Transmitted by the expert
from the Russian Federation

Informal document **GRVA-04-37**
4th GRVA session 24-27 September 2019
Agenda item 3

Yandex

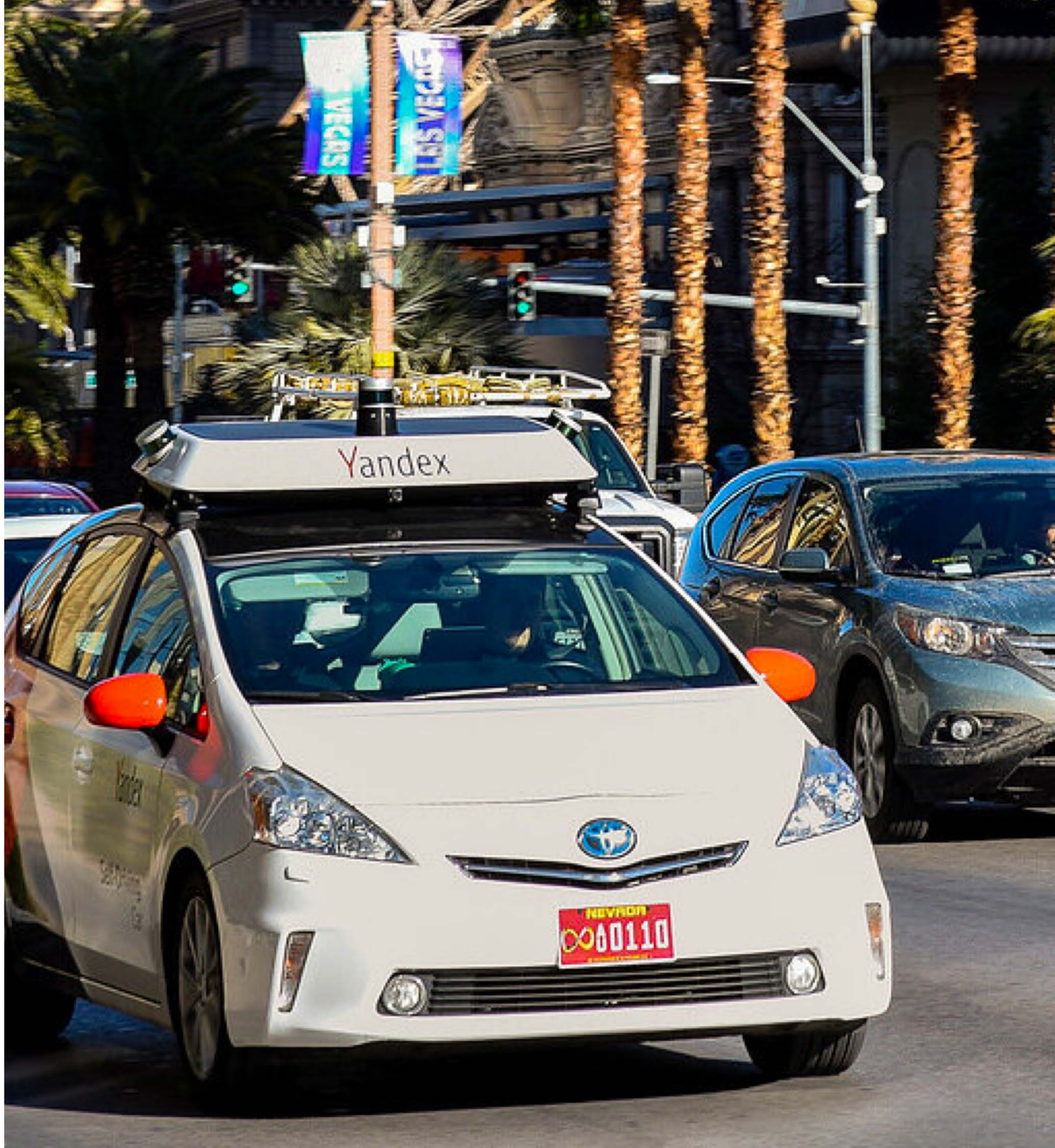
Yandex Self-Driving Car

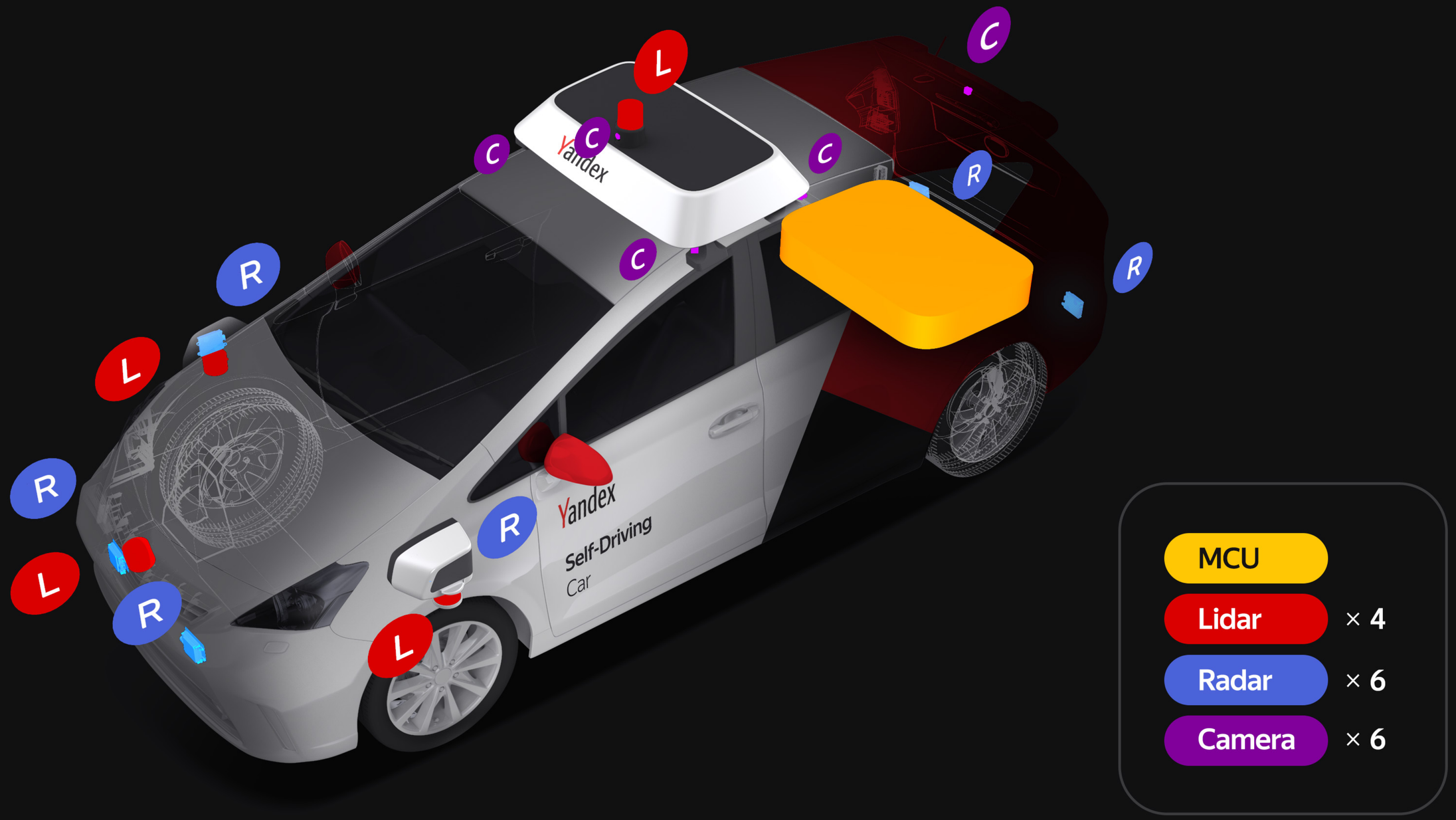
Project Overview

Developing scalable AV solution

- An initiative of a private company within the framework of the roadmap of the Russian National Technological Initiative “Autonet” approved by the Russian Federation Presidential Council for modernization of the economy and innovative development of Russia of April 24, 2018, No. 1
- Deployed robo-taxi service (test mode) in two locations in Russia. 4,000+ passenger rides completed.
- Autonomously driving passengers around during all seasonal weather conditions
- Public road tests in Russia, Israel and USA
- 60 vehicles are being tested on public roads 24x7

sdc.yandex.com
medium.com/yandex-self-driving-car

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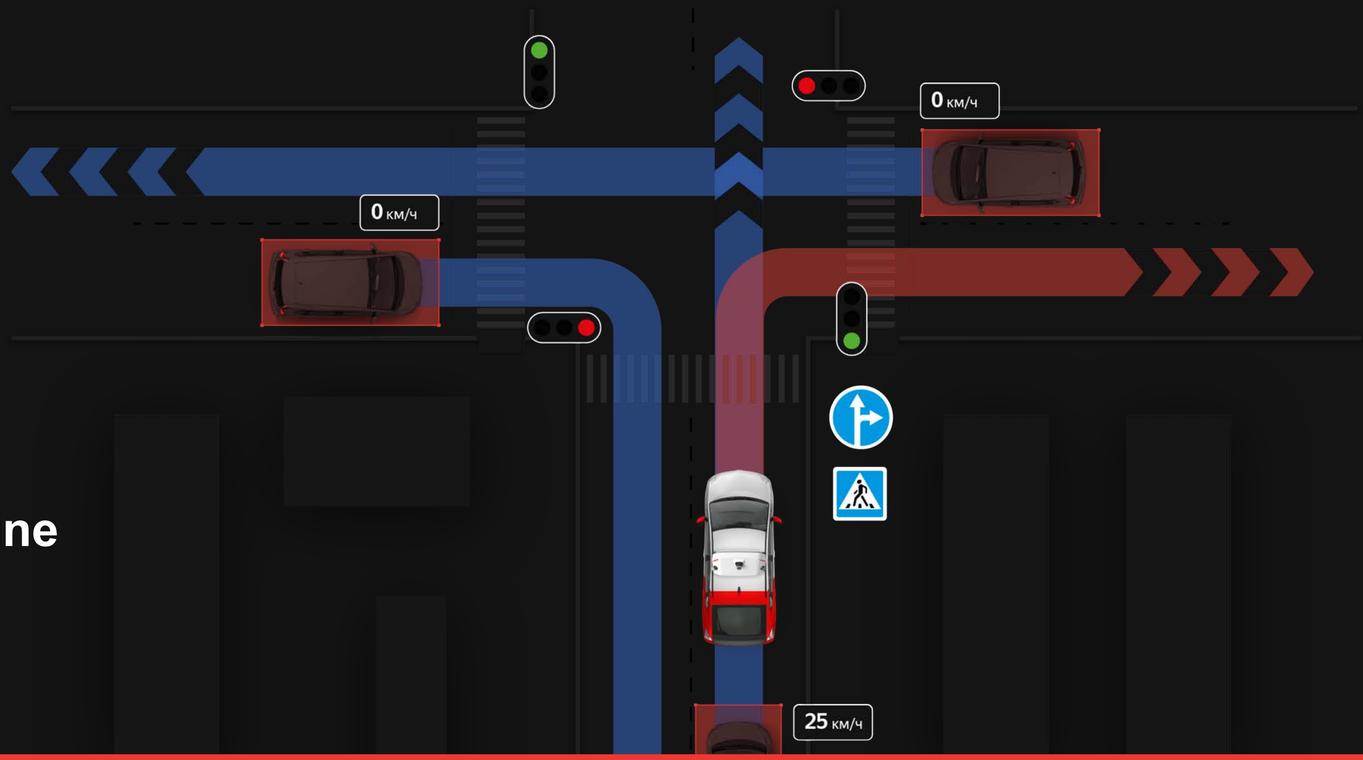
Yandex
Yandex
Self-Driving
Car
MCU
Lidar
× 4
Radar
× 6
Camera
× 6

Software

The main component of self-driving

Built on the solid foundation of Yandex machine learning technology stack



Localization

- Centimeter accuracy
- Using Yandex-created HD maps
- GNSS is not needed for on-the-route localization

Perception

- Neural networks based object detection & classification
- Reconstructing detailed 3D scene within 200+ meters around the vehicle
- Objects speed and velocity measured tens times per second

Prediction

- Most challenging component of self-driving pipeline
- Technology predicts how road scene would change in the upcoming moments

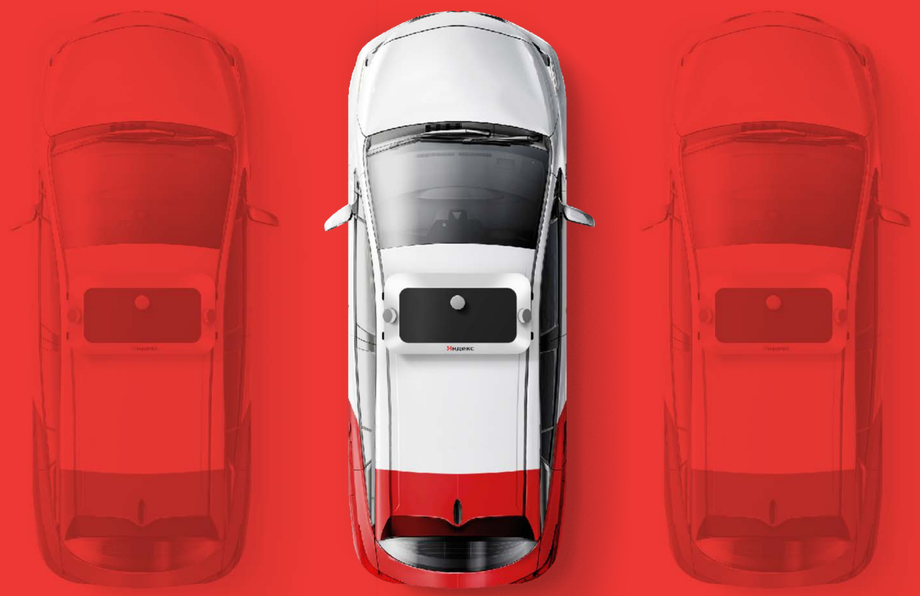
Planning

- Self-driving car builds tens of possible trajectories every second
- The optimal one is selected
- If the optimal one is blocked for whatever reason, the next best unblocked trajectory is executed

City street testing phase

Regulations have to enable technological advancements

- Continuous tests on public roads are critical for technology development
- Infinite number of road traffic scenarios could not be simulated on closed tracks



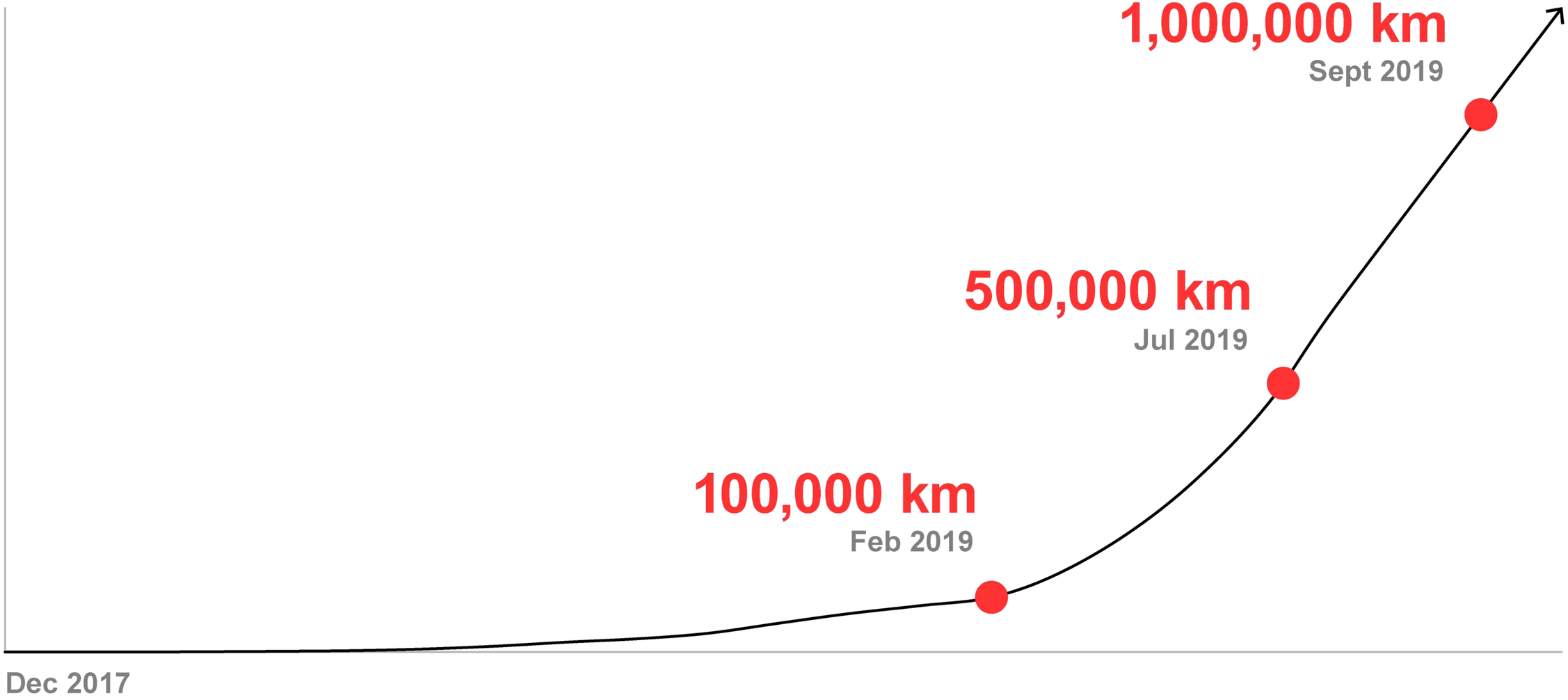
California: 63 companies

Beijing: 8 companies

Israel: 2 companies

Russia: 1 company

Autonomous kilometers driven since December 2017

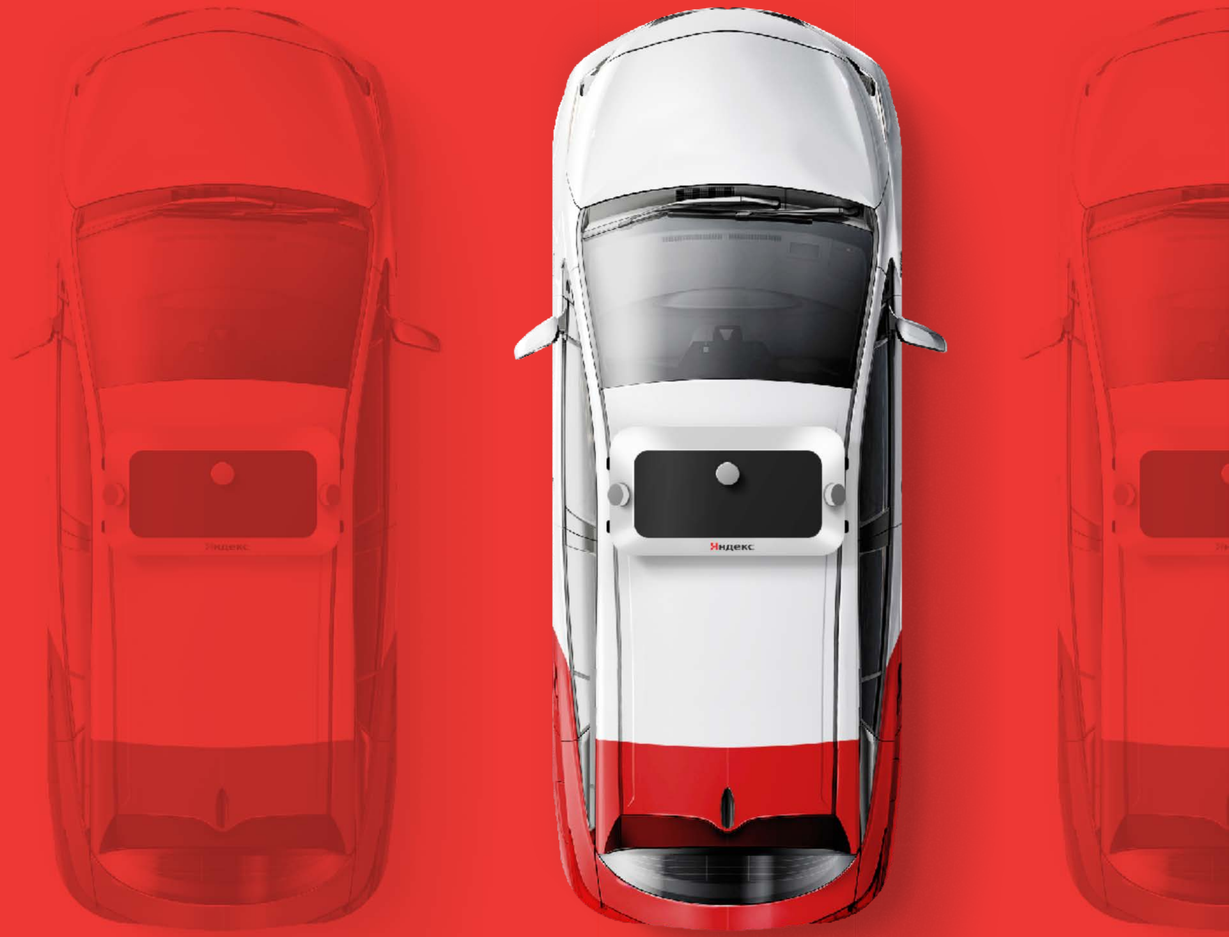


Yandex SDC test in operating countries

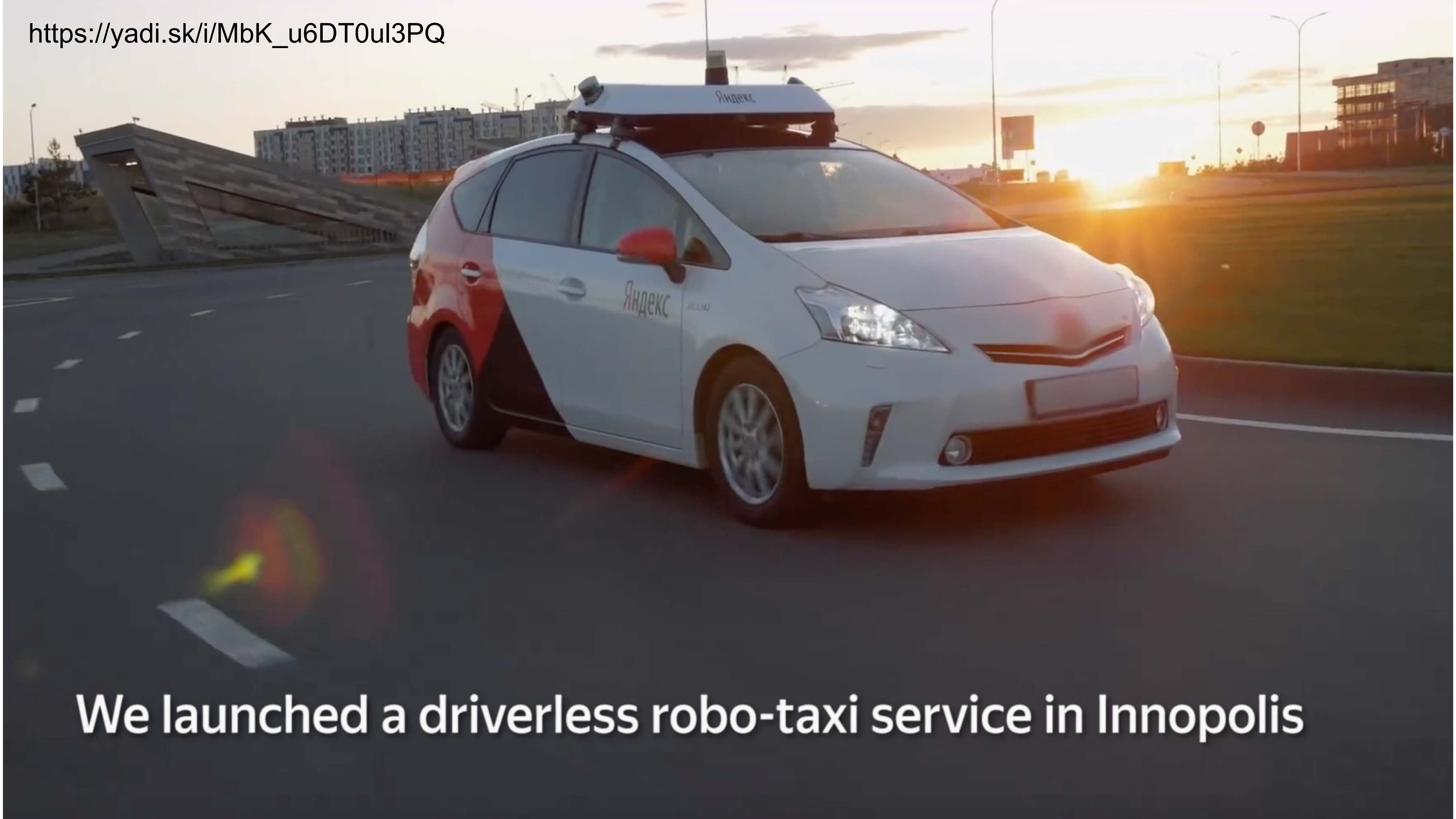
Russia (Moscow, Tatarstan)	**Israel** (Tel-Aviv)	**USA** (State of Nevada example)
Governmental Decree №1415 of November 26, 2018 on carrying out the trial operation of the highly automated vehicles on public roads in Moscow and the Republic of Tatarstan from Dec. 1, 2018 till March 1, 2022 Each vehicle should be checked and certified by NAMI All tests on public roads are to be conducted with an engineer behind the wheel Legal liability insurance – 10 mln. rubles for each vehicle Yandex is responsible for all damages in case of an accident	All tests are conducted with an engineer behind the wheel Public road tests are allowed in areas approved by Israeli ministry of transportation The first vehicle is checked and certified by Vehicle and Mechanical Laboratory of Technion. The following vehicles are checked for the system assembly quality and similarities of autonomous driving system engagement / disengagement procedures in comparison to the tested vehicle	Access to public roads is provided on the principles of self-certification Legal liability insurance – 5 mln. USD Access to public roads is possible with no engineer at the wheel

What is crucial to develop our technology further

- Legislative possibility to conduct public road tests with no engineer behind the wheel
- Develop clear self-driving cars certification requirements for mass deployment
- Liability for incidents involving self-driving cars



https://yadi.sk/i/MbK_u6DT0ul3PQ



Thank you!