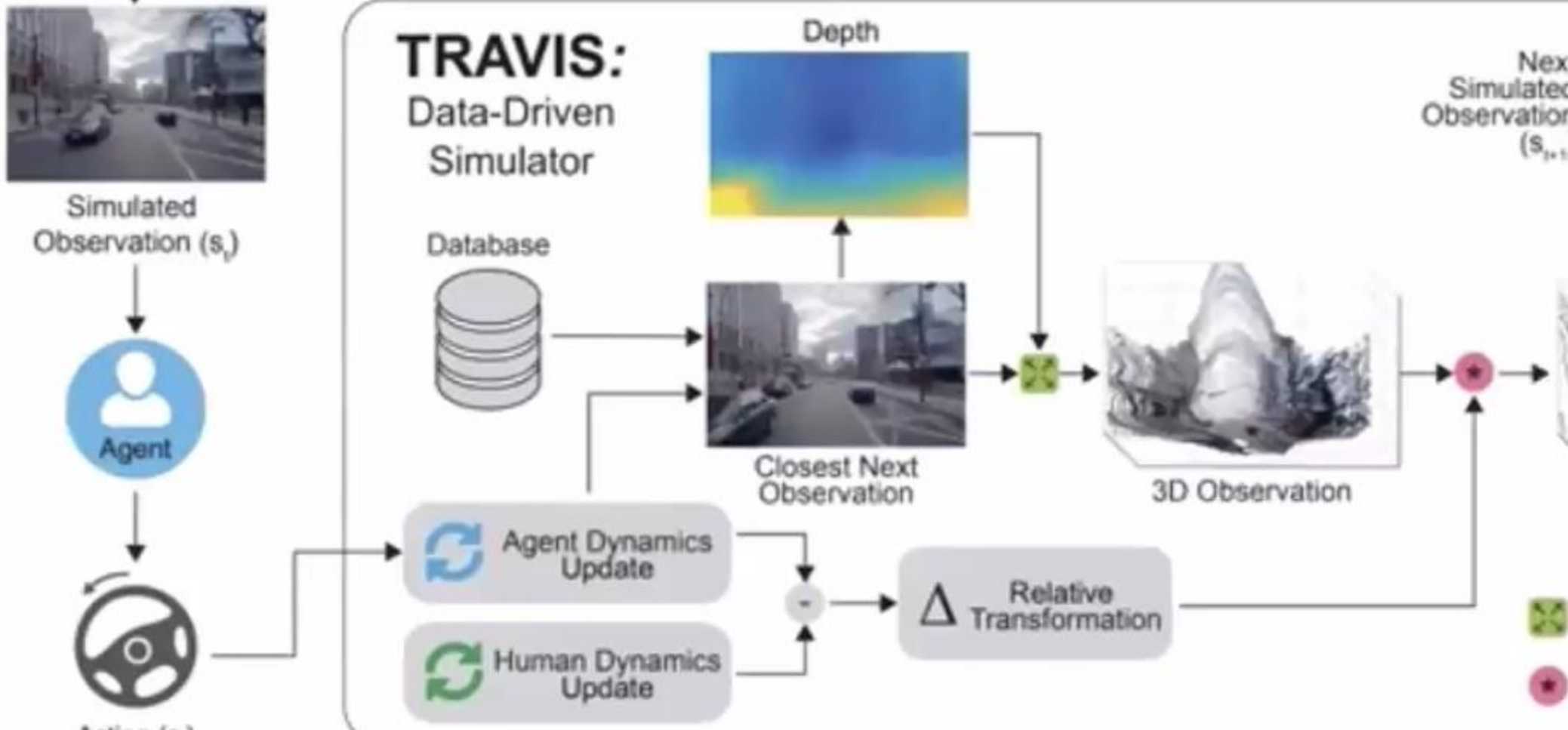
$$r_t = \begin{cases} 1 & \text{if } \|T\| < \varepsilon \\ 0 & \text{otherwise} \end{cases} \implies \text{"crash"}$$

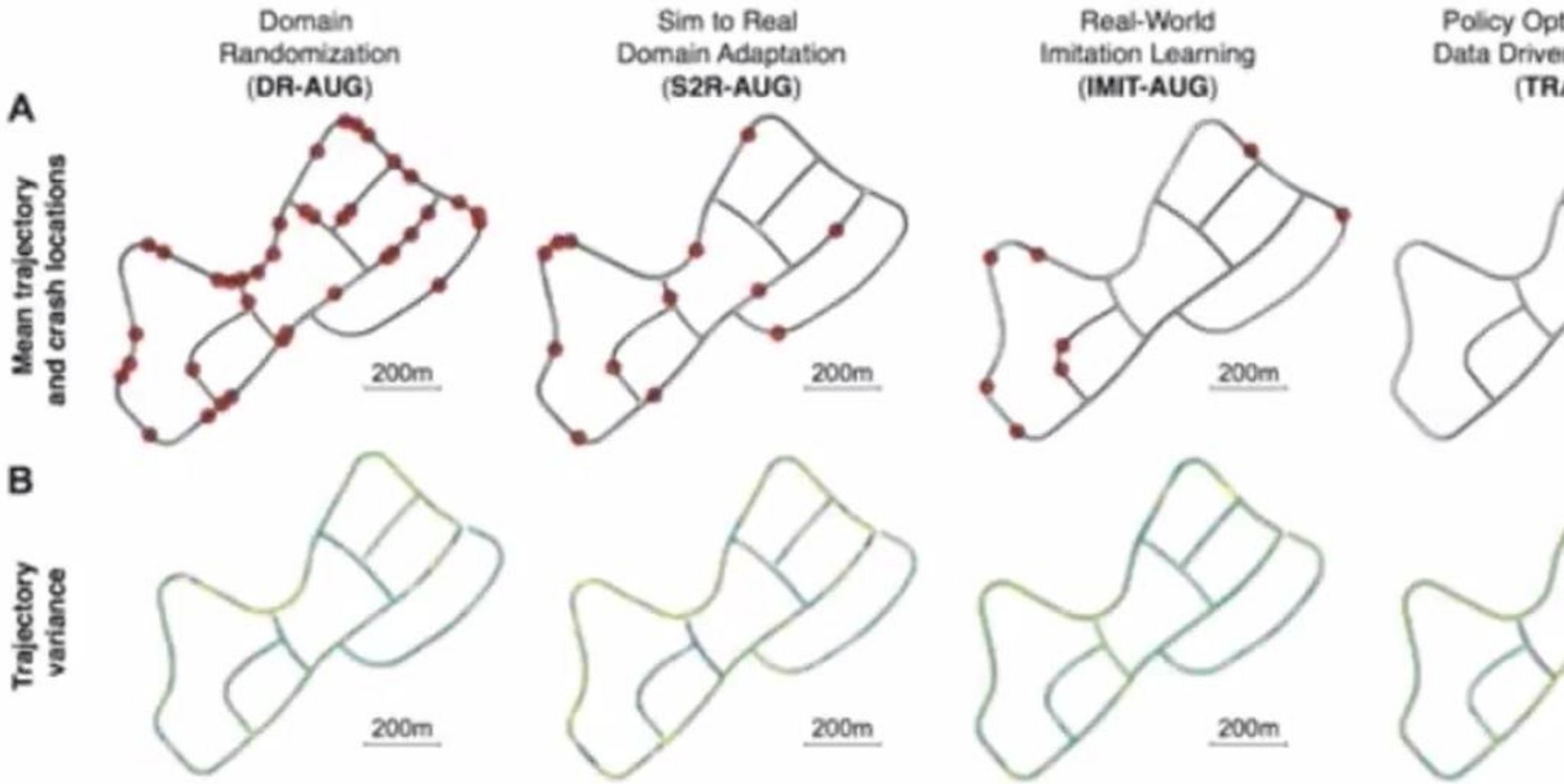
Instead of imitating a human driver, directly **optimize the agent to maximize its ov**

$$\max_{\pi_\theta} \mathbb{E}_{\tau \sim \pi_\theta} \left[\sum_t \gamma^t r_t \right]$$

$$\tau = \{(a_1, s_1, r_1), (a_2, s_2, r_2), \ldots\} \sim \pi_\theta(a_t | s_t)$$

End-to-end without human supervision





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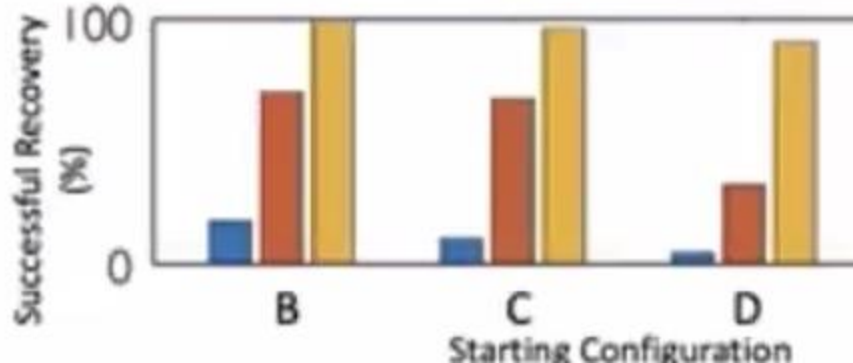
Results

Direct deployment to real-world without any adjustments

Superior robustness to recover challenging off-orientation



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vel reward functions

it human supervision

The Information

Waymo's Big Ambitions Slowed by Tech Trouble

CHANDLER, Ariz.—Alphabet's Waymo unit is a worldwide leader in autonomous vehicle development for suburban environments. It has said it would launch a driverless robo-taxi service to suburban Phoenix residents this year. Yet its self-driving minivan prototypes have trouble crossing the T-intersection closest to the company's Phoenix-area headquarters here.

Two weeks ago, Lisa Hargis, an administrative assistant who works at an office a stone's throw from Waymo's vehicle depot, said she nearly hit a Waymo Chrysler Pacifica minivan because it stopped abruptly while making a right turn at the intersection. "Go!" she shouted angrily, the road, after getting stuck in the intersection

WIRED

Why People Keep Rear-E Driving Cars

Human drivers (and one cyclist) have rear-ended se California—accounting for nearly two-thirds of robo

When self-driving cars crash, they're

Slides

Arjuna Productions

Social Value Orientation (SVO) Ring

Capturing Human Preferences in Social Dilemmas

Altruistic: Maximize other party's utility, wit
consideration of own outcome.

Prosocial: Benefiting a group as a whole.

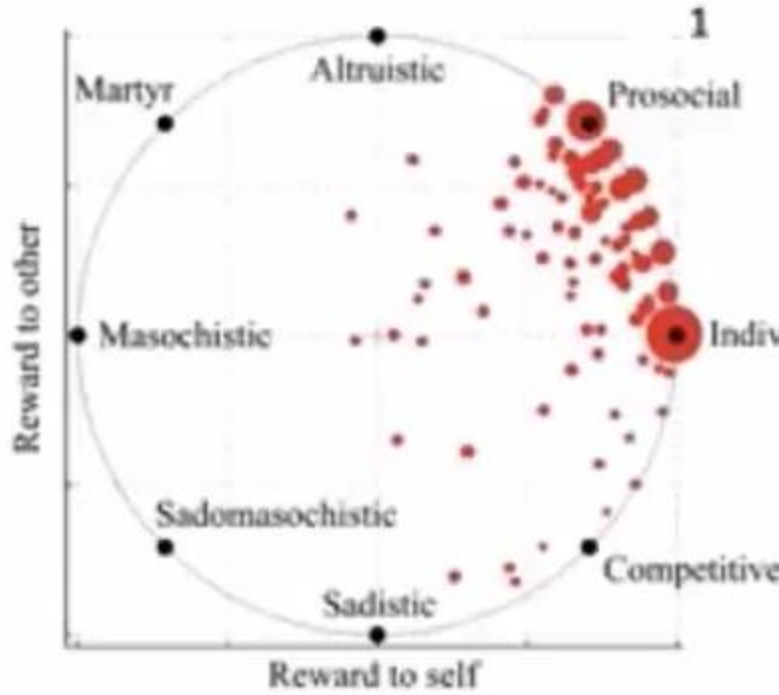
Individualistic: Maximize their own outcome
concern of the utility of other agents.

Competitive: Improve relative gain over oth

Cooperative: All agents are better off.

Social Value Orientation (SVO) Ring

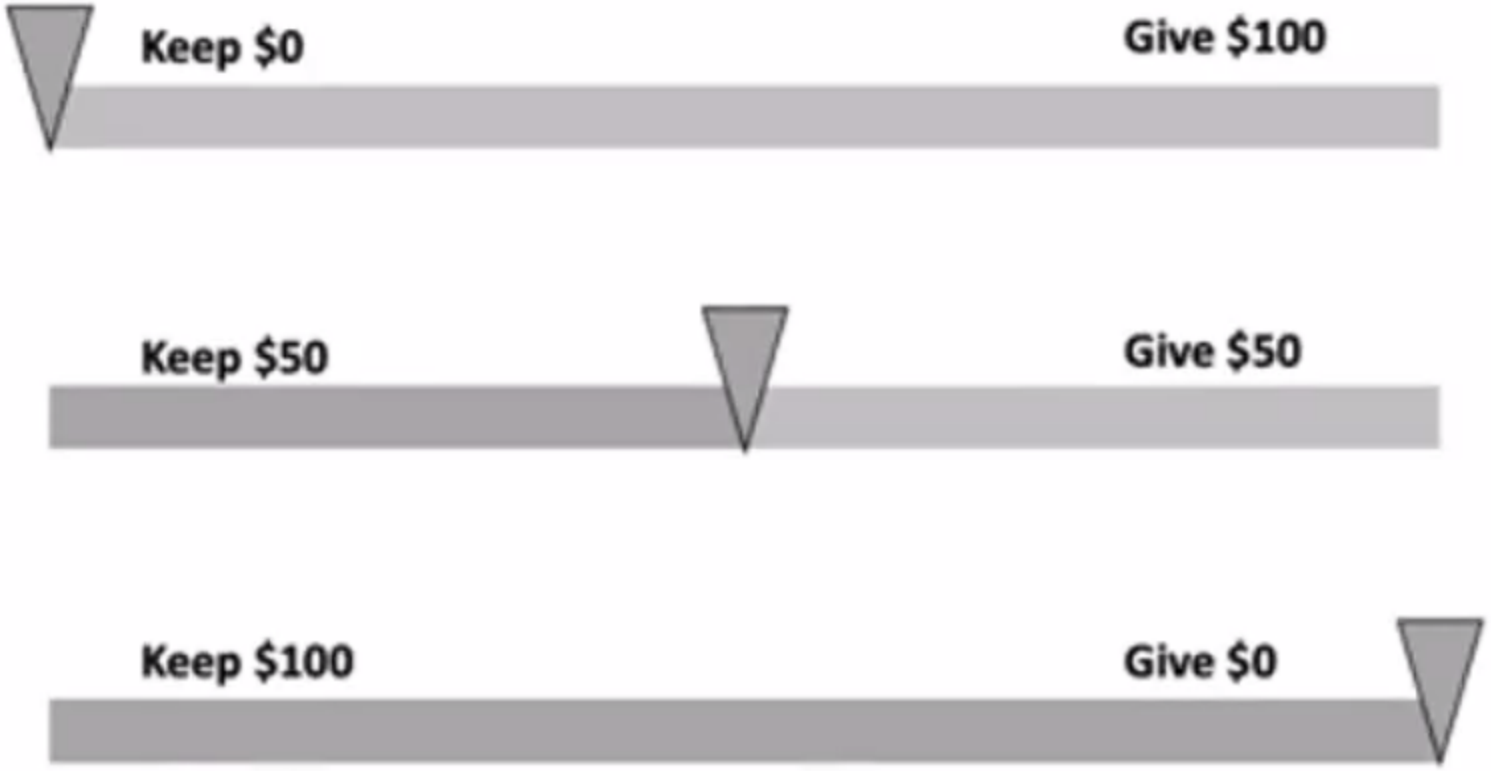
Studies of Human Preferences

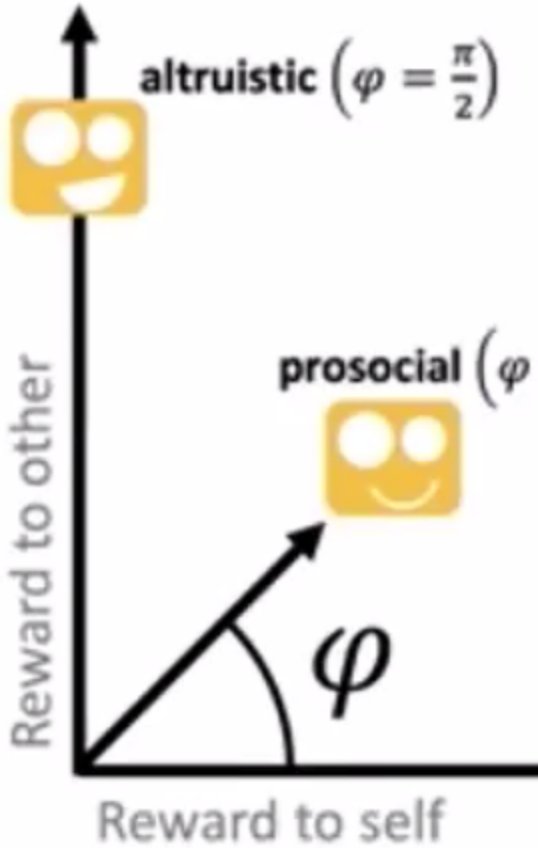


~ 90% of individuals are either prosocial (~ 50%) or individualistic (~ 40%) [2]

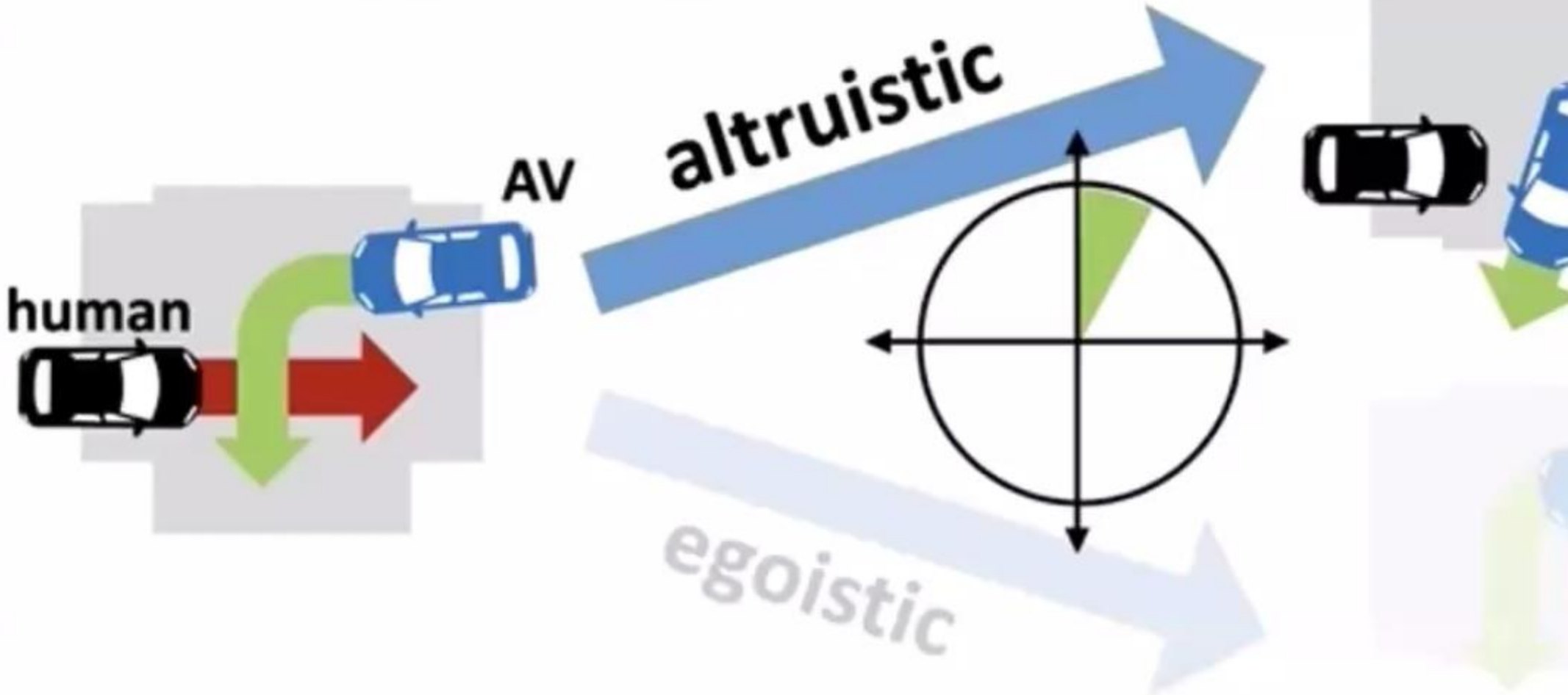
[1] A. Garapin, L. Muller, and B. Rahali, "Does trust mean giving and not risking? experimental evidence from the trust game," Revue d'' economie politique, vol. 125, no. 5, pp. 70
[2] R. O. Murphy, K. A. Ackermann, and M. Handgraaf, "Measuring social value orientation," Judgment and Decision Making, vol. 6, no. 8, pp. 771–781, 2011.

Split $100 with a stranger…





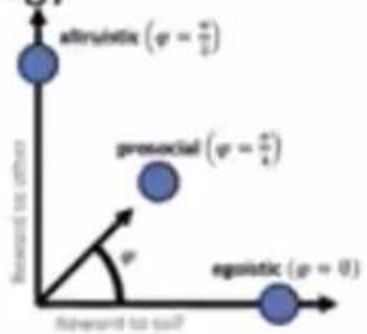
Social Value Orientation



Our Approach

Social Value Orientation

- Behavior model from social psychology



$$g_i(\cdot) = \cos\varphi_i\, r_i + \sin\varphi_i\, r_j$$

- Weight reward to self vs other

Best Response Game

- Each agent maximizes its individual utility

$$G_i(\boldsymbol{x}^0, \boldsymbol{u}, \varphi_i) = \sum_{k=0}^{N-1} g_i\left(\boldsymbol{x}^k, \boldsymbol{u}^k, \varphi_i\right) + g_i^N(\boldsymbol{x}^N, \varphi_i)$$

$$\boldsymbol{u}_i^* = \underset{\boldsymbol{u}_i}{\operatorname{argmax}}\, G_i(\boldsymbol{x}^0, \boldsymbol{u}_i, \boldsymbol{u}_{-i}, \varphi_i)$$

- Solve for Nash Equilibrium

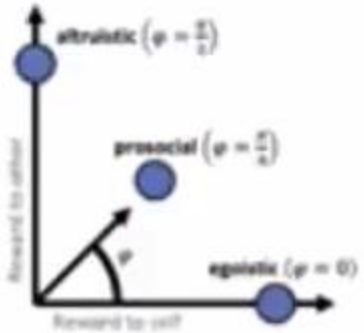
Learned

- Inverse Reinforce
- Calibrate reward set

Utility-Maximizing Policy with SVO

- Joint reward weighted by SVO

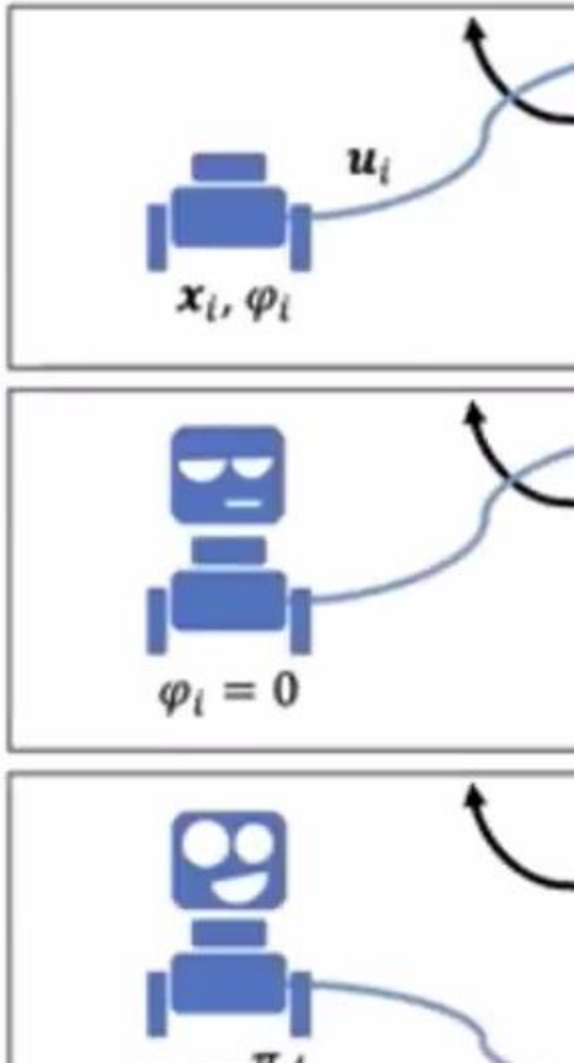
$$g_i(\cdot) = \cos\varphi_i\, r_i + \sin\varphi_i\, r_j$$



- Utility over time horizon

$$G_i(\boldsymbol{x}^0, \boldsymbol{u}, \varphi_i) = \sum_{k=0}^{N-1} g_i(\boldsymbol{x}^k, \boldsymbol{u}^k, \varphi_i) + g_i^N(\boldsymbol{x}^N, \varphi_i)$$

- Find control $\boldsymbol{u}_i^*$ that maximizes utility



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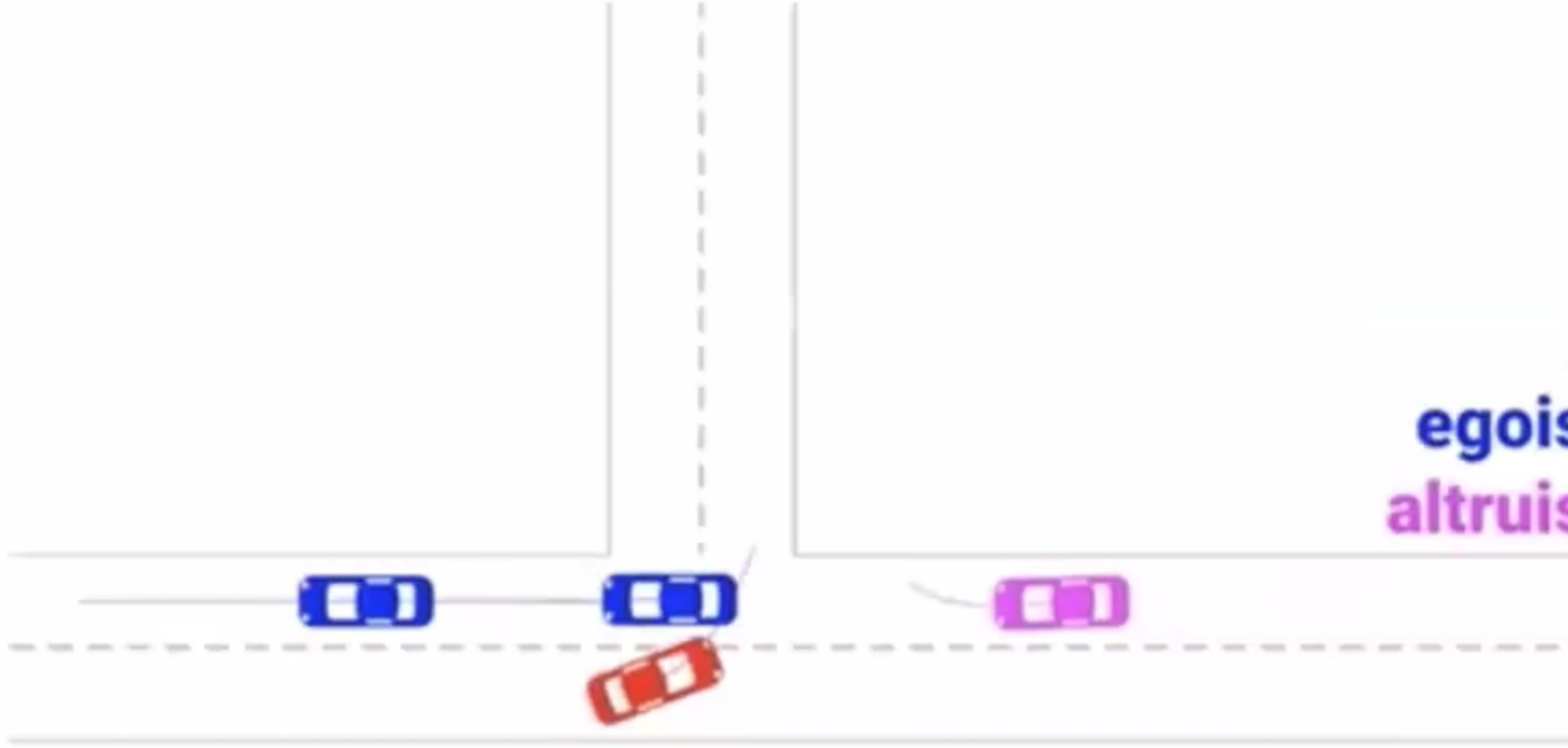
Unprotected Left Turns

The AV must wait for an altruistic driver to yield



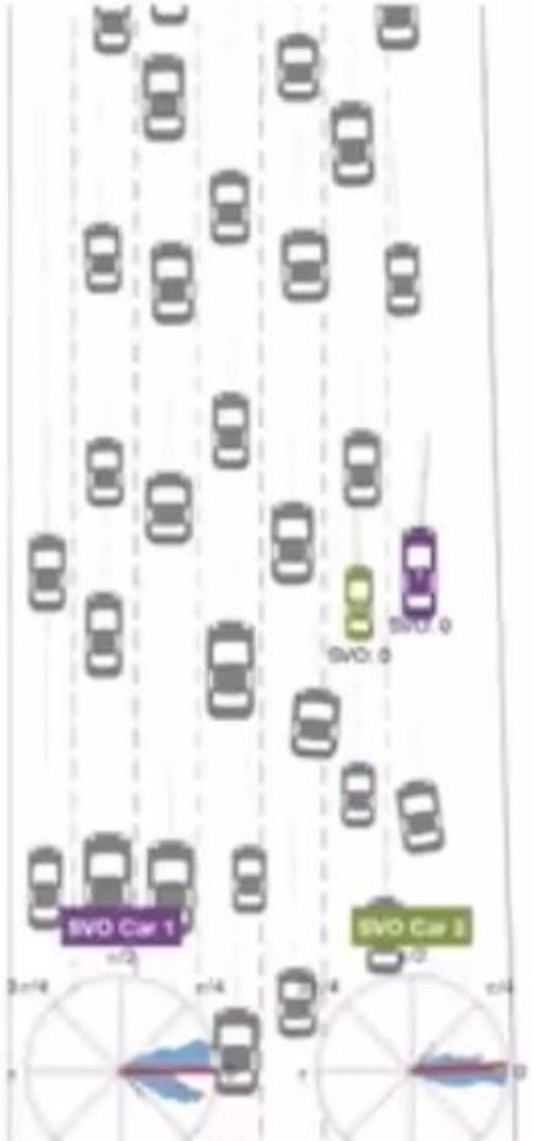
Prosocial Merge

Prosocial drivers create a gap for the AV to merge

Estimate SVO online

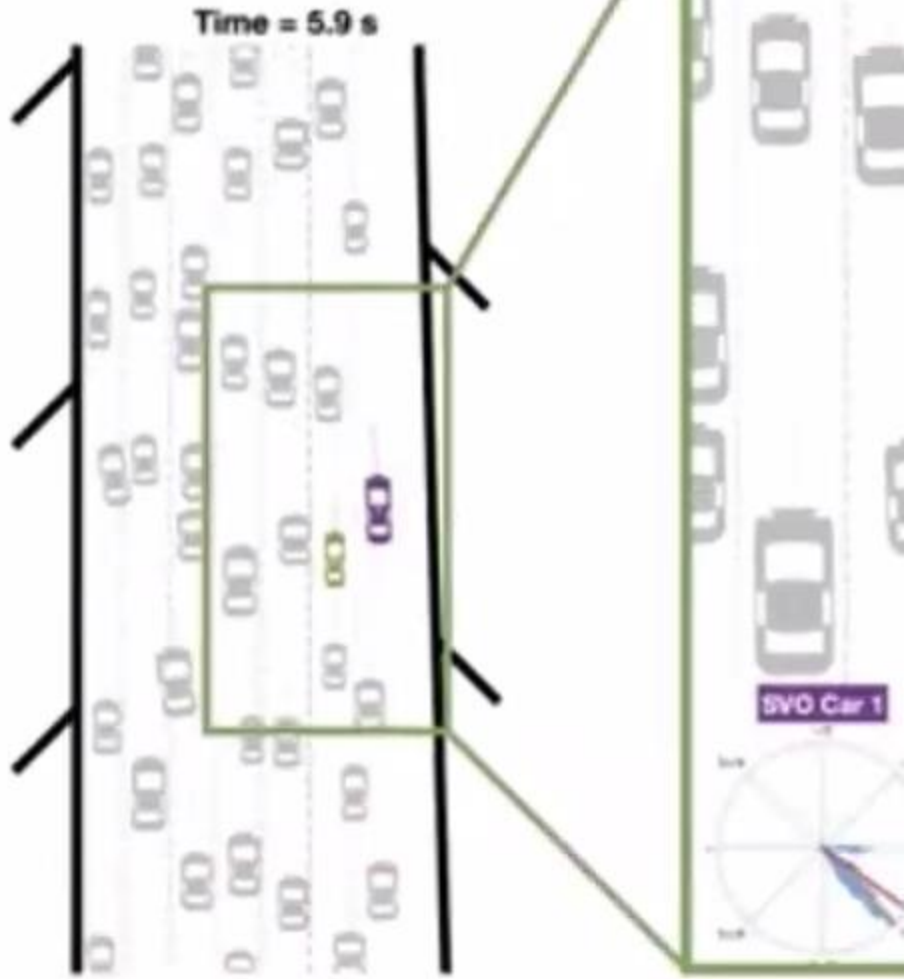
Estimate SVO of other drivers online

Integrate into motion planner to improve decision-making and predictions

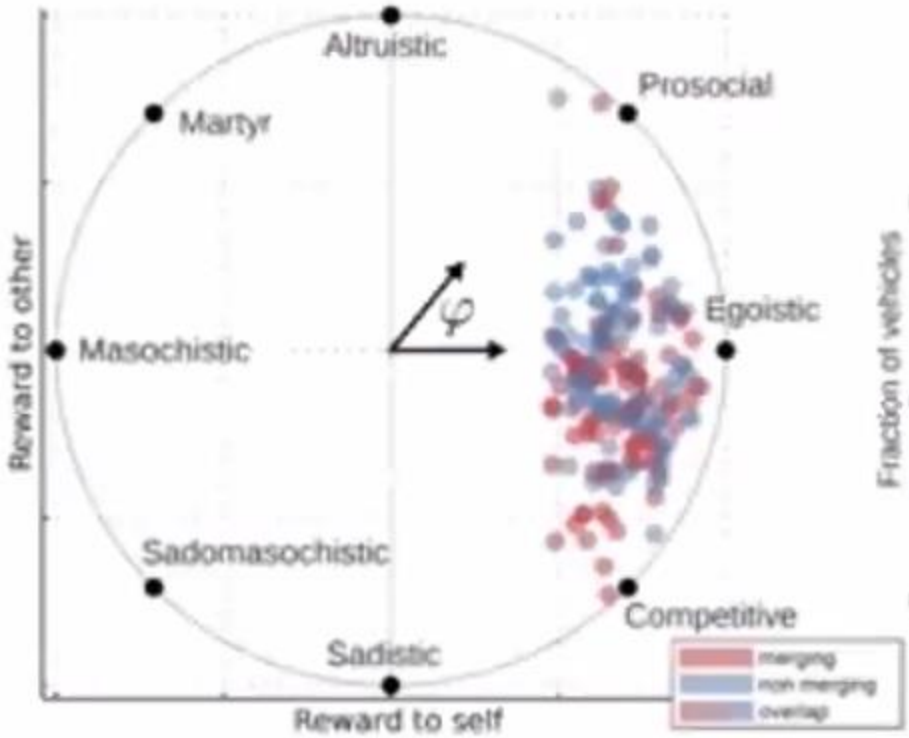


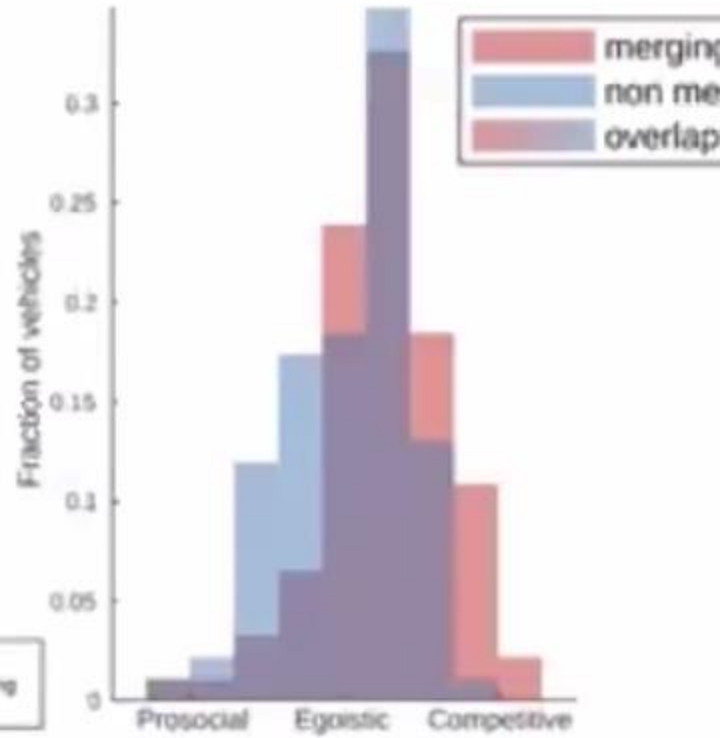
SVO Predictions on NGSIM

Estimating driver SVO improves trajectory predictions by 25%



SVO Trends in NGSIM dataset

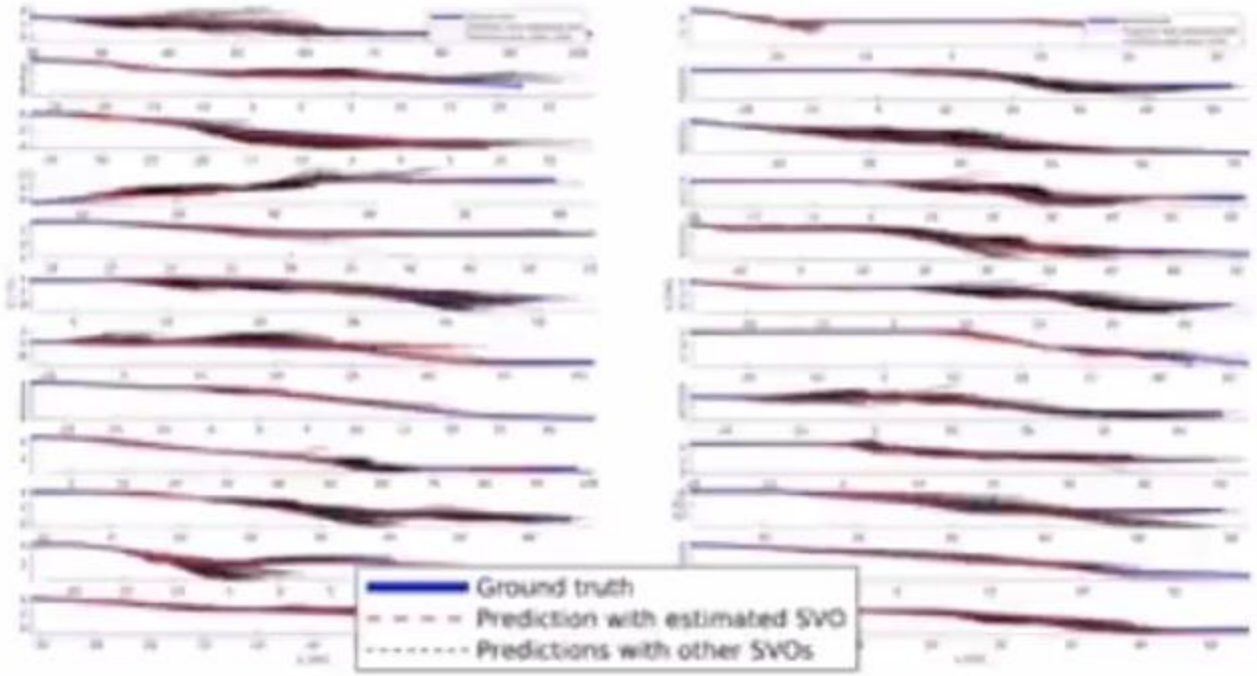




Merging vehicles are more competitive than non merging vehicles ($p < 0.002$)

Evaluation of SVO on NGSIM dataset

Improved prediction with dynamically estimated SVO during m



Prediction	baseline	multi-agent
SVO	-	egoistic stat
MSE position	1.0	0.947 0.82

Table 1. Relative mean square position error and actual trajectories, as compared to a single

25% reduced prediction error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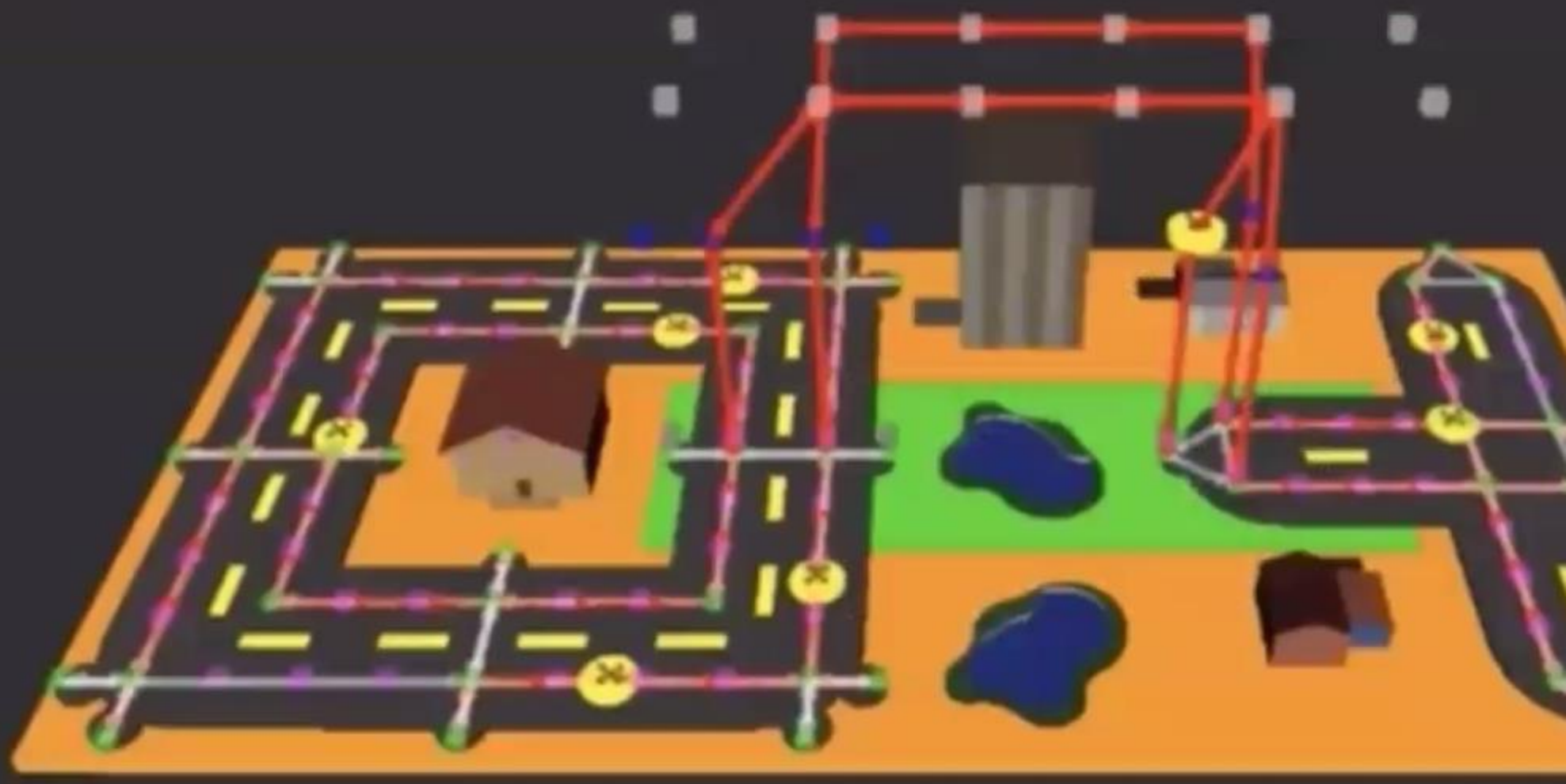
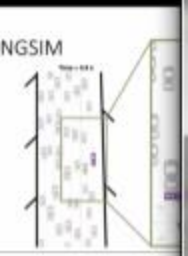
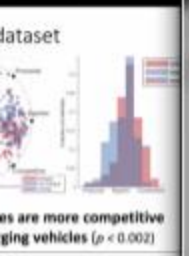
Ground travel is energy efficient, but
is slow and offers limited mobility

Arjuna Productions

Our system plans paths
both flying and driving




NGSIM


dataset
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ging vehicles ($p < 0.002$)


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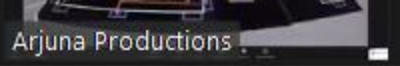
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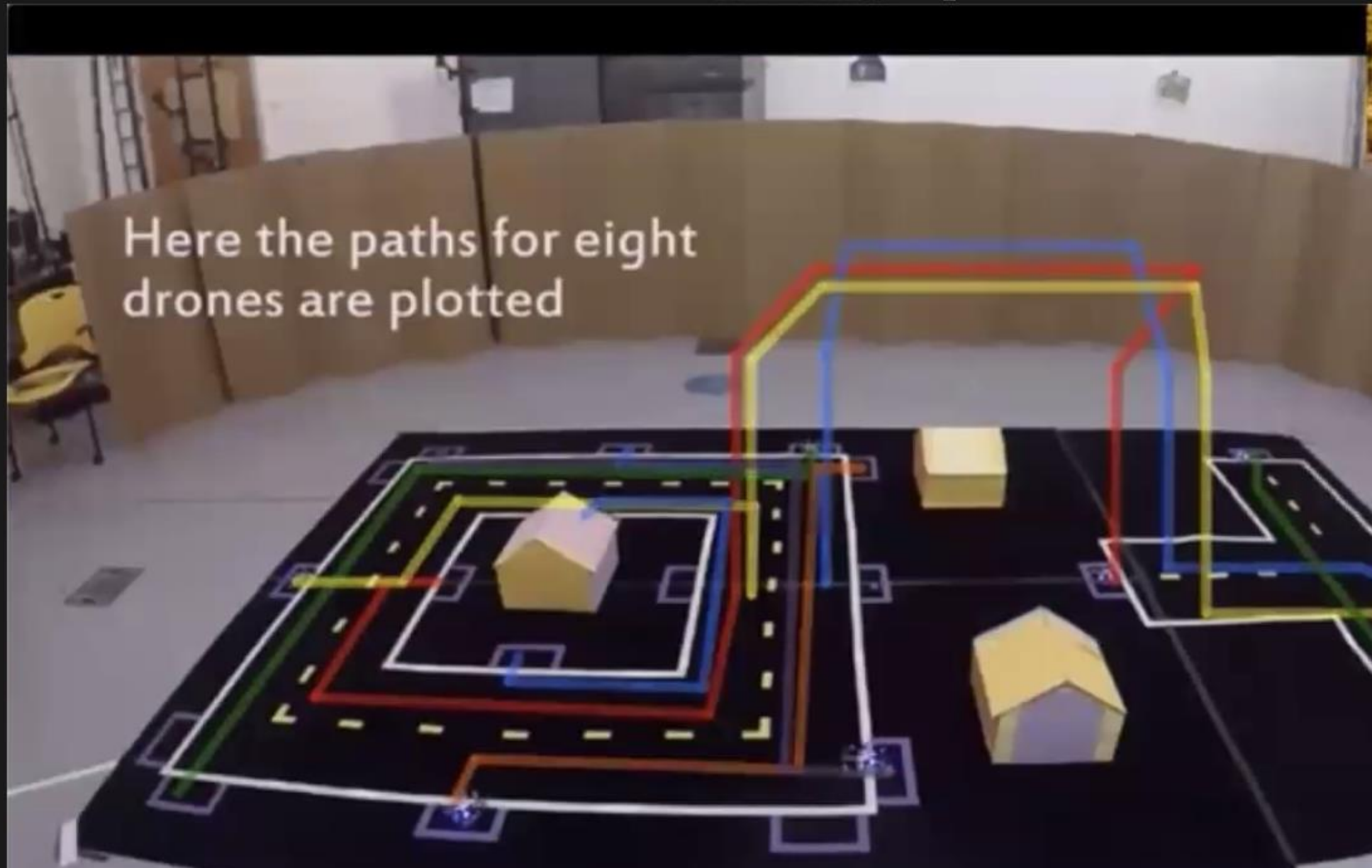
Here the paths for eight
drones are plotted

•The Future: Pervasive self-driving (flying)

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Conclusions

- Today: self-driving cars at low speed i low complexity environments
- Tomorrow: increased speed and complexity, mobility as a service
- The Future: Pervasive self-driving (fly cars, pervasive robotics

INTERNATIONAL WEBINAR

Development in the New Capital City of Indonesia : Planning For Technology Implementation of Autonomous Electric Vehicle for the New Capital City

Arjuna Productions

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1

Electric-based sustainable transportation concept

Jessika E. Trancik

MIT Institute for Data, Systems, and Society
trancik.mit.edu

December 21, 2020

2

Electric-based sustainable transportation concept

Jessika E. Trancik

MIT Institute for Data, Systems, and Society
trancik.mit.edu

December 21, 2020

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Recording

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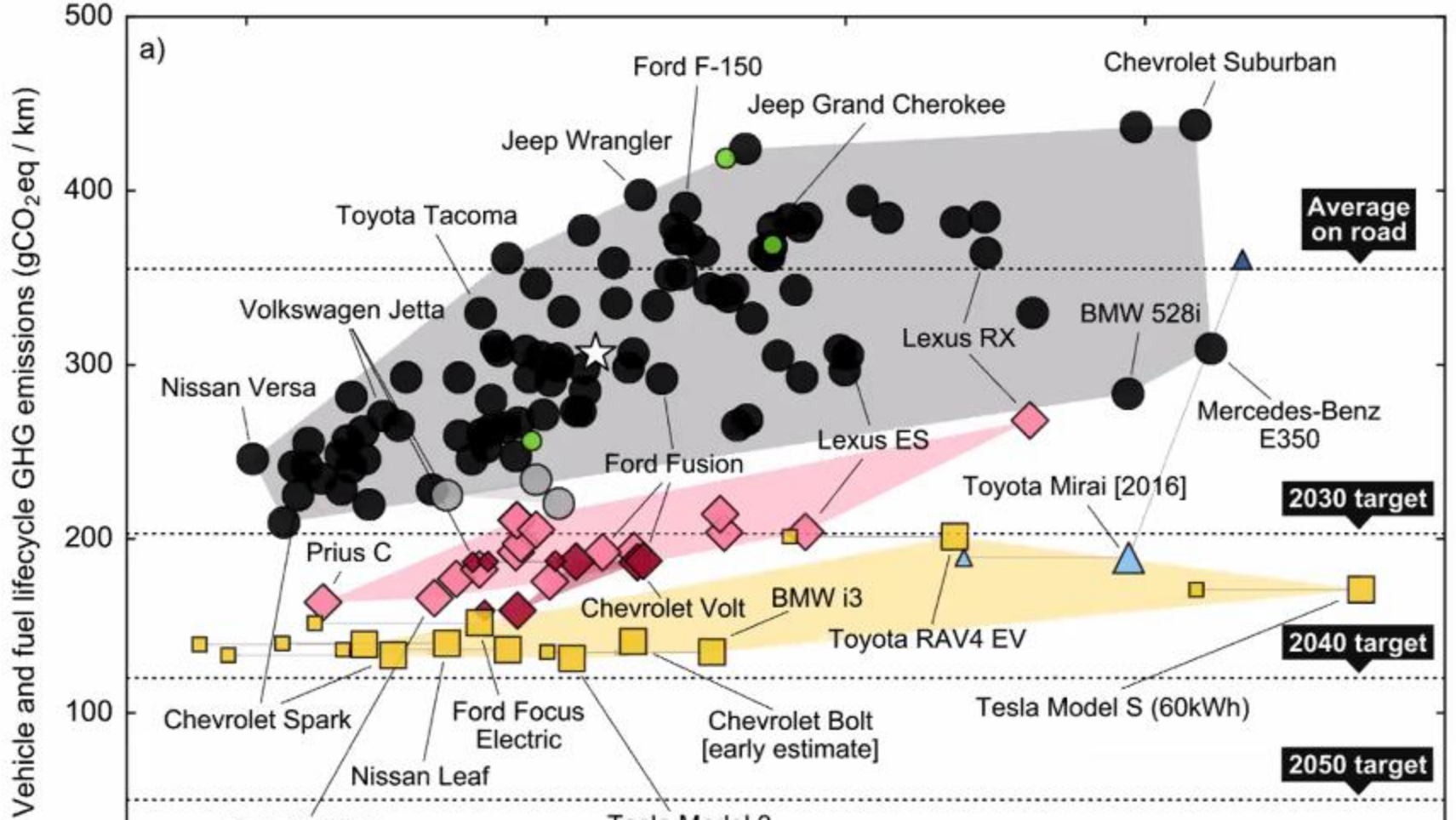
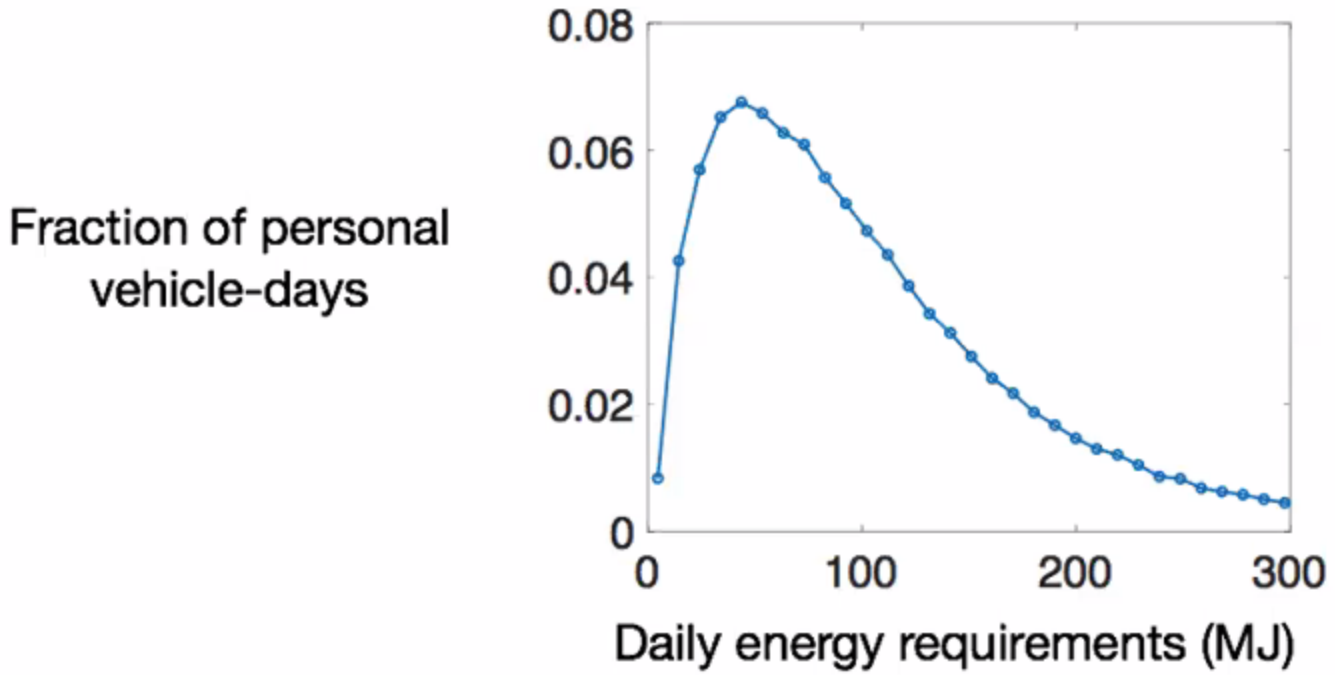
Recording

Electric vehicles offer major emissions savings (see carboncounter.com and carboncounter.lu)



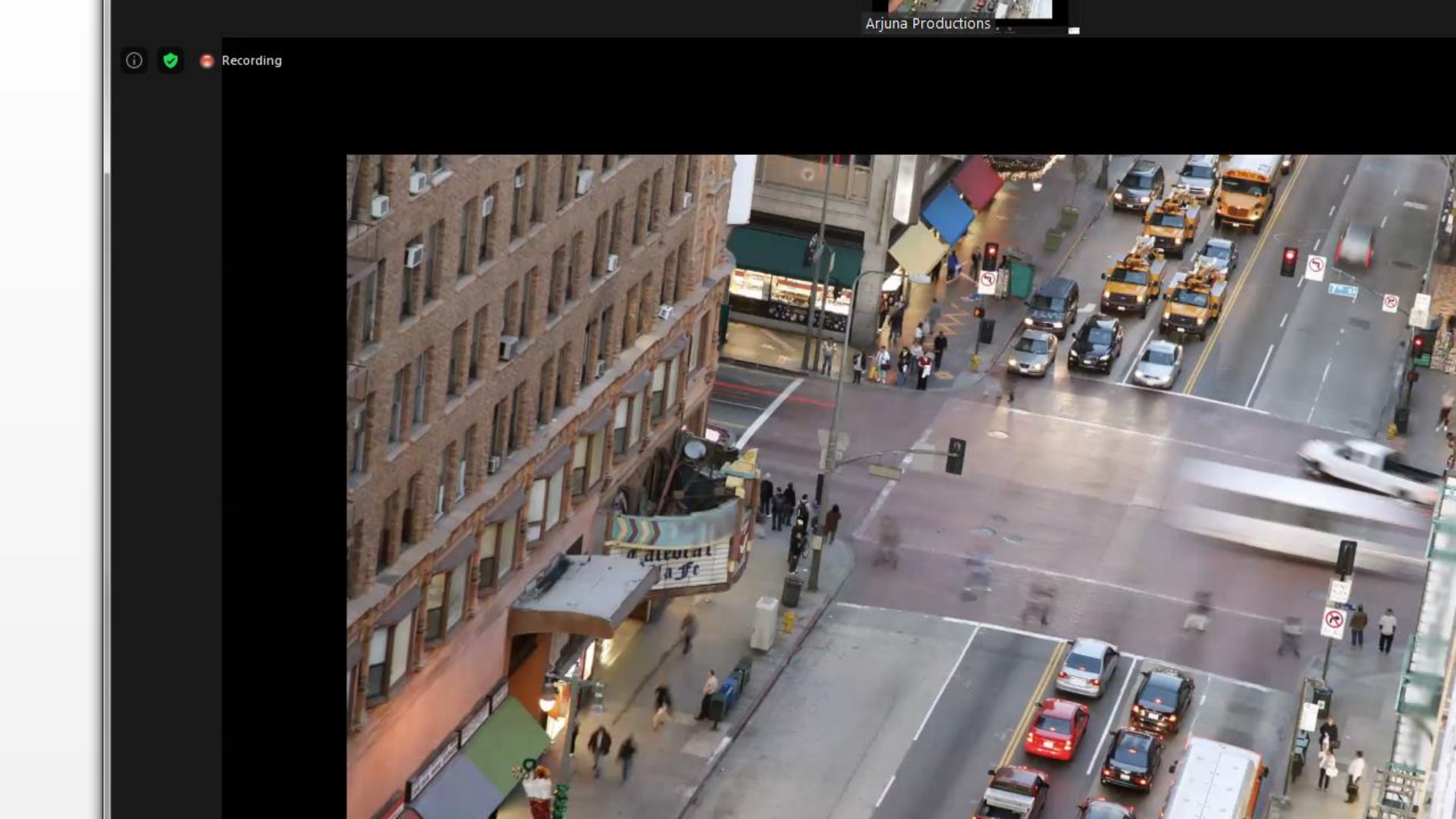
Important to consider the entire energy distribution to identify convenient electrification options



- Most people in most locations (including in Indonesia) experience ‘high-energy’ days
- Sustainable transport concept: Provide convenient access to clean, enjoyable mobility se

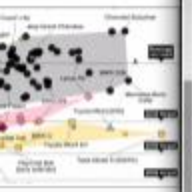
Strategic plan to support sustainable, electrified transportation

- Consider residents' travel needs and preferences
- Account for technological capabilities, evolution trends, and technology limits
- Match charging infrastructure expansion plan and incentives to travel behaviors and technological capabilities
- Develop a transition plan toward deep decarbonization and a smart, sustainable transportation system
- Incentivize homegrown Indonesian innovation in business models and software to enable transition


Arjuna Productions
Recording


Arjuna Productions
Recording

major emissions savings
om and carboncounter.l



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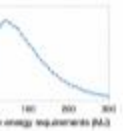

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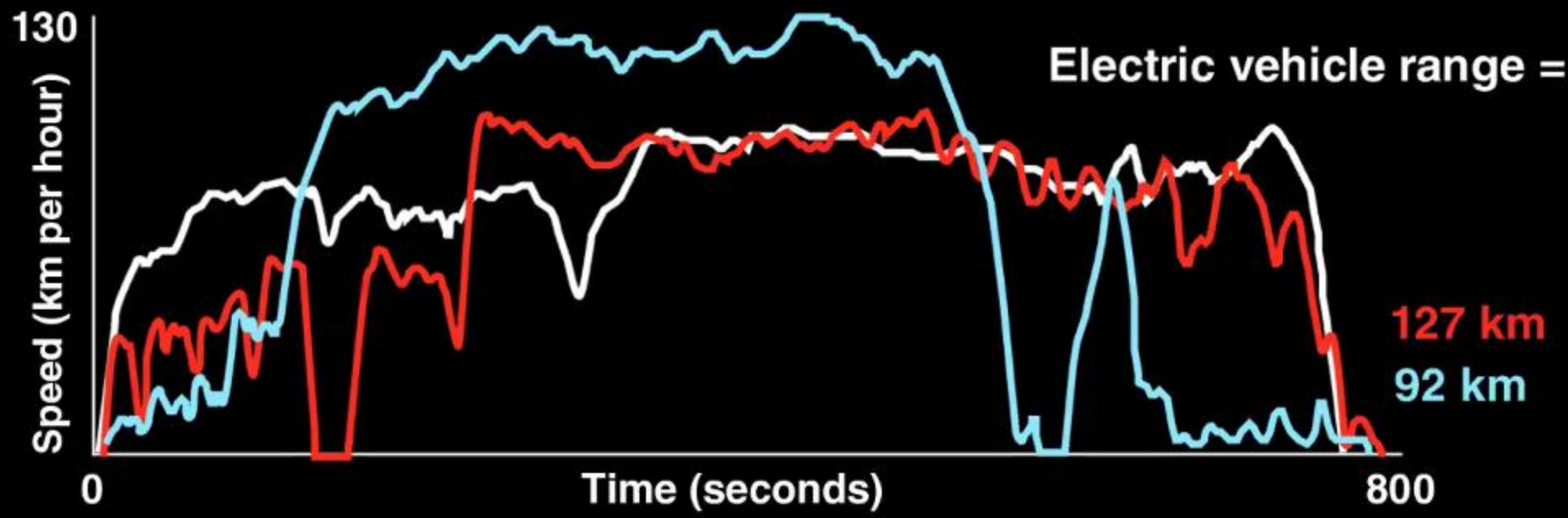
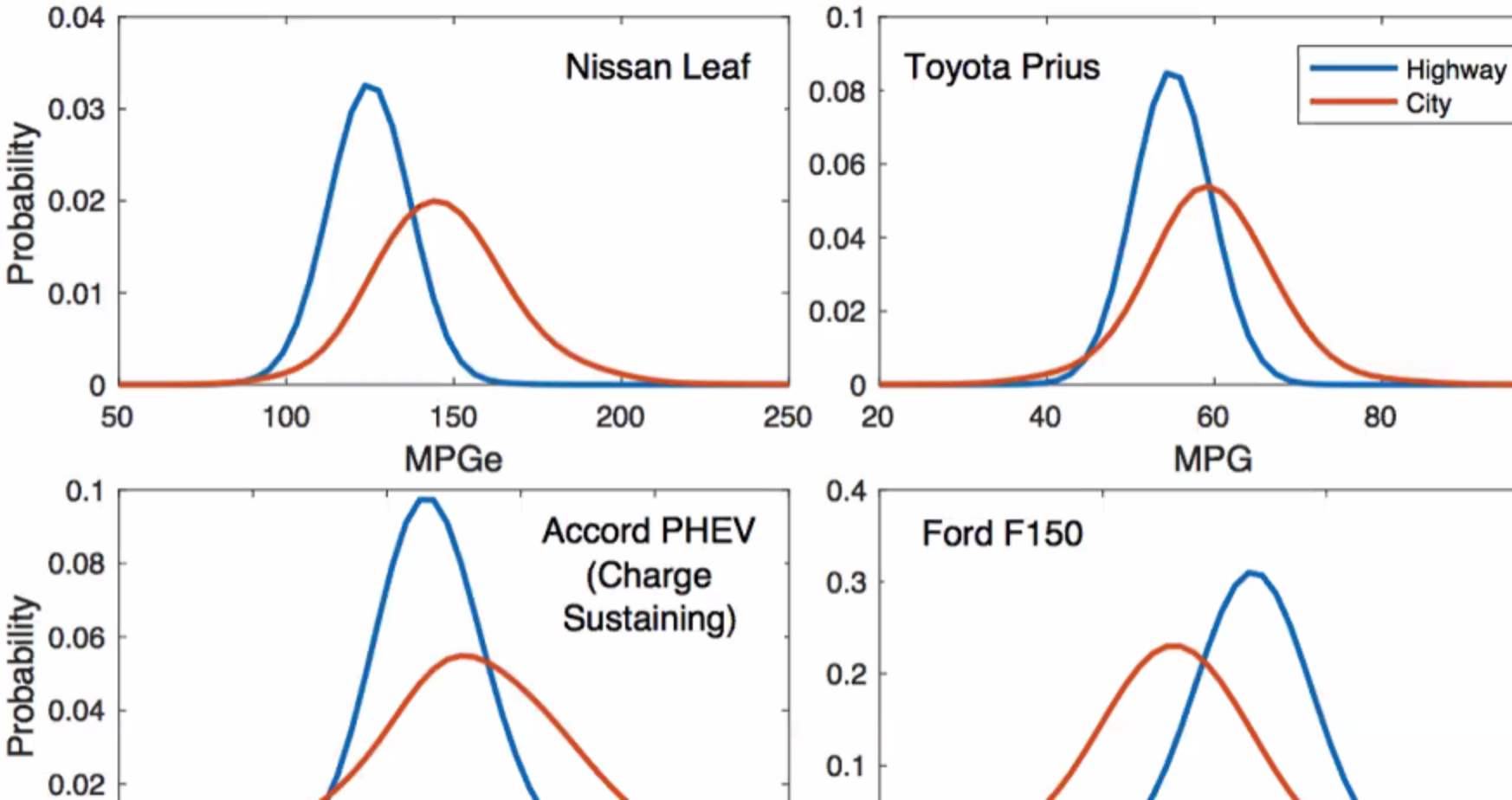
Recording



Range is not a single number



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Recording

Methods development: TripEnergy model

Travel Survey:

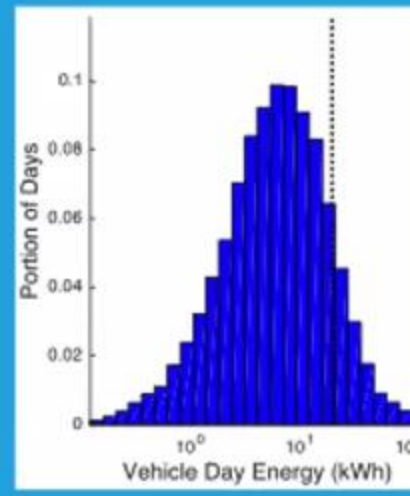
Limited information on a specific trip

TripEnergy Matching

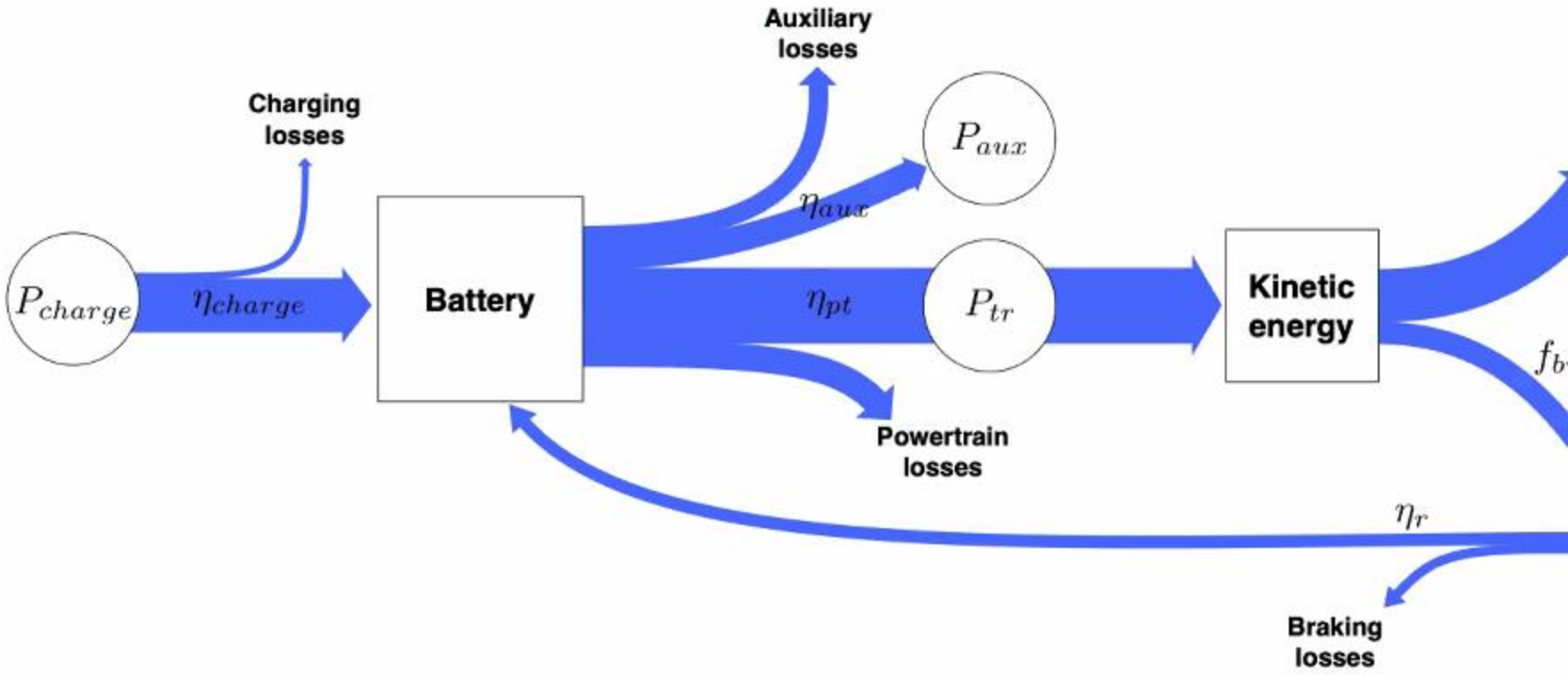
Vehicle Model

GPS surveys:

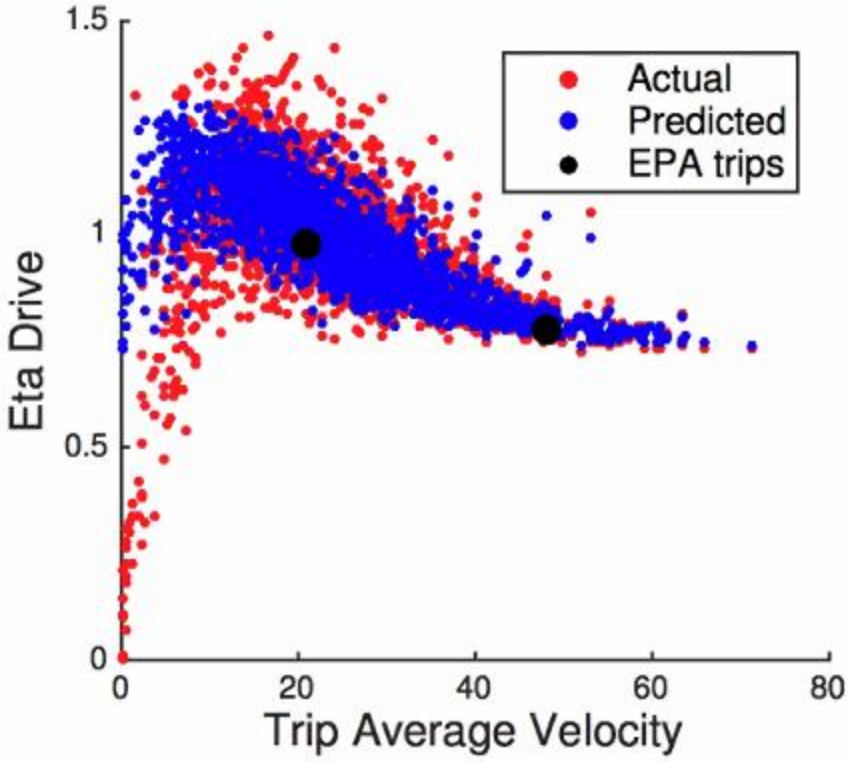
Trips with known trajectory

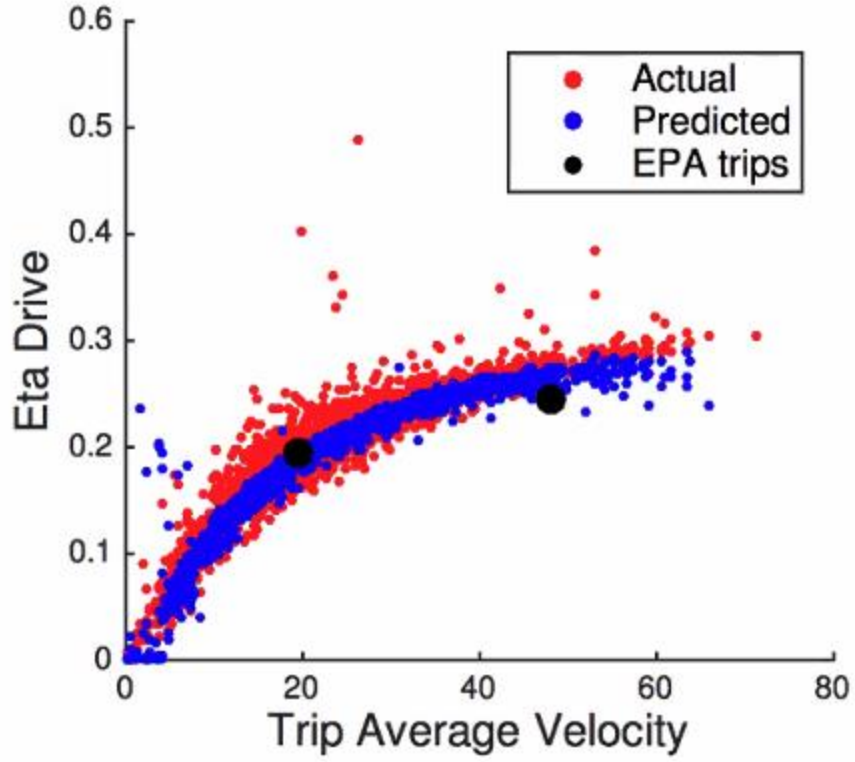


Computationally efficient vehicle model that operates in real-time



Model validation





Internal combustion engine vehicle

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How many US cars on the road could be replaced b lower-cost electric vehicle (Nissan Leaf and similar) a still meet daily energy needs/ support travel activities

- Less than 10%
- 10%
- 30%
- 50%
- 70%
- 90%
- More than 90%

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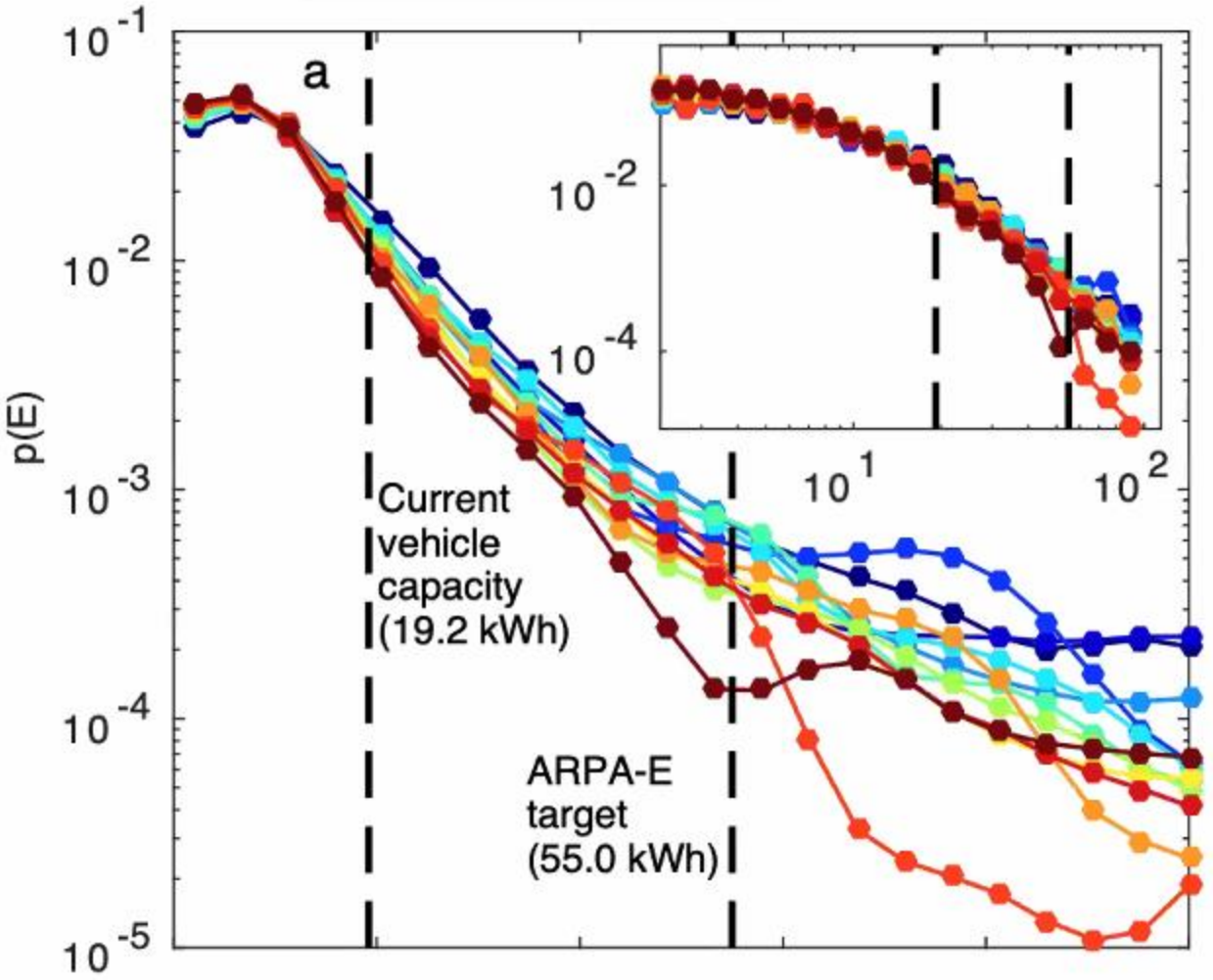
Recording

But need to consider high-energy days…



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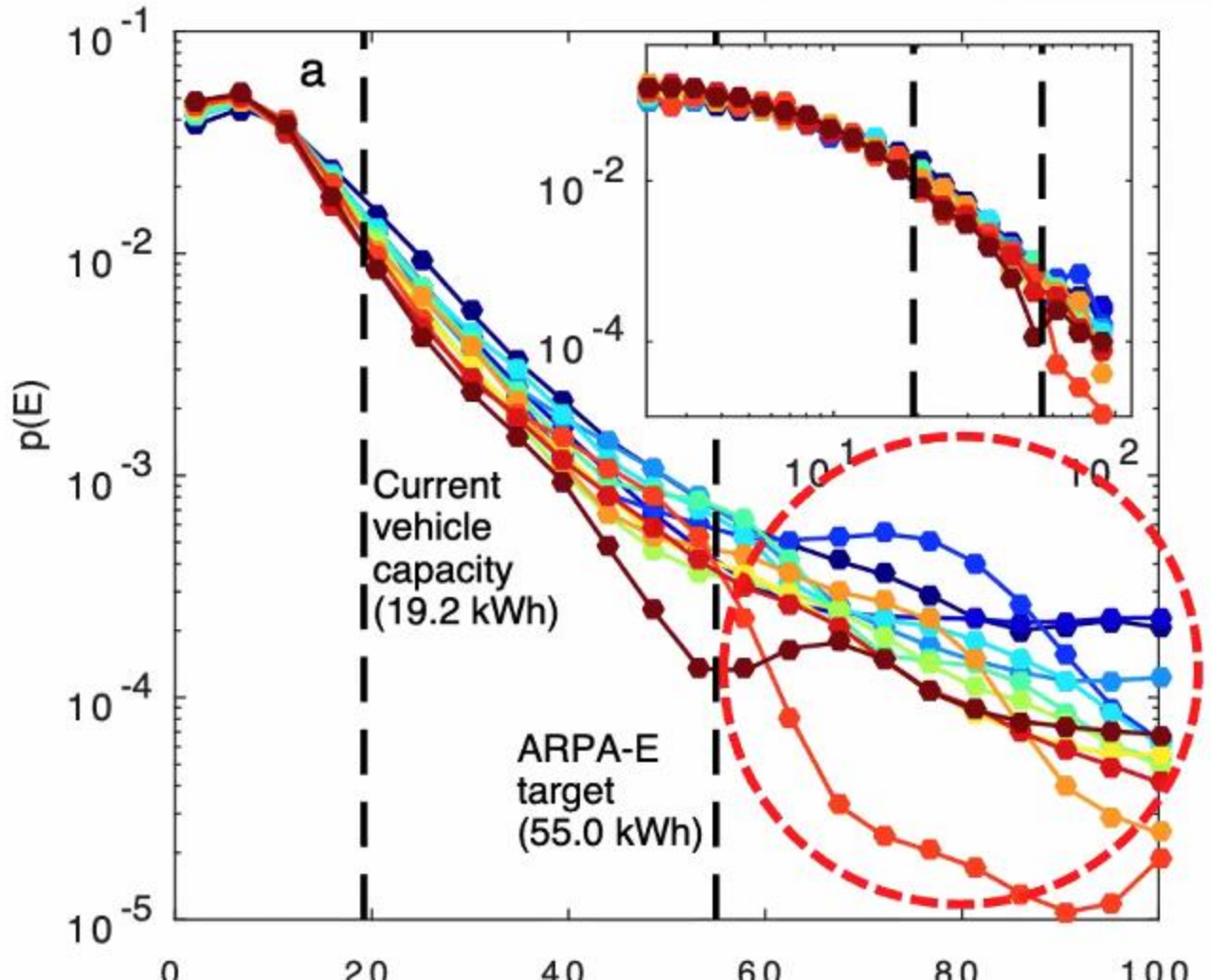
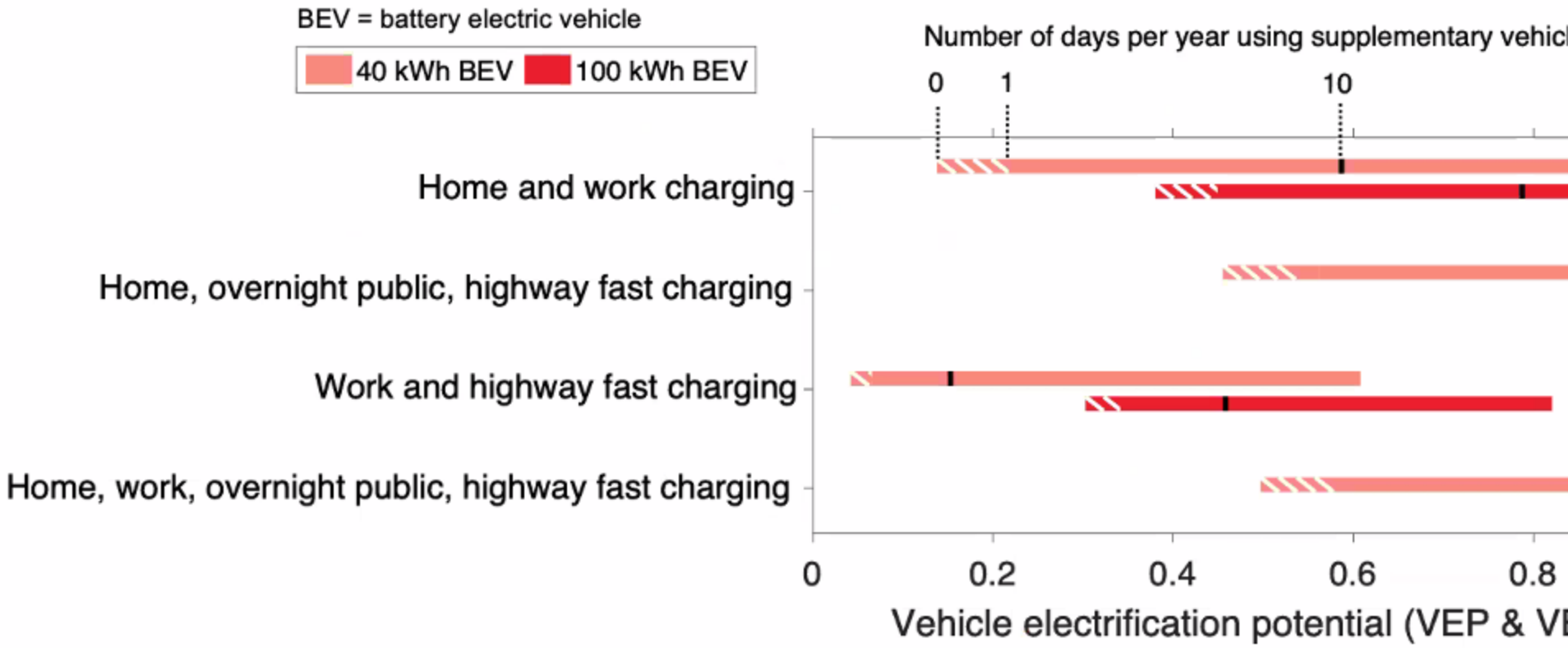


Strategic packages of charging infrastructure and other support for electrification



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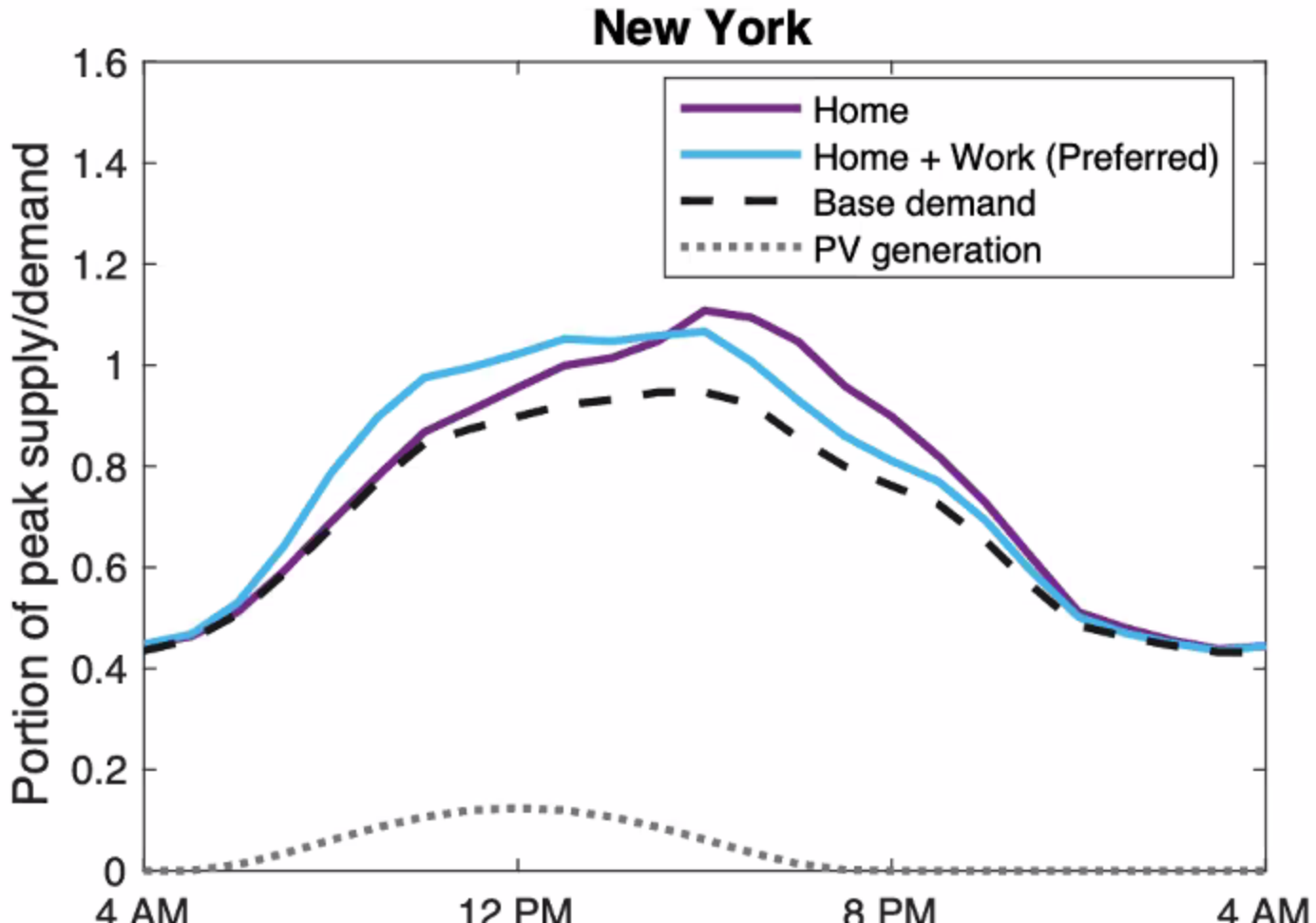
Indonesia-MIT team meetings

Preliminary results: Electrification potential in Indonesia

- High potential for electrification of 4-wheel vehicles (public and private), motorcycles
- Understanding of Indonesian high-energy vehicle days can inform infrastructure development plan
- Geographical distribution of cities, road network, travel patterns in Indonesia presents unique opportunities

Charging strategies can allow vehicles to act as g storage of solar and wind energy



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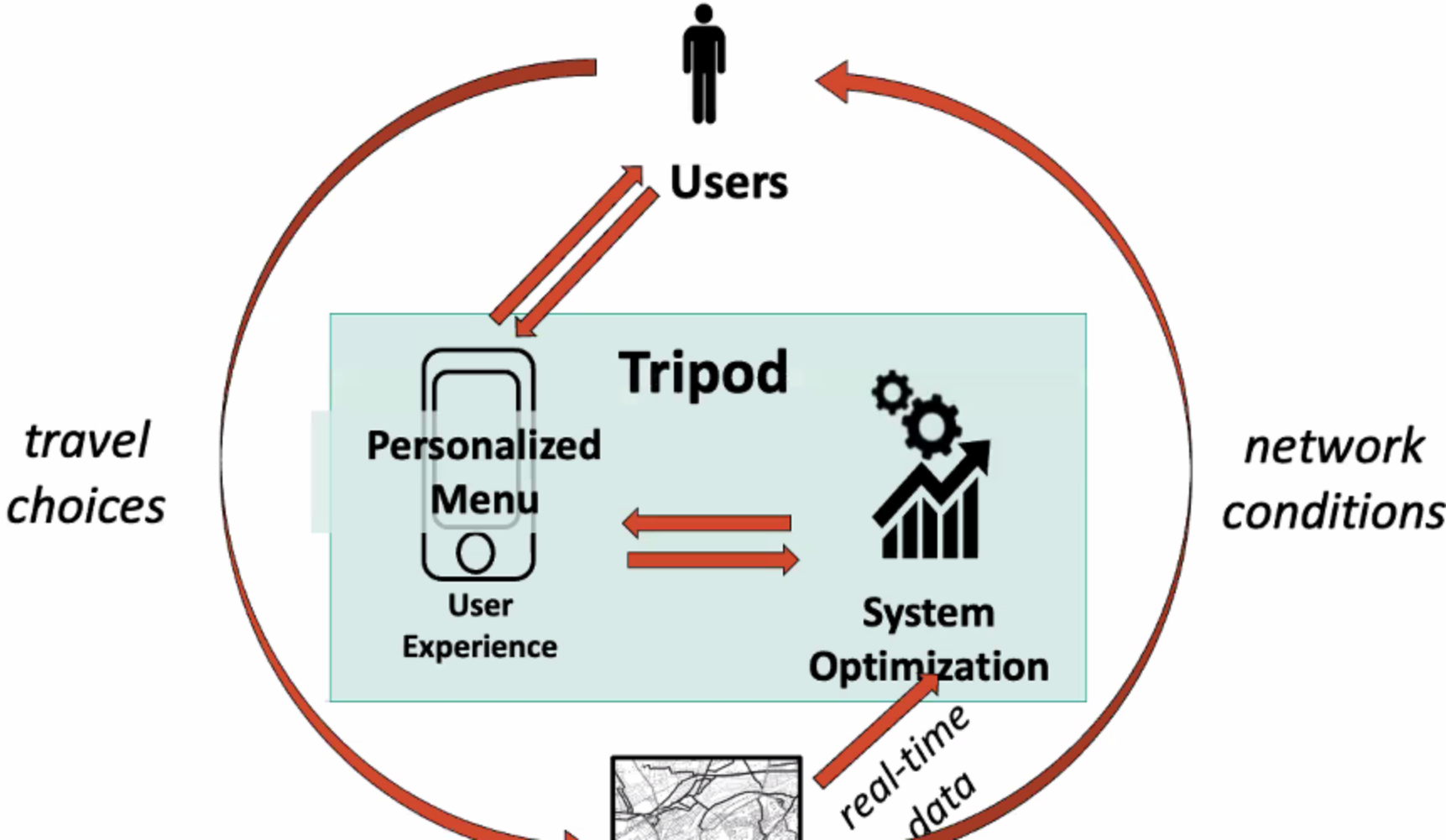
Knowledge of energy behavior enables incentive schemes to reduce pollution, enable access



Conclusions

- Information in detailed and expansive datasets can be combined to accurately estimate energy consumption across a population
- Predictive models inform strategic infrastructure expansion and incentives
- Research can provide critical input on a transition plan toward deep decarbonization and a smart, sustainable transportation system

Strategic plan to support sustainable, electrified transportation

- Consider residents' travel needs and preferences
- Account for technological capabilities, evolution trends, and technology limits
- Match charging infrastructure expansion plan and incentives to travel behaviors and technological capabilities
- Develop a transition plan toward deep decarbonization and a smart transportation system
- Incentivize homegrown Indonesian innovation in business models and software to enable transition

➢ This can be done!

INTERNATIONAL WEBINAR

Development in the New Capital City of Indonesia : Planning For Technology Implementation of Autonomous Electric Vehicle for the New Capital City

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A Roadmap for Autonomous Electric Vehicle in The New Capital City of Indonesia

Bambang Riyanto Trilaksono
School of Electrical Engineering and Informatics, ITB
National Center for Sustainable Transportation Technology, ITB
National Center for Artificial Intelligence, ITB

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Local identity

Sustainable development

Future city

City for the World

Development Concept

New Capital Cit

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New Capital City Transport

- Electric vehicle
- Autonomous vehicle
- Autonomous public transport (bus, railway)

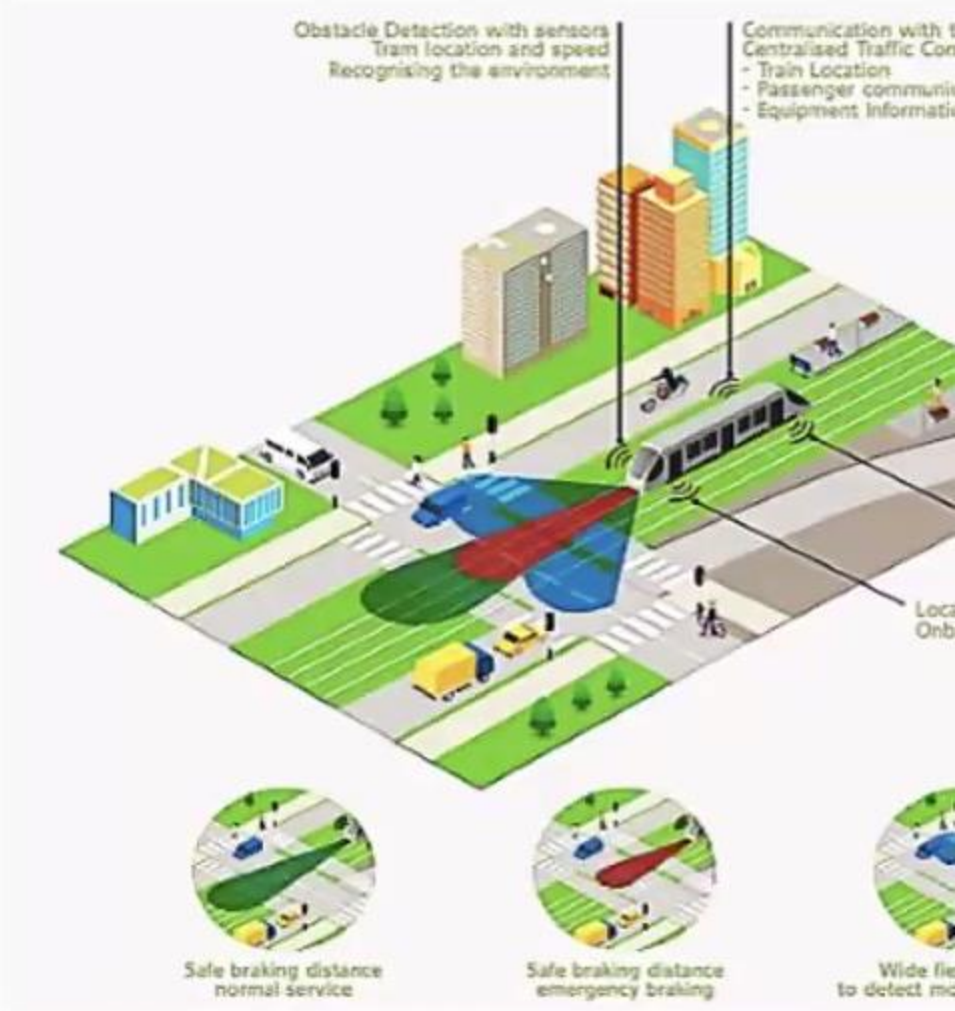
2

Future Possibility: Autonomous Vehicle – ART/Autonomo

AUTOMATIC SYSTEM: a system that performs task sequences based on pre-defined rules; the information needed to understand its environment is given to it to make its decisions. It can be with or without a driver.

AUTONOMOUS SYSTEM: a system capable of making its own decisions to respond to all cases without human-defined instructions. It must therefore manage the functions of comprehension, environment analysis, and decision making – responsibilities which so far are largely reserved for human beings.

To be autonomous, the tram must be able to capture, perceive, analyze decisions and act without human intervention. Moreover, all of this must be real time.



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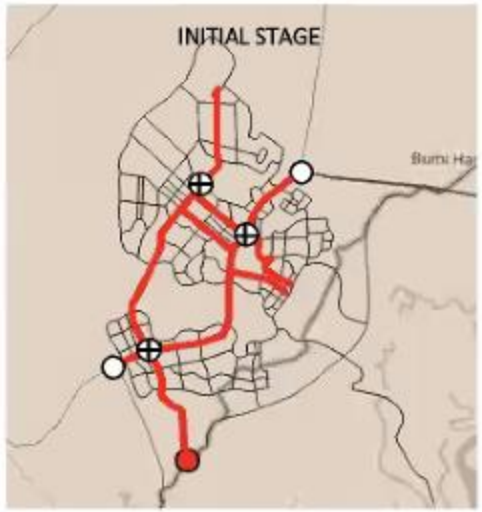
Planning Development New Capital Transport Network

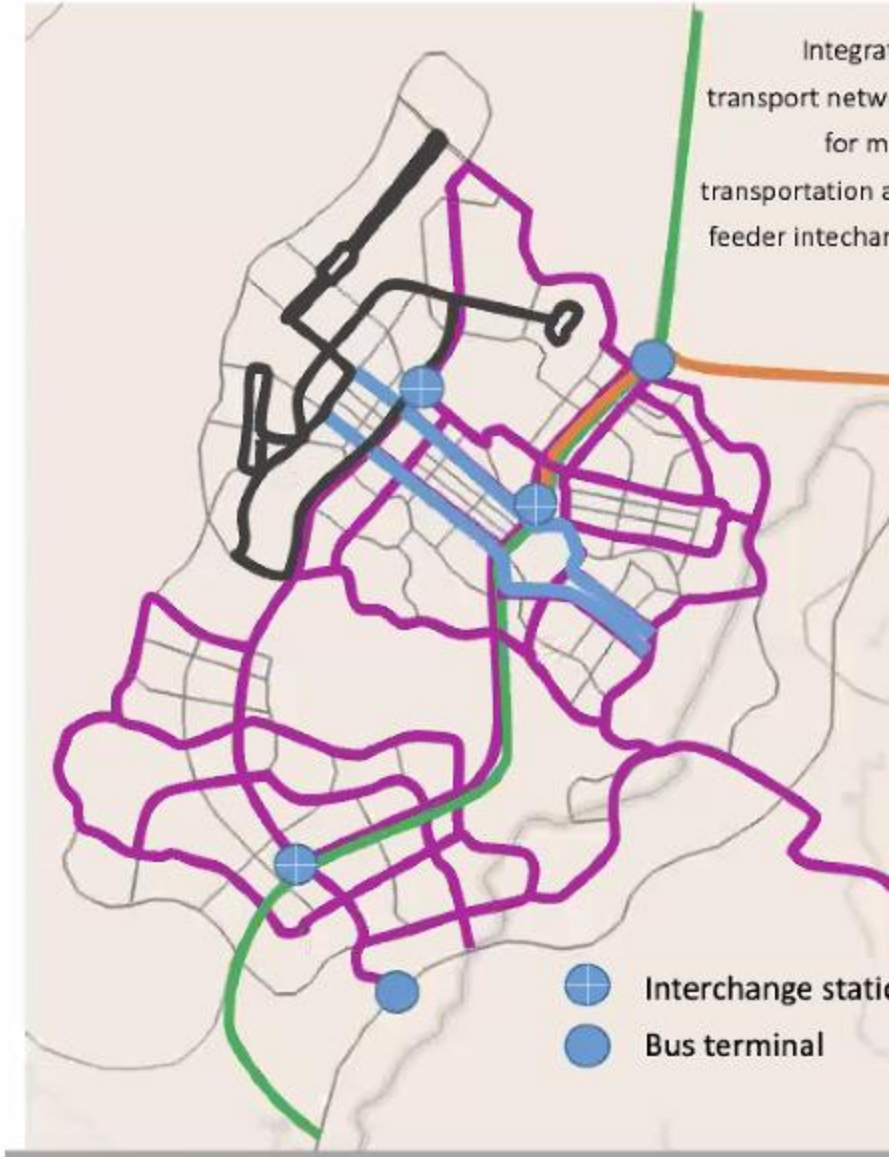
Legend
- Intercity MRT/LRT Corridor
- Airport Train
- Dedicated BRT Corridor
- Interchange Station
- City Bus Terminal
- Intercity Bus Terminal



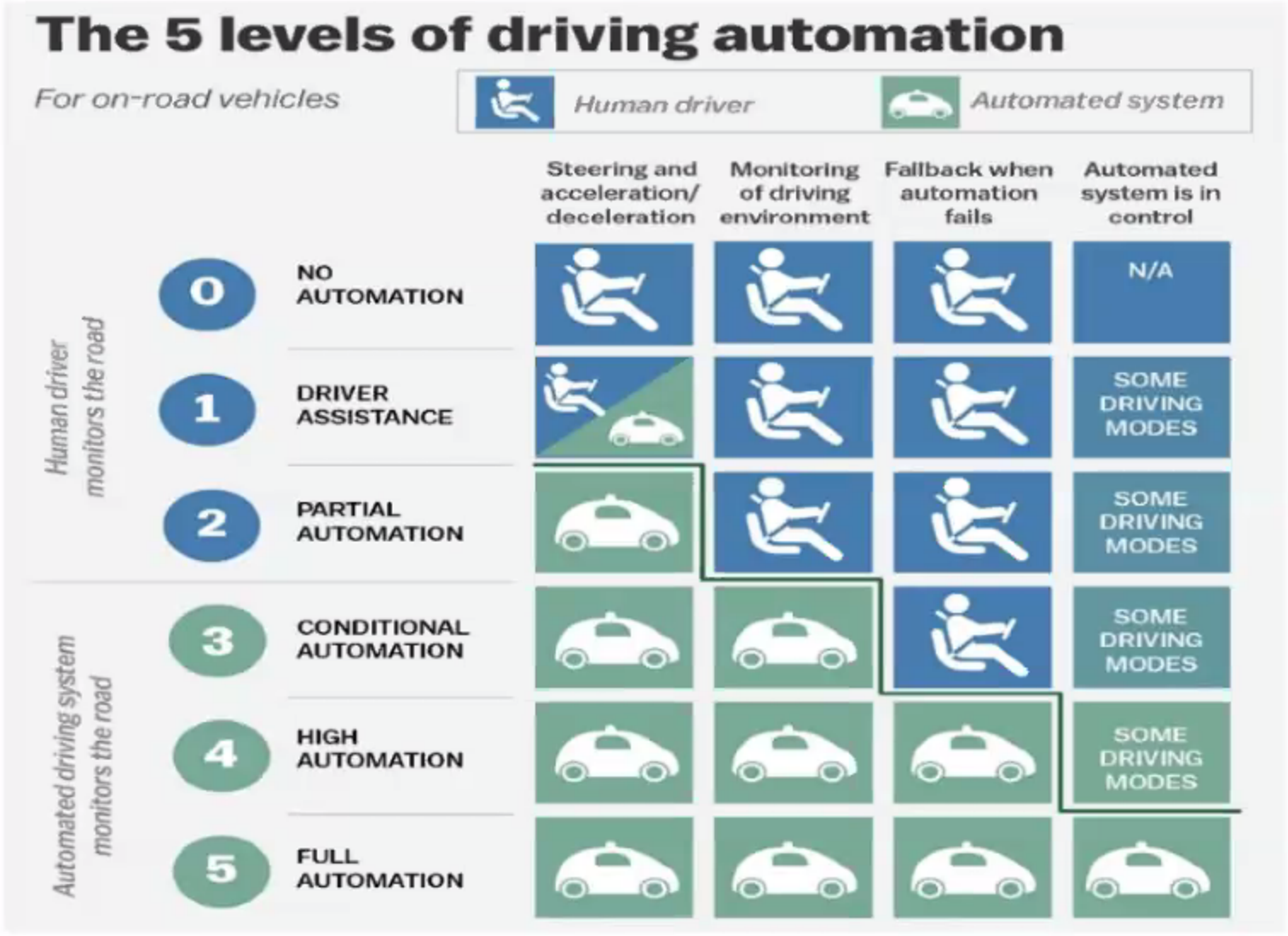
Proposed Transport Logistic

- **Logistic Terminal**
- **Distribution center and hub**
- **Distribution pattern for feeder**

Proposed Public Transport Service Mass Transport Station



Level of Autonomy defined by The Society of Automotive Engineering (SAE)



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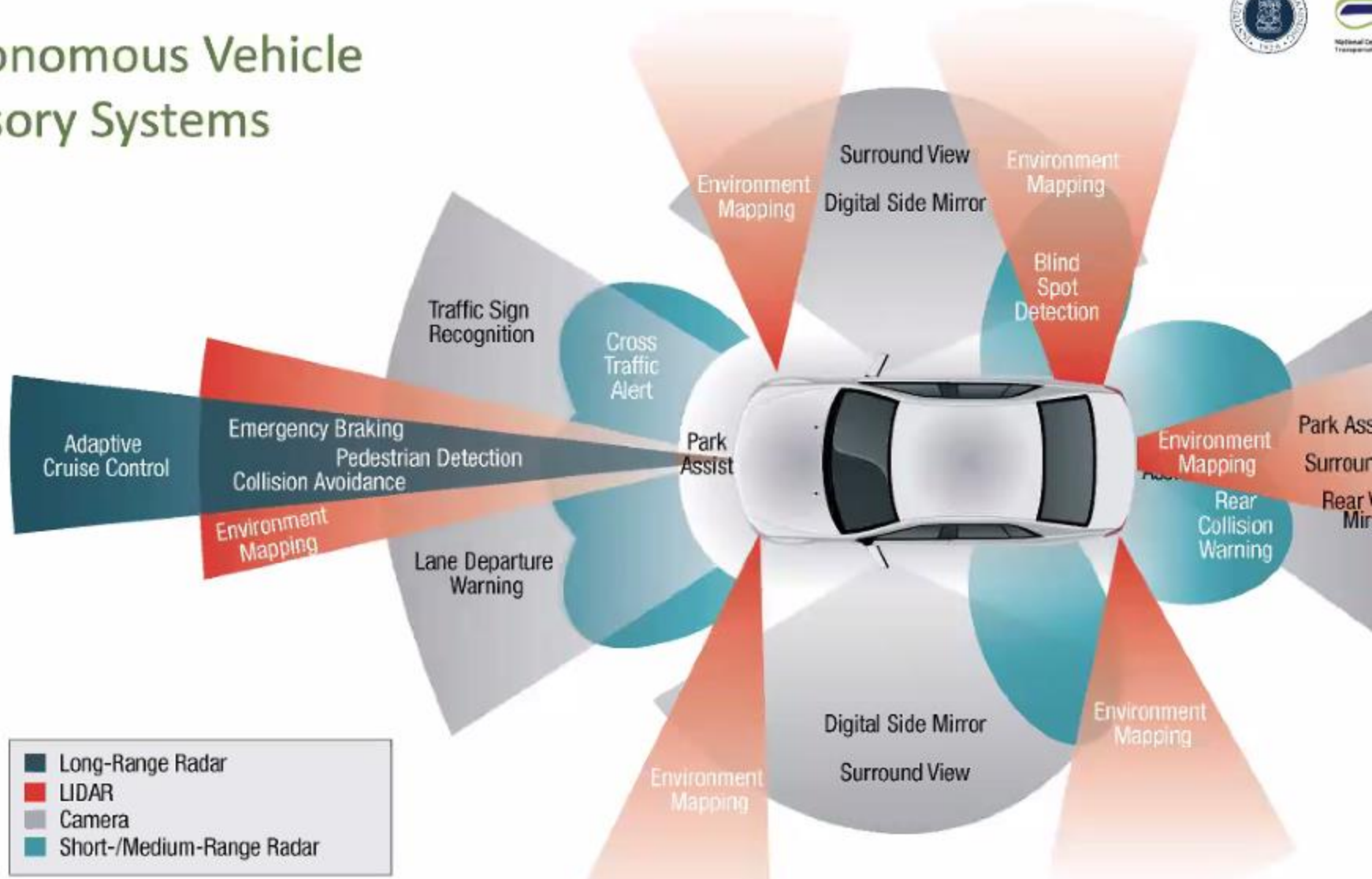
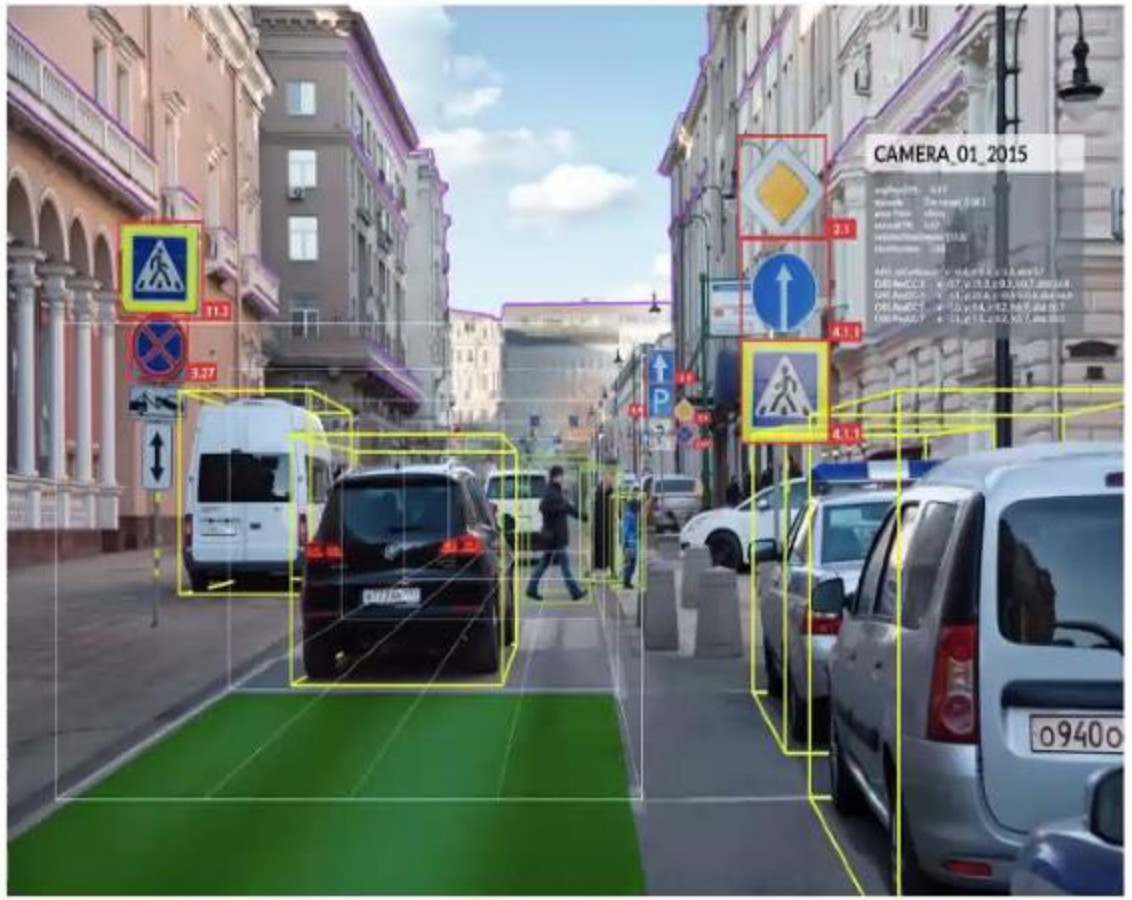
Recording

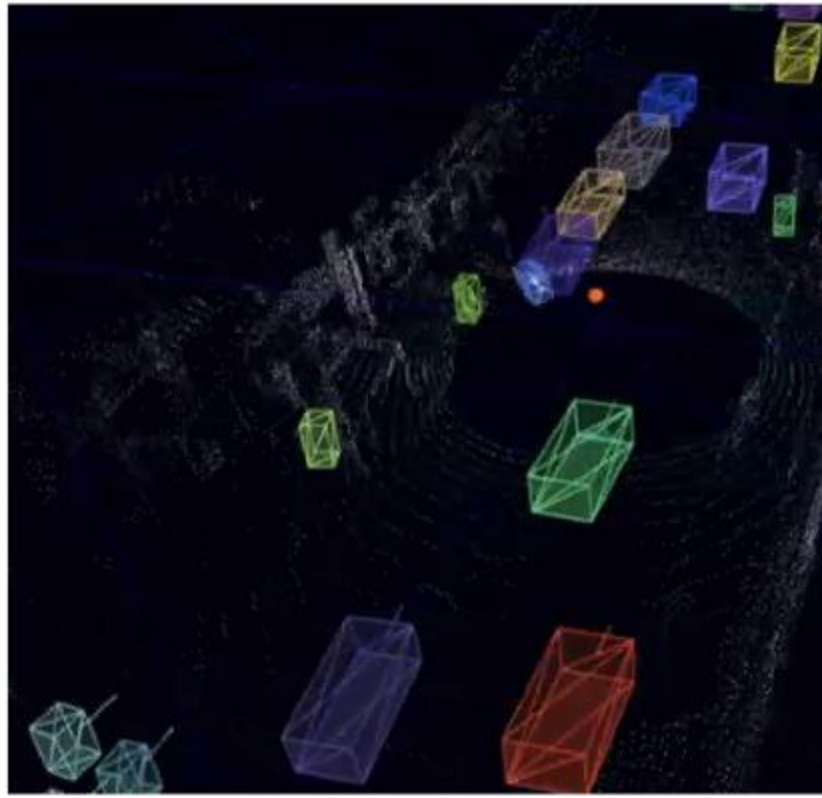
Autonomous Vehicle Sensory Systems





AV visual perception

AV perception through Lid



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Recording

The Map of Autonomous Car

@augiewidyotriatmo

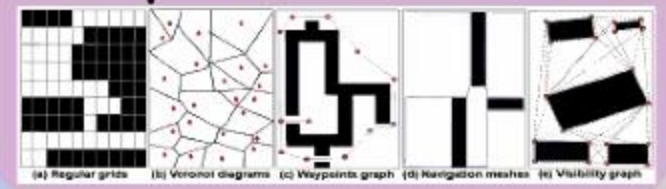
3D Map

Terrain Map

Visual SLAM

Laser-Based SLAM

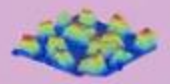
2D Map



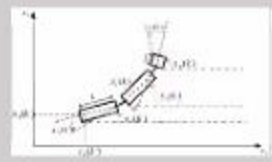
RRT

A*

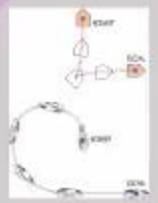
constraints



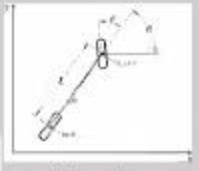
Potential Field



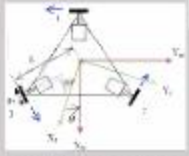
Truck-trailer



Nonholonomic system



Bicycle



Holonomic system

Sim

Planning

Modeling & Simulation

Mapping

SLAM

Localization

Control

Perception/ Recognition

Collision Avoidance

Social Behavior

Multi-Vehicles

V2X & ITS

Autonomous Car

Triangulation

Map Matching

GPS

Trileteration

Dead Reckoning IMU

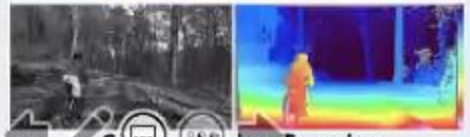
3D LIDAR

CNN

Object Recognition

Connected vehicle

Cooperative lane changing



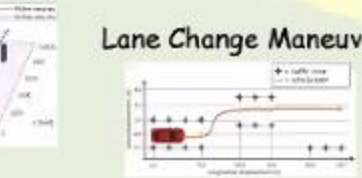
Stereo Vision Imaging

Platooning

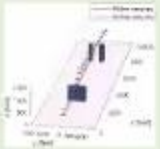
Adaptive Cruise Control

Intelligent Intersection

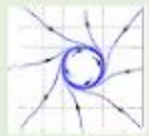
Driving Personalities



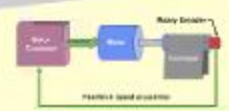
Lane Change Maneuver



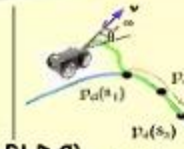
Path Re-planning



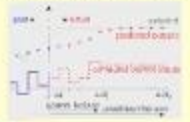
Limit Cycle



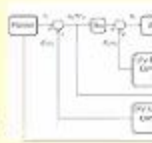
Motor control (AC, DC, BLDC)



Path-



MPC



Co

Optimized Trajectory

observer

kalman filter

sigma-point

particle

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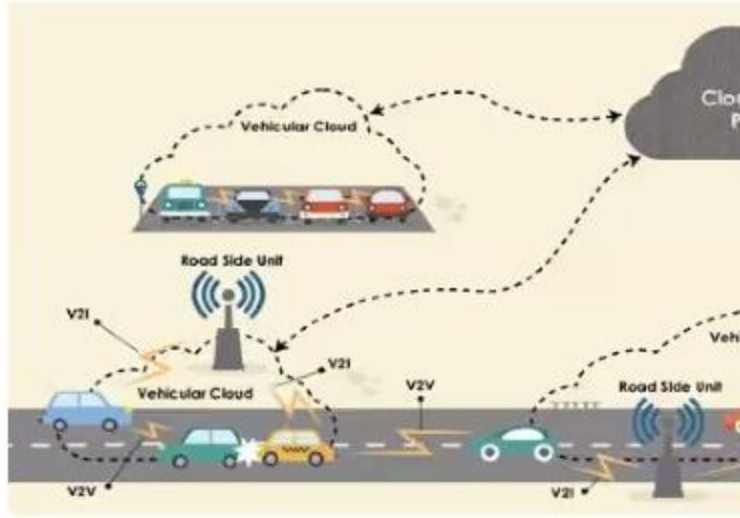
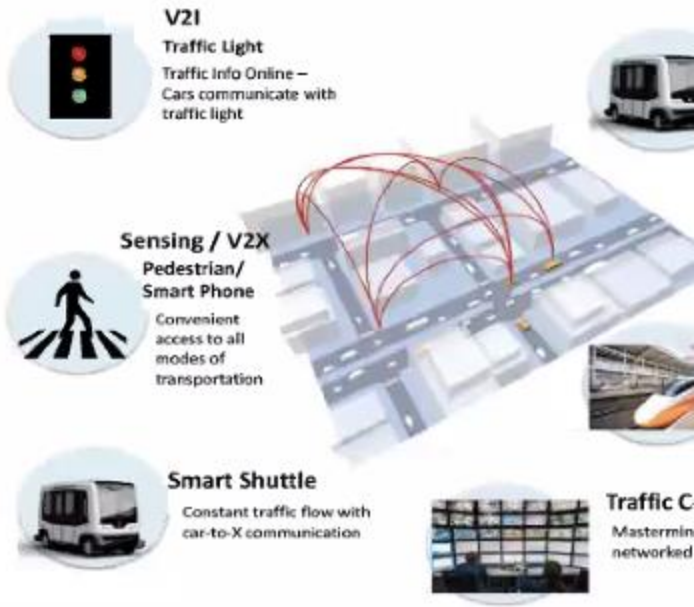
Recording

V2V, V2I, V2X Network Infrastructure





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Recording

Road Infrastructure for Autonomous Electric Vehic

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Recording

Guidance framework for testing and deployment of autonomous vehicle

Scope & Process Guidance

- Test/Production Vehicle
- FMVSS Certification/ Exemption
- HAV Registration

Guidance Applicable to All HAV Systems on the Vehicle

- Data Recording and Sharing
- Privacy
- System Safety
- Vehicle Cybersecurity
- Human-Machine Interface
- Crashworthiness
- Consumer Education and Training
- Post-Crash Vehicle Behavior
- Federal, State and Local Laws
- Ethical Considerations

Guidance Specific to Each HAV System

Describe the ODD (Where does it operate?)	Object and Event Detection and Response	Fall Back Minimal Risk Condition
Geographic Location	Normal Driving	Driver
Roadway Type	Crash Avoidance - Hazards	System
Speed		
Day/Night		
Weather Conditions		
Other Domain Constraints		

- Testing and Validation
  - Simulation
  - Track
  - On-Road

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Recording

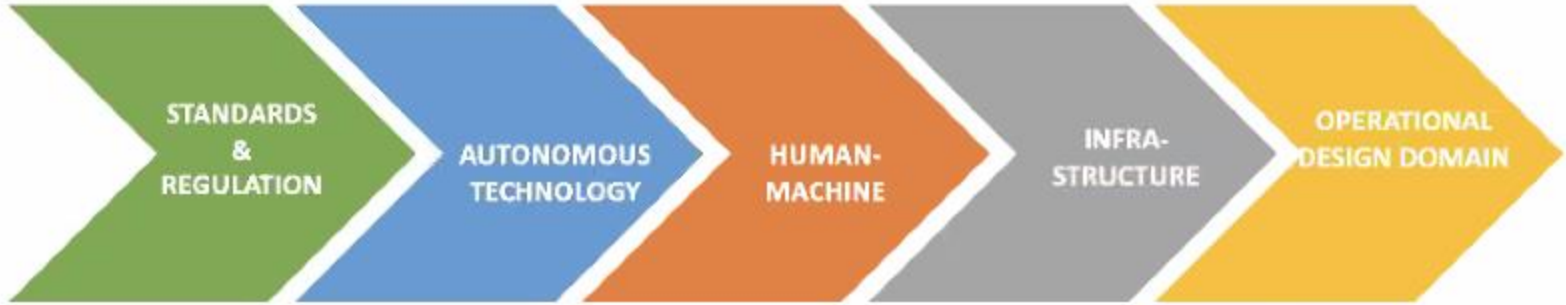
Autonomous Vehicle Technology Readiness

Technology Enablers

Control, V2V/I, Localization, Mapping, SLAM, Perception, Social Behavior, Fault Identification

Infrastructure

Telecommunication, Localization, Monitoring



Standard as the Baseline

Definition, Taxonomy, Architecture, Operational, Functional, Tactical, Strategies, Safety, regulation

Human Machine Interaction

Machine Monitoring, Human Monitoring, Human Intervene

Domain

Mix, privilege, limited/unlimited

Autonomous Vehicle Implementation Roadmap for The New Capital City

2021	• Strengthen regulation and plan for AEV infrastructure • Drafting policy and incentive for AEV, survey of AEV acceptance • Drafting the agency responsible for managing AEV deployment
2022	• Establishing policy for AEV piloting location • Supporting policy for SAE Level 3 AEV's R&D • Drafting policy for 4G & 5G network coverage
2023	• Testing SAE Level 3 AEV in restricted area • Drafting policy and R&D for SAE Level 4 AEV's piloting • 4G & 5G network testing for V2V (*vehicle-to-vehicle)* and V2I (*vehicle-to-infras*
2024	• Testing SAE Level 4 AEV in restricted • AEV consumer experience in piloting area • Drafting policy and R&D for SAE Level 5 AEV piloting
2025	• Testing for SAE Level 4 AEV in the New Capital City's restricted area • *Piloting* SAE Level 5 AEV in the New capital City's restricted area

On-going research on AEV at ITB : Autonomous Tram

2019 : Related Research

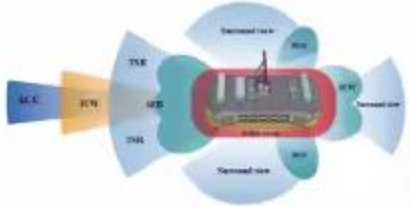
- ❑ Object Percepction System
- ❑ Autonomous multi container truck control

2020 : Related Research

- ❑ Path Planning Algorithm
- ❑ Object based Slam
- ❑ Automatic Guided Vehicles

2021 : *Tram Driving Assistance*

- ❑ Object detection & Collision-Avoidance Assist
- ❑ Speed Limit Assist
- ❑ Face recognition & Driver Attention Warning



2022 : *Autonomous Tram*

- ❑ Adaptive Cruise Control
- ❑ Autonomous Emergency Breaking
- ❑ Traffic Sign Recognition

2023 : Prototype & Commercialization

- ❑ Testing in a mixed traffic environment
- ❑ Commercialization preparation, standardization and licensing

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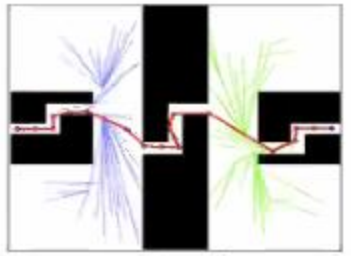
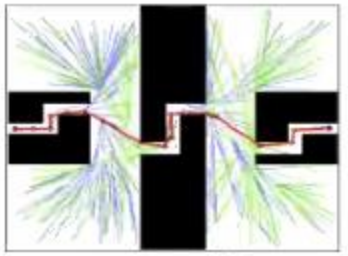
Recording

On-going research on AEV at ITB : Autonomous Car

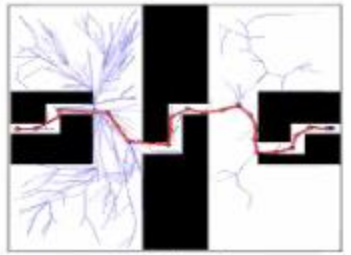


Iteration : 351
Time : 227 ms
Path cost : 504.72

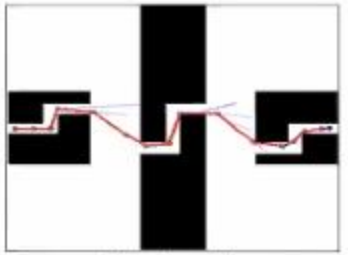


Iteration : 807
Time : 1,849 ms
Path cost : 480,09

Example of path improvement in a tree using the RRT*-Connect



Iteration : 1
Time : 5,368 ms
Path cost : 483,51



Iteration : 81
Time : 29,231 ms
Path cost : 440,82

Example of path improvement in a tree using the RRT-ACS alg

Combined ART+ACS Alg for Path P

Autonomous Golf Cart